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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

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# 1 Scope

The present document establishes the minimum RF characteristics and minimum performance requirements for E-UTRA User Equipment (UE).

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## 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain"
- [3] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [4] 3GPP TS 36.211: "Physical Channels and Modulation".
- [5] 3GPP TS 36.212: "Multiplexing and channel coding".
- [6] 3GPP TS 36.213: "Physical layer procedures".
- [7] 3GPP TS 36.331: " Requirements for support of radio resource management ".
- [8] 3GPP TS 36.307: " Requirements on User Equipments (UEs) supporting a release-independent frequency band".
- [9] 3GPP TS 36.423: "X2 application protocol (X2AP) ".
- [10] 3GPP TS 23.303: "Technical Specification Group Services and System Aspects; Proximity-based services (ProSe); Stage 2".
- [11] 3GPP TS36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".
- [12] 3GPP TS36.104: "Base Station (BS) radio transmission and reception".
- [13] ETSI TS 102 792: "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply in the case of a single component carrier. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Aggregated Channel Bandwidth:** The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

**Aggregated Transmission Bandwidth Configuration:** The number of resource block allocated within the aggregated channel bandwidth.

**Carrier aggregation:** Aggregation of two or more component carriers in order to support wider transmission bandwidths.

**Carrier aggregation band:** A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

**Carrier aggregation bandwidth class:** A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

**Carrier aggregation configuration:** A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

**Channel edge:** The lowest and highest frequency of the carrier, separated by the channel bandwidth.

**Channel bandwidth:** The RF bandwidth supporting a single E-UTRA RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell. The channel bandwidth is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

**Composite spectrum emission mask:** Emission mask requirement for intraband non-contiguous carrier aggregation which is a combination of individual sub-block spectrum emissions masks.

**Composite spurious emission requirement:** Spurious emission requirement for intraband non-contiguous carrier aggregation which is a combination of individual sub-block spurious emission requirements.

**Contiguous carriers:** A set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

**Contiguous resource allocation:** A resource allocation of consecutive resource blocks within one carrier or across contiguously aggregated carriers. The gap between contiguously aggregated carriers due to the nominal channel spacing is allowed.

**Contiguous spectrum:** Spectrum consisting of a contiguous block of spectrum with no sub-block gaps.

**Enhanced downlink control channel performance requirements type A:** This defines performance requirements for downlink control channel assuming as baseline receiver reference symbol based linear minimum mean square error interference rejection combining plus CRS interference cancellation.

**Enhanced downlink control channel performance requirements type B:** This defines performance requirements for downlink control channel assuming as baseline receiver reference symbol based enhanced linear minimum mean square error interference rejection combining plus CRS interference cancellation.

**Enhanced performance requirements type A:** This defines performance requirements assuming as baseline receiver reference symbol based linear minimum mean square error interference rejection combining.

**Enhanced performance requirements type B:** This defines performance requirements assuming as baseline receiver using network assisted interference cancellation and suppression.

**Enhanced performance requirements type C:** This defines performance requirements assuming as baseline receiver inter-stream interference cancellation.

**Inter-band carrier aggregation:** Carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

**Intra-band contiguous carrier aggregation:** Contiguous carriers aggregated in the same operating band.

**Intra-band non-contiguous carrier aggregation:** Non-contiguous carriers aggregated in the same operating band.

**Lower sub-block edge:** The frequency at the lower edge of one sub-block. It is used as a frequency reference point for both transmitter and receiver requirements.

**Category NB1/NB2 stand-alone operation:** category NB1/NB2 is operating standalone when it utilizes its own spectrum, for example the spectrum used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

**Category NB1/NB2 guard band operation:** category NB1/NB2 is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

**Category NB1/NB2 in-band operation:** category NB1/NB2 is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier or within a normal NR carrier plus 15 kHz at each edge (and not within NR minimum guard band).

**Non-contiguous spectrum:** Spectrum consisting of two or more sub-blocks separated by sub-block gap(s).

**ProSe-enabled UE:** A UE that supports ProSe requirements and associated procedures.

NOTE: As defined in TS 23.303 [10].

**ProSe Direct Communication:** A communication between two or more UEs in proximity that are ProSe-enabled.

NOTE: As defined in TS 23.303 [10].

**ProSe Direct Discovery:** A procedure employed by a ProSe-enabled UE to discover other ProSe-enabled UEs in its vicinity.

NOTE: As defined in TS 23.303 [10].

**sTTI :** A transmission time interval (TTI) of either one slot or one subslot as defined in TS 36.211 [4] on either uplink or downlink.

**Sub-block:** This is one contiguous allocated block of spectrum for transmission and reception by the same UE. There may be multiple instances of sub-blocks within an RF bandwidth.

**Sub-block bandwidth:** The bandwidth of one sub-block.

**Sub-block gap:** A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

**Synchronized operation:** Operation of TDD in two different systems, where no simultaneous uplink and downlink occur.

**Unsynchronized operation:** Operation of TDD in two different systems, where the conditions for synchronized operation are not met.

**Upper sub-block edge:** The frequency at the upper edge of one sub-block. It is used as a frequency reference point for both transmitter and receiver requirements.

**V2X Communication:** V2X (Vehicle to Everything) service is operating in ITS spectrum and/or LTE licensed operating bands.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

|                             |  |
|-----------------------------|--|
| $BW_{\text{Channel}}$       | Channel bandwidth  |
| $BW_{\text{Channel,block}}$ | Sub-block bandwidth, expressed in MHz. $BW_{\text{Channel,block}} = F_{\text{edge,block,high}} - F_{\text{edge,block,low}}$ .  |
| $BW_{\text{Channel\_CA}}$   | Aggregated channel bandwidth, expressed in MHz.  |
| $BW_{\text{GB}}$            | Virtual guard band to facilitate transmitter (receiver) filtering above / below edge CCs.  |
| $E_{RS}$                    | Transmitted energy per RE for reference symbols during the useful part of the symbol, i.e. excluding the cyclic prefix, (average power normalized to the subcarrier spacing) at the eNode B transmit antenna connector |

|                                  |  |
|----------------------------------|--|
| $\hat{E}_s$                      | The averaged received energy per RE of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set of REs used for the transmission of physical channels (including user specific RSs when present), divided by the number of REs within the set, and normalized to the subcarrier spacing |
| F                                | Frequency  |
| $F_{\text{agg\_alloc\_low}}$     | Aggregated Transmission Bandwidth Configuration. The lowest frequency of the simultaneously transmitted resource blocks.   |
| $F_{\text{agg\_alloc\_high}}$    | Aggregated Transmission Bandwidth Configuration. The highest frequency of the simultaneously transmitted resource blocks.  |
| $F_{\text{Interferer (offset)}}$ | Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)  |
| $F_{\text{Interferer}}$          | Frequency of the interferer  |
| $F_{\text{offset}}$              | Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)   |
| $F_C$                            | Frequency of the carrier centre frequency  |
| $F_{C\_agg}$                     | Aggregated Transmission Bandwidth Configuration. Center frequency of the aggregated carriers.  |
| $F_{C,block,high}$               | Center frequency of the highest transmitted/received carrier in a sub-block.   |
| $F_{C,block,low}$                | Center frequency of the lowest transmitted/received carrier in a sub-block.  |
| $F_{C\_low}$                     | The centre frequency of the <i>lowest carrier</i> , expressed in MHz.  |
| $F_{C\_high}$                    | The centre frequency of the <i>highest carrier</i> , expressed in MHz.   |
| $F_{DL\_low}$                    | The lowest frequency of the downlink operating band  |
| $F_{DL\_high}$                   | The highest frequency of the downlink operating band   |
| $F_{UL\_low}$                    | The lowest frequency of the uplink operating band  |
| $F_{UL\_high}$                   | The highest frequency of the uplink operating band   |
| $F_{\text{edge,block,low}}$      | The lower sub-block edge, where $F_{\text{edge,block,low}} = F_{C,block,low} - F_{\text{offset}}$ .  |
| $F_{\text{edge,block,high}}$     | The upper sub-block edge, where $F_{\text{edge,block,high}} = F_{C,block,high} + F_{\text{offset}}$ .  |
| $F_{\text{edge\_low}}$           | The <i>lower edge</i> of aggregated channel bandwidth, expressed in MHz.   |
| $F_{\text{edge\_high}}$          | The <i>higher edge</i> of aggregated channel bandwidth, expressed in MHz.  |
| $F_{\text{offset}}$              | Frequency offset from $F_{C\_high}$ to the <i>higher edge</i> or $F_{C\_low}$ to the <i>lower edge</i> .   |
| $F_{\text{offset,block,low}}$    | Separation between lower edge of a sub-block and the center of the lowest component carrier within the sub-block   |
| $F_{\text{offset,block,high}}$   | Separation between higher edge of a sub-block and the center of the highest component carrier within the sub-block   |
| $F_{\text{offset\_NS\_23}}$      | Frequency offset in MHz needed if NS_23 is used  |
| $F_{\text{OOB}}$                 | The boundary between the E-UTRA out of band emission and spurious emission domains.  |
| $I_o$                            | The power spectral density of the total input signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the UE antenna connector, including the own-cell downlink signal   |
| $I_{or}$                         | The total transmitted power spectral density of the own-cell downlink signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the eNode B transmit antenna connector   |
| $\hat{I}_{or}$                   | The total received power spectral density of the own-cell downlink signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the UE antenna connector  |
| $I_{ot}$                         | The received power spectral density of the total noise and interference for a certain RE (average power obtained within the RE and normalized to the subcarrier spacing) as measured at the UE antenna connector   |
| $L_{\text{CRB}}$                 | Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks  |
| $L_{\text{Ctone}}$               | Transmission bandwidth which represents the length of a contiguous sub-carrier allocation expressed in units of tones  |
| $N_{\text{cp}}$                  | Cyclic prefix length   |
| $N_{\text{DL}}$                  | Downlink EARFCN  |

|                           |  |
|---------------------------|--|
| $N_{oc}$                  | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing), simulating interference from cells that are not defined in a test procedure, as measured at the UE antenna connector   |
| $N_{oc1}$                 | The power spectral density of a white noise source (average power per RE normalized to the subcarrier spacing), simulating interference in non-CRS symbols in ABS subframe from cells that are not defined in a test procedure, as measured at the UE antenna connector.   |
| $N_{oc2}$                 | The power spectral density of a white noise source (average power per RE normalized to the subcarrier spacing), simulating interference in CRS symbols in ABS subframe from all cells that are not defined in a test procedure, as measured at the UE antenna connector.   |
| $N_{oc3}$                 | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing), simulating interference in non-ABS subframe from cells that are not defined in a test procedure, as measured at the UE antenna connector   |
| $N_{oc}'$                 | The power spectral density (average power per RE normalised to the subcarrier spacing) of the summation of the received power spectral densities of the strongest interfering cells explicitly defined in a test procedure plus $N_{oc}$ , as measured at the UE antenna connector. The respective power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value, or the respective power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated Es/Noc value. |
| $N_{\text{Offs-DL}}$      | Offset used for calculating downlink EARFCN  |
| $N_{\text{Offs-UL}}$      | Offset used for calculating uplink EARFCN  |
| $N_{otx}$                 | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing) simulating eNode B transmitter impairments as measured at the eNode B transmit antenna connector  |
| $N_{RB}$                  | Transmission bandwidth configuration, expressed in units of resource blocks  |
| $N_{RB\_agg}$             | The number of the aggregated RBs within the fully allocated Aggregated Channel bandwidth.  |
| $N_{RB\_alloc}$           | Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth.   |
| $N_{RB,c}$                | The transmission bandwidth configuration of component carrier $c$ , expressed in units of resource blocks  |
| $N_{RB,largest\ BW}$      | The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks   |
| $N_{RX}$                  | Number of receiver antennas  |
| $N_{tone}$                | Transmission bandwidth configuration for category NB1 and NB2, expressed in units of tones.  |
| $N_{tone\ 3.75kHz}$       | Transmission bandwidth configuration for category NB1 and NB2 with 3.75 kHz sub-carrier spacing, expressed in units of tones.  |
| $N_{tone\ 15kHz}$         | Transmission bandwidth configuration for category NB1 and NB2 with 15 kHz sub-carrier spacing, expressed in units of tones.  |
| $N_{UL}$                  | Uplink EARFCN.   |
| $R_{av}$                  | Minimum average throughput per RB.   |
| $P_{CMAX}$                | The configured maximum UE output power.  |
| $P_{CMAX,c}$              | The configured maximum UE output power for serving cell $c$ .  |
| $P_{EMAX}$                | Maximum allowed UE output power signalled by higher layers. Same as IE $P\text{-Max}$ , defined in [7].  |
| $P_{EMAX,c}$              | Maximum allowed UE output power signalled by higher layers for serving cell $c$ . Same as IE $P\text{-Max}$ , defined in [7].  |
| $P_{Interferer}$          | Modulated mean power of the interferer   |
| $P_{PowerClass}$          | $P_{PowerClass}$ is the nominal UE power (i.e., no tolerance).   |
| $P_{PowerClass\_Default}$ | $P_{PowerClass\_Default}$ is the default nominal UE power (i.e., no tolerance) for the band.   |
| $P_{UMAX}$                | The measured configured maximum UE output power.   |
| $P_{uw}$                  | Power of an unwanted DL signal   |
| $P_w$                     | Power of a wanted DL signal  |
| $RB_{start}$              | Indicates the lowest RB index of transmitted resource blocks.  |
| $RB_{end}$                | Indicates the highest RB index of transmitted resource blocks.   |
| $T_{no\_hopping}$         | Transmission period within a TTI duration when consecutive symbols are transmitted without applying any frequency hopping  |
| $\Delta f_{OoB}$          | $\Delta$ Frequency of Out Of Band emission.  |
| $\Delta P_{PowerClass}$   | Adjustment to maximum output power for a given power class.  |
| $\Delta R_{IB,c}$         | Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell $c$ .  |

|                    |   |
|--------------------|---|
| $\Delta R_{IB,4R}$ | Reference sensitivity adjustment due to support for 4 antenna ports.  |
| $\Delta R_{IB,8R}$ | Reference sensitivity adjustment due to support for 8 antenna ports.  |
| $\Delta T_{IB,c}$  | Allowed maximum configured output power relaxation due to support for inter-band CA operation, for serving cell $c$ . |
| $\Delta T_C$       | Allowed operating band edge transmission power relaxation.  |
| $\Delta T_{C,c}$   | Allowed operating band edge transmission power relaxation for serving cell $c$ .                                      |
| $\Delta T_{ProSe}$ | Allowed operating band transmission power relaxation due to support of E-UTRA ProSe on an operating band.             |
| $\rho_A$           | According to Clause 5.2 in TS 36.213 [6]  |
| $\rho_B$           | According to Clause 5.2 in TS 36.213 [6]  |
| $\sigma$           | Test specific auxiliary variable used for the purpose of downlink power allocation, defined in Annex C.3.2.           |
| $W_{gap}$          | Sub-block gap size  |
| $W_{gap,L}$        | Sub-block gap size between lowest two CCs in frequency domain on CA_X-X-X   |
| $W_{gap,H}$        | Sub-block gap size between highest two CCs in frequency domain on CA_X-X-X  |

### 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

|            |   |
|------------|---|
| ABS        | Almost Blank Subframe   |
| ACLR       | Adjacent Channel Leakage Ratio  |
| ACS        | Adjacent Channel Selectivity  |
| A-MPR      | Additional Maximum Power Reduction  |
| AWGN       | Additive White Gaussian Noise   |
| BS         | Base Station  |
| CA         | Carrier Aggregation   |
| CA_X       | Intra-band contiguous CA of component carriers in one sub-block within Band X where X is the applicable E-UTRA operating band   |
| CA_X-X     | Intra-band non-contiguous CA of component carriers in two sub-blocks within Band X where X is the applicable E-UTRA operating band  |
| CA_X-X-X   | Intra-band non-contiguous CA of component carriers in three sub-blocks within Band X where X is the applicable E-UTRA operating band  |
| CA_X-X-X-X | Intra-band non-contiguous CA of component carriers in four sub-blocks within Band X where X is the applicable E-UTRA operating band   |
| CA_X-Y     | Inter-band CA of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating band |
| CA_X-X-Y   | CA of component carriers in two sub-blocks within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating bands            |
| CC         | Component Carriers  |
| CG         | Carrier Group   |
| CPE        | Customer Premise Equipment  |
| CPE_X      | Customer Premise Equipment for E-UTRA operating band X  |
| CW         | Continuous Wave   |
| DC         | Dual Connectivity   |
| DC_X-Y     | Inter-band DC of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating band |
| DL         | Downlink  |
| DIP        | Dominant Interferer Proportion  |
| EARFCN     | E-UTRA Absolute Radio Frequency Channel Number  |
| EIRP       | Effective Isotropic Radiated Power  |
| EPRE       | Energy Per Resource Element   |
| E-UTRA     | Evolved UMTS Terrestrial Radio Access   |
| EUTRAN     | Evolved UMTS Terrestrial Radio Access Network   |
| EVM        | Error Vector Magnitude  |
| FDD        | Frequency Division Duplex   |
| FRC        | Fixed Reference Channel   |



|         |  |
|---------|--|
| GNSS    | Global Navigation Satellite Systems  |
| HD      | Half-Duplex for Sidelink Operation   |
| HD-FDD  | Half- Duplex FDD   |
| ITS     | Intelligent Transportation Systems   |
| MCS     | Modulation and Coding Scheme   |
| MCG     | Master Cell Group  |
| MOP     | Maximum Output Power   |
| MPR     | Maximum Power Reduction  |
| MSD     | Maximum Sensitivity Degradation  |
| OCNG    | OFDMA Channel Noise Generator  |
| OFDMA   | Orthogonal Frequency Division Multiple Access  |
| OOB     | Out-of-band  |
| PA      | Power Amplifier  |
| PCC     | Primary Component Carrier  |
| P-MPR   | Power Management Maximum Power Reduction   |
| ProSe   | Proximity-based Services   |
| PSBCH   | Physical Sidelink Broadcast CHannel  |
| PSCCH   | Physical Sidelink Control CHannel  |
| PSDCH   | Physical Sidelink Discovery CHannel  |
| PSS     | Primary Synchronization Signal   |
| PSS_RA  | PSS-to-RS EPRE ratio for the channel PSS   |
| SSSS    | Secondary Sidelink Synchronization Signal  |
| PSSCH   | Physical Sidelink Shared CHannel   |
| PSSS    | Primary Sidelink Synchronization Signal  |
| RE      | Resource Element   |
| REFSENS | Reference Sensitivity power level  |
| r.m.s   | Root Mean Square   |
| SCC     | Secondary Component Carrier  |
| SCG     | Secondary Cell Group   |
| SINR    | Signal-to-Interference-and-Noise Ratio   |
| SNR     | Signal-to-Noise Ratio  |
| SSS     | Secondary Synchronization Signal   |
| SSS_RA  | SSS-to-RS EPRE ratio for the channel SSSSSSS Secondary Sidelink Synchronization Signal                   |
| TDD     | Time Division Duplex   |
| UE      | User Equipment   |
| UL      | Uplink   |
| UL-MIMO | Up Link Multiple Antenna transmission  |
| UMTS    | Universal Mobile Telecommunications System   |
| UTRA    | UMTS Terrestrial Radio Access  |
| UTRAN   | UMTS Terrestrial Radio Access Network  |
| V2X     | Vehicle to Everything  |
| xCH_RA  | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols not containing cell-specific RS |
| xCH_RB  | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols containing cell-specific RS     |

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## 4 General

### 4.1 Relationship between minimum requirements and test requirements

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 36.521-1 Annex F defines Test Tolerances. These Test Tolerances are individually calculated for each test. The Test Tolerances are used to relax the Minimum Requirements in this specification to create Test Requirements.

The measurement results returned by the Test System are compared - without any modification - against the Test Requirements as defined by the shared risk principle.

The Shared Risk principle is defined in ITU-R M.1545 [3].

### 4.2 Applicability of minimum requirements

- a) In this specification the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios
- b) For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.
- c) The reference sensitivity power levels defined in subclause 7.3 are valid for the specified reference measurement channels.
- d) NOTE: Receiver sensitivity degradation may occur when:
  - 1) The UE simultaneously transmits and receives with bandwidth allocations less than the transmission bandwidth configuration (see Figure 5.6-1), and
  - 2) Any part of the downlink transmission bandwidth is within an uplink transmission bandwidth from the downlink center subcarrier.
- e) The spurious emissions power requirements are for the long term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal.
- f) The requirements in this specification for TDD operating bands apply for downlink and uplink operations using Frame Structure Type 2 [4] except for Band 46 operating with Frame Structure Type 3.
- g) The requirements related to subslot TTI and/or slot TTI shall apply only if UE supports multiple TTI patterns. And these requirements only apply to subslot and/or slot TTI configurations

### 4.3 Void

#### 4.3A Applicability of minimum requirements (CA, UL-MIMO, ProSe, Dual Connectivity, UE category 0, UE category M1, UE category M2, UE category 1bis, UE category NB1 and NB2, V2X Communication, MBMS UE)

The requirements in clauses 5, 6 and 7 which are specific to CA, UL-MIMO, ProSe, Dual Connectivity, UE category 0, UE category M1, UE category M2, UE category 1bis, UE category NB1 and NB2 and V2X Communication are specified as suffix A, B, C, D, E, F and G where;

- a) Suffix A additional requirements need to support CA

- b) Suffix B additional requirements need to support UL-MIMO
- c) Suffix C additional requirements need to support Dual Connectivity
- d) Suffix D additional requirements need to support ProSe
- e) Suffix E additional requirements need to support UE category 0, category M1, category M2, and category 1bis
- f) Suffix F additional requirements need to support UE category NB1 and NB2
- g) Suffix G additional requirements need to support V2X Communication

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional subclause (suffix A, B, C, D, E, F and G) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional subclause requirements (suffix A, B, C, D, E, F and G) in clauses 5, 6 and 7, the tighter requirements are applicable unless stated otherwise in the additional subclause.

A terminal which supports more than one feature (CA, UL-MIMO, ProSe, Dual Connectivity, UE category 0, UE category M1, UE category M2, UE category 1bis, UE category NB1 and NB2 and V2X Communication) in clauses 5, 6 and 7 shall meet all of the separate corresponding requirements.

For a terminal supporting CA, compliance with minimum requirements for non-contiguous intra-band carrier aggregation in any given operating band does not imply compliance with minimum requirements for contiguous intra-band carrier aggregation in the same operating band.

For a terminal supporting CA, compliance with minimum requirements for contiguous intra-band carrier aggregation in any given operating band does not imply compliance with minimum requirements for non-contiguous intra-band carrier aggregation in the same operating band.

A terminal which supports a DL CA configuration shall support all the lower order fallback DL CA combinations and it shall support at least one bandwidth combination set for each of the constituent lower order DL combinations containing all the bandwidths specified within each specific combination set of the upper order DL combination.

A terminal which supports CA, for each supported CA configuration, shall support Pcell transmissions in each of the aggregated Component Carriers unless indicated otherwise in clause 5.6A.1.

Terminal supporting Dual Connectivity configuration shall meet the minimum requirements for corresponding CA configuration (suffix A), unless otherwise specified.

For a terminal that supports ProSe Direct Communication and/or ProSe Direct Discovery, the minimum requirements are applicable when

- the UE is associated with a serving cell on the ProSe carrier, or
- the UE is not associated with a serving cell on the ProSe carrier and is provisioned with the preconfigured radio parameters for ProSe Direct Communications and/or ProSe Direct Discovery that are associated with known Geographical Area, or
- the UE is associated with a serving cell on a carrier different than the ProSe carrier, and the radio parameters for ProSe Direct Discovery on the ProSe carrier are provided by the serving cell, or
- the UE is associated with a serving cell on a carrier different than the ProSe carrier, and has a non-serving cell selected on the ProSe carrier that supports ProSe Direct Discovery and/or ProSe Direct Communication.

When the ProSe UE is not associated with a serving cell on the ProSe carrier, and the UE does not have knowledge of its geographical area, or is provisioned with preconfigured radio parameters that are not associated with any Geographical Area, ProSe transmissions are not allowed, and the requirements in Section 6.3.3D apply.

A terminal that supports simultaneous E-UTRA ProSe sidelink transmissions and E-UTRA uplink transmissions for the inter-band E-UTRA ProSe/E-UTRA bands specified in Table 5.5D-2, shall meet the minimum requirements for the corresponding inter-band UL CA configuration (suffix A), unless otherwise specified. For transmitter characteristics specified in clause 6, the terminal is required to meet the conformance tests for the corresponding inter-band UL CA configuration and is not required to be retested with simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions.

A terminal that supports E-UTRA V2X intra-band multi-carrier operation including carrier aggregation for the band specified in Table 5.5G-3, shall meet the corresponding transmitter characteristics requirements (in subclauses with suffix G in Section 6) only when there are multiple active transmissions on all of the configured carrier components. When there is only one active transmission on one of the configured carrier components, the corresponding requirements for V2X single carrier operation apply for the corresponding active carrier component.

A terminal which supports MBMS (including 15 kHz, 7.5 kHz, 1.25 kHz, 2.5 kHz and 0.37 kHz subcarrier spacing), shall meet the minimum requirements in clauses 5 and 7. A terminal which supports MBMS is not required to support all kinds of subcarrier spacing.

A terminal that supports multiple TTI patterns in different carriers, different TTI patterns can only be used when the carriers are aggregated in inter-band manner. For intra-band carrier aggregation, only same TTI patterns and same TAG are allowed in aggregated carriers.

## 4.4 RF requirements in later releases

The standardisation of new frequency bands and carrier aggregation configurations (downlink and uplink aggregation) may be independent of a release. However, in order to implement a UE that conforms to a particular release but supports a band of operation or a carrier aggregation configuration that is specified in a later release, it is necessary to specify some extra requirements. TS 36.307 [8] specifies requirements on UEs supporting a frequency band or a carrier aggregation configuration that is independent of release.

**NOTE:** For UEs conforming to the 3GPP release of the present document, some RF requirements of later releases may be mandatory independent of whether the UE supports the bands specified or carrier aggregation configurations defined in later releases or not. The set of RF requirements of later releases that is also mandatory for UEs conforming to the 3GPP release of the present document is determined by regional regulation.

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# 5 Operating bands and channel arrangement

## 5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

**NOTE:** Other operating bands and channel bandwidths may be considered in future releases.

## 5.2 Void

## 5.3 Void

## 5.4 Void

## 5.5 Operating bands

E-UTRA is designed to operate in the operating bands defined in Table 5.5-1.

**Table 5.5-1 E-UTRA operating bands**

| E-UTRA<br>Operating<br>Band | Uplink (UL) operating band<br>BS receive<br>UE transmit | Downlink (DL) operating<br>band<br>BS transmit<br>UE receive | Duplex<br>Mode |
|-----------------------------|---|--|----------------|
|-----------------------------|---|--|----------------|

|                  | FUL_low    | – | FUL_high   | FDL_low    | – | FDL_high   |                   |
|------------------|------------|---|------------|------------|---|------------|-------------------|
| 1                | 1920 MHz   | – | 1980 MHz   | 2110 MHz   | – | 2170 MHz   | FDD               |
| 2                | 1850 MHz   | – | 1910 MHz   | 1930 MHz   | – | 1990 MHz   | FDD               |
| 3                | 1710 MHz   | – | 1785 MHz   | 1805 MHz   | – | 1880 MHz   | FDD               |
| 4                | 1710 MHz   | – | 1755 MHz   | 2110 MHz   | – | 2155 MHz   | FDD               |
| 5                | 824 MHz    | – | 849 MHz    | 869 MHz    | – | 894 MHz    | FDD               |
| 6 <sup>1</sup>   | 830 MHz    | – | 840 MHz    | 875 MHz    | – | 885 MHz    | FDD               |
| 7                | 2500 MHz   | – | 2570 MHz   | 2620 MHz   | – | 2690 MHz   | FDD               |
| 8                | 880 MHz    | – | 915 MHz    | 925 MHz    | – | 960 MHz    | FDD               |
| 9                | 1749.9 MHz | – | 1784.9 MHz | 1844.9 MHz | – | 1879.9 MHz | FDD               |
| 10               | 1710 MHz   | – | 1770 MHz   | 2110 MHz   | – | 2170 MHz   | FDD               |
| 11               | 1427.9 MHz | – | 1447.9 MHz | 1475.9 MHz | – | 1495.9 MHz | FDD               |
| 12               | 699 MHz    | – | 716 MHz    | 729 MHz    | – | 746 MHz    | FDD               |
| 13               | 777 MHz    | – | 787 MHz    | 746 MHz    | – | 756 MHz    | FDD               |
| 14               | 788 MHz    | – | 798 MHz    | 758 MHz    | – | 768 MHz    | FDD               |
| 15               | Reserved   |   |            | Reserved   |   |            | FDD               |
| 16               | Reserved   |   |            | Reserved   |   |            | FDD               |
| 17               | 704 MHz    | – | 716 MHz    | 734 MHz    | – | 746 MHz    | FDD               |
| 18               | 815 MHz    | – | 830 MHz    | 860 MHz    | – | 875 MHz    | FDD               |
| 19               | 830 MHz    | – | 845 MHz    | 875 MHz    | – | 890 MHz    | FDD               |
| 20               | 832 MHz    | – | 862 MHz    | 791 MHz    | – | 821 MHz    | FDD               |
| 21               | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | FDD               |
| 22               | 3410 MHz   | – | 3490 MHz   | 3510 MHz   | – | 3590 MHz   | FDD               |
| 23 <sup>1</sup>  | 2000 MHz   | – | 2020 MHz   | 2180 MHz   | – | 2200 MHz   | FDD               |
| 24 <sup>17</sup> | 1626.5 MHz | – | 1660.5 MHz | 1525 MHz   | – | 1559 MHz   | FDD               |
| 25               | 1850 MHz   | – | 1915 MHz   | 1930 MHz   | – | 1995 MHz   | FDD               |
| 26               | 814 MHz    | – | 849 MHz    | 859 MHz    | – | 894 MHz    | FDD               |
| 27               | 807 MHz    | – | 824 MHz    | 852 MHz    | – | 869 MHz    | FDD               |
| 28               | 703 MHz    | – | 748 MHz    | 758 MHz    | – | 803 MHz    | FDD               |
| 29               | N/A        |   |            | 717 MHz    | – | 728 MHz    | FDD <sup>2</sup>  |
| 30 <sup>15</sup> | 2305 MHz   | – | 2315 MHz   | 2350 MHz   | – | 2360 MHz   | FDD               |
| 31               | 452.5 MHz  | – | 457.5 MHz  | 462.5 MHz  | – | 467.5 MHz  | FDD               |
| 32               | N/A        |   |            | 1452 MHz   | – | 1496 MHz   | FDD <sup>2</sup>  |
| 33               | 1900 MHz   | – | 1920 MHz   | 1900 MHz   | – | 1920 MHz   | TDD               |
| 34               | 2010 MHz   | – | 2025 MHz   | 2010 MHz   | – | 2025 MHz   | TDD               |
| 35               | 1850 MHz   | – | 1910 MHz   | 1850 MHz   | – | 1910 MHz   | TDD               |
| 36               | 1930 MHz   | – | 1990 MHz   | 1930 MHz   | – | 1990 MHz   | TDD               |
| 37               | 1910 MHz   | – | 1930 MHz   | 1910 MHz   | – | 1930 MHz   | TDD               |
| 38               | 2570 MHz   | – | 2620 MHz   | 2570 MHz   | – | 2620 MHz   | TDD               |
| 39               | 1880 MHz   | – | 1920 MHz   | 1880 MHz   | – | 1920 MHz   | TDD               |
| 40               | 2300 MHz   | – | 2400 MHz   | 2300 MHz   | – | 2400 MHz   | TDD               |
| 41               | 2496 MHz   | – | 2690 MHz   | 2496 MHz   | – | 2690 MHz   | TDD               |
| 42               | 3400 MHz   | – | 3600 MHz   | 3400 MHz   | – | 3600 MHz   | TDD               |
| 43               | 3600 MHz   | – | 3800 MHz   | 3600 MHz   | – | 3800 MHz   | TDD               |
| 44               | 703 MHz    | – | 803 MHz    | 703 MHz    | – | 803 MHz    | TDD               |
| 45               | 1447 MHz   | – | 1467 MHz   | 1447 MHz   | – | 1467 MHz   | TDD               |
| 46               | 5150 MHz   | – | 5925 MHz   | 5150 MHz   | – | 5925 MHz   | TDD <sup>8</sup>  |
| 47               | 5855 MHz   | – | 5925 MHz   | 5855 MHz   | – | 5925 MHz   | TDD <sup>11</sup> |
| 48               | 3550 MHz   | – | 3700 MHz   | 3550 MHz   | – | 3700 MHz   | TDD               |
| 49               | 3550 MHz   | – | 3700 MHz   | 3550 MHz   | – | 3700 MHz   | TDD <sup>16</sup> |
| 50               | 1432 MHz   | – | 1517 MHz   | 1432 MHz   | – | 1517 MHz   | TDD <sup>13</sup> |
| 51               | 1427 MHz   | – | 1432 MHz   | 1427 MHz   | – | 1432 MHz   | TDD <sup>13</sup> |
| 52               | 3300 MHz   | – | 3400 MHz   | 3300 MHz   | – | 3400 MHz   | TDD               |
| 53               | 2483.5 MHz | – | 2495 MHz   | 2483.5 MHz | – | 2495 MHz   | TDD               |
| ...              |            |   |            |            |   |            |                   |
| 64               | Reserved   |   |            |            |   |            |                   |
| 65               | 1920 MHz   | – | 2010 MHz   | 2110 MHz   | – | 2200 MHz   | FDD               |
| 66               | 1710 MHz   | – | 1780 MHz   | 2110 MHz   | – | 2200 MHz   | FDD <sup>4</sup>  |
| 67               | N/A        |   |            | 738 MHz    | – | 758 MHz    | FDD <sup>2</sup>  |
| 68               | 698 MHz    | – | 728 MHz    | 753 MHz    | – | 783 MHz    | FDD               |
| 69               | N/A        |   |            | 2570 MHz   | – | 2620 MHz   | FDD <sup>2</sup>  |

|   |                     |                     |                   |
|---|---------------------|---------------------|-------------------|
| 70  | 1695 MHz – 1710 MHz | 1995 MHz – 2020 MHz | FDD <sup>10</sup> |
| 71  | 663 MHz – 698 MHz   | 617 MHz – 652 MHz   | FDD               |
| 72  | 451 MHz – 456 MHz   | 461 MHz – 466 MHz   | FDD               |
| 73  | 450 MHz – 455 MHz   | 460 MHz – 465 MHz   | FDD               |
| 74  | 1427 MHz – 1470 MHz | 1475 MHz – 1518 MHz | FDD               |
| 75  | N/A                 | 1432 MHz – 1517 MHz | FDD <sup>2</sup>  |
| 76  | N/A                 | 1427 MHz – 1432 MHz | FDD <sup>2</sup>  |
| 85  | 698 MHz – 716 MHz   | 728 MHz – 746 MHz   | FDD               |
| 87  | 410 MHz – 415 MHz   | 420 MHz – 425 MHz   | FDD               |
| 88  | 412 MHz – 417 MHz   | 422 MHz – 427 MHz   | FDD               |
| <p>NOTE 1: Band 6, 23 is not applicable</p> <p>NOTE 2: Restricted to E-UTRA operation when carrier aggregation is configured. The downlink operating band is paired with the uplink operating band (external) of the carrier aggregation configuration that is supporting the configured Pcell.</p> <p>NOTE 3: A UE that complies with the E-UTRA Band 65 minimum requirements in this specification shall also comply with the E-UTRA Band 1 minimum requirements.</p> <p>NOTE 4: The range 2180-2200 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured.</p> <p>NOTE 5: A UE that supports E-UTRA Band 66 shall receive in the entire DL operating band</p> <p>NOTE 6: A UE that supports E-UTRA Band 66 and CA operation in any CA band shall also comply with the minimum requirements specified for the DL CA configurations CA_66B, CA_66C and CA_66A-66A.</p> <p>NOTE 7: A UE that complies with the E-UTRA Band 66 minimum requirements in this specification shall also comply with the E-UTRA Band 4 minimum requirements.</p> <p>NOTE 8: This band is an unlicensed band restricted to licensed-assisted operation using Frame Structure Type 3</p> <p>NOTE 9: In this version of the specification, restricted to E-UTRA DL operation when carrier aggregation is configured.</p> <p>NOTE 10: The range 2010-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 300 MHz The range 2005-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 295 MHz.</p> <p>NOTE 11: This band is unlicensed band used for V2X communication. There is no expected network deployment in this band so Frame Structure Type 1 is used.</p> <p>NOTE 12: A UE that complies with the E-UTRA Band 74 minimum requirements in this specification shall also comply with the E-UTRA Band 11 and Band 21 minimum requirements.</p> <p>NOTE 13: UE that complies with the E-UTRA Band 50 minimum requirements in this specification shall also comply with the E-UTRA Band 51 minimum requirements.</p> <p>NOTE 14: A UE that complies with the E-UTRA Band 75 minimum requirements in this specification shall also comply with the E-UTRA Band 76 minimum requirements.</p> <p>NOTE 15: Uplink transmission is not allowed at this band for UE with external vehicle-mounted antennas.</p> <p>NOTE 16: This band is restricted to licensed-assisted operation using Frame Structure Type 3</p> <p>NOTE 17: DL operation in this band is restricted to 1526 – 1536 MHz and UL operation is restricted to 1627.5 – 1637.5 MHz and 1646.5 – 1656.5 MHz.</p> |                     |                     |                   |

## 5.5A Operating bands for CA

E-UTRA carrier aggregation is designed to operate in the operating bands defined in Tables 5.5A-1, 5.5A-2, 5.5A-2a, 5.5A-2b, 5.5A-2c, 5.5A-3, 5.5A-4 and 5.5A-5.

**Table 5.5A-1: Intra-band contiguous CA operating bands**

| E-UTRA CA Band | E-UTRA Band<br>(Table 5.5-1) |
|----------------|------------------------------|
| CA_1           | 1                            |
| CA_2           | 2                            |
| CA_3           | 3                            |
| CA_5           | 5                            |
| CA_7           | 7                            |
| CA_8           | 8                            |

|       |    |
|-------|----|
| CA_12 | 12 |
| CA_23 | 23 |
| CA_27 | 27 |
| CA_28 | 28 |
| CA_38 | 38 |
| CA_39 | 39 |
| CA_40 | 40 |
| CA_41 | 41 |
| CA_42 | 42 |
| CA_43 | 43 |
| CA_48 | 48 |
| CA_66 | 66 |
| CA_70 | 70 |

**Table 5.5A-2: Inter-band CA operating bands (two bands)**

| E-UTRA CA Band | E-UTRA Band<br>(Table 5.5-1) |
|----------------|------------------------------|
| CA_1-3         | 1, 3                         |
| CA_1-1-3       | 1, 3                         |
| CA_1-1-3-3     | 1, 3                         |
| CA_1-3-3       | 1, 3                         |
| CA_1-5         | 1, 5                         |
| CA_1-1-5       | 1, 5                         |
| CA_1-7         | 1, 7                         |
| CA_1-1-7       | 1, 7                         |
| CA_1-7-7       | 1, 7                         |
| CA_1-8         | 1, 8                         |
| CA_1-11        | 1, 11                        |
| CA_1-18        | 1, 18                        |
| CA_1-19        | 1, 19                        |
| CA_1-20        | 1, 20                        |
| CA_1-21        | 1, 21                        |
| CA_1-26        | 1, 26                        |
| CA_1-28        | 1, 28                        |
| CA_1-1-28      | 1, 28                        |
| CA_1-32        | 1, 32                        |
| CA_1-38        | 1, 38                        |
| CA_1-40        | 1, 40                        |
| CA_1-41        | 1, 41                        |
| CA_1-42        | 1, 42                        |
| CA_1-42-42     | 1, 42                        |
| CA_1-43        | 1, 43                        |
| CA_1-46        | 1, 46                        |
| CA_2-4         | 2, 4                         |
| CA_2-2-4       | 2, 4                         |
| CA_2-2-4-4     | 2, 4                         |
| CA_2-4-4       | 2, 4                         |
| CA_2-5         | 2, 5                         |
| CA_2-2-5       | 2, 5                         |
| CA_2-7         | 2, 7                         |
| CA_2-2-7       | 2, 7                         |
| CA_2-7-7       | 2, 7                         |
| CA_2-12        | 2, 12                        |
| CA_2-2-12      | 2, 12                        |
| CA_2-2-12-12   | 2, 12                        |
| CA_2-12-12     | 2, 12                        |

|               |         |
|---------------|---------|
| CA_2-13       | 2, 13   |
| CA_2-2-13     | 2, 13   |
| CA_2-14       | 2, 14   |
| CA_2-2-14     | 2, 14   |
| CA_2-17       | 2, 17   |
| CA_2-26       | 2, 26   |
| CA_2-28       | 2, 28   |
| CA_2-29       | 2, 29   |
| CA_2-2-29     | 2, 29   |
| CA_2-30       | 2, 30   |
| CA_2-2-30     | 2, 30   |
| CA_2-46       | 2, 46   |
| CA_2-2-46     | 2, 46   |
| CA_2-46-46    | 2, 46   |
| CA_2-48       | 2, 48   |
| CA_2-48-48    | 2, 48   |
| CA_2-49       | 2, 49   |
| CA_2-66       | 2, 66   |
| CA_2-2-66     | 2, 66   |
| CA_2-2-66-66  | 2, 66   |
| CA_2-66-66    | 2, 66   |
| CA_2-66-66-66 | 2, 66   |
| CA_2-71       | 2, 71   |
| CA_2-2-71     | 2, 71   |
| CA_3-5        | 3, 5    |
| CA_3-3-5      | 3, 3, 5 |
| CA_3-7        | 3, 7    |
| CA_3-3-7      | 3, 7    |
| CA_3-3-7-7    | 3, 7    |
| CA_3-7-7      | 3, 7    |
| CA_3-8        | 3, 8    |
| CA_3-3-8      | 3, 8    |
| CA_3-11       | 3, 11   |
| CA_3-18       | 3, 18   |
| CA_3-19       | 3, 19   |
| CA_3-3-19     | 3, 19   |
| CA_3-20       | 3, 20   |
| CA_3-3-20     | 3, 20   |
| CA_3-21       | 3, 21   |
| CA_3-3-21     | 3, 21   |
| CA_3-26       | 3, 26   |
| CA_3-27       | 3, 27   |
| CA_3-28       | 3, 28   |
| CA_3-3-28     | 3, 28   |
| CA_3-31       | 3, 31   |
| CA_3-32       | 3, 32   |
| CA_3-38       | 3, 38   |
| CA_3-40       | 3, 40   |
| CA_3-40-40    | 3, 40   |
| CA_3-41       | 3, 41   |
| CA_3-3-41     | 3, 41   |
| CA_3-42       | 3, 42   |
| CA_3-3-42     | 3, 42   |
| CA_3-42-42    | 3, 42   |
| CA_3-43       | 3, 43   |
| CA_3-46       | 3, 46   |
| CA_3-3-46     | 3, 46   |



|              |       |
|--------------|-------|
| CA_3-69      | 3, 69 |
| CA_4-5       | 4, 5  |
| CA_4-4-5     | 4, 5  |
| CA_4-7       | 4, 7  |
| CA_4-4-7     | 4, 7  |
| CA_4-7-7     | 4, 7  |
| CA_4-12      | 4, 12 |
| CA_4-4-12    | 4, 12 |
| CA_4-4-12-12 | 4, 12 |
| CA_4-12-12   | 4, 12 |
| CA_4-13      | 4, 13 |
| CA_4-4-13    | 4, 13 |
| CA_4-17      | 4, 17 |
| CA_4-27      | 4, 27 |
| CA_4-28      | 4, 28 |
| CA_4-29      | 4, 29 |
| CA_4-4-29    | 4, 29 |
| CA_4-30      | 4, 30 |
| CA_4-4-30    | 4, 30 |
| CA_4-46      | 4, 46 |
| CA_4-46-46   | 4, 46 |
| CA_4-48      | 4, 48 |
| CA_4-71      | 4, 71 |
| CA_4-4-71    | 4, 71 |
| CA_5-7       | 5, 7  |
| CA_5-7-7     | 5, 7  |
| CA_5-12      | 5, 12 |
| CA_5-12-12   | 5, 12 |
| CA_5-13      | 5, 13 |
| CA_5-17      | 5, 17 |
| CA_5-25      | 5, 25 |
| CA_5-28      | 5, 28 |
| CA_5-29      | 5, 29 |
| CA_5-30      | 5, 30 |
| CA_5-38      | 5, 38 |
| CA_5-40      | 5, 40 |
| CA_5-5-40    | 5, 40 |
| CA_5-40-40   | 5, 40 |
| CA_5-41      | 5, 41 |
| CA_5-46      | 5, 46 |
| CA_5-48      | 5, 48 |
| CA_5-66      | 5, 66 |
| CA_5-5-66    | 5, 66 |
| CA_5-66-66   | 5, 66 |
| CA_5-5-66-66 | 5, 66 |
| CA_7-8       | 7, 8  |
| CA_7-7-8     | 7, 8  |
| CA_7-12      | 7, 12 |
| CA_7-13      | 7, 13 |
| CA_7-7-13    | 7, 13 |
| CA_7-20      | 7, 20 |
| CA_7-7-20    | 7, 20 |
| CA_7-22      | 7, 22 |
| CA_7-26      | 7, 26 |
| CA_7-7-26    | 7, 26 |
| CA_7-28      | 7, 28 |
| CA_7-7-28    | 7, 28 |

|                       |        |
|-----------------------|--------|
| CA_7-29               | 7,29   |
| CA_7-7-29             | 7,29   |
| CA_7-30               | 7, 30  |
| CA_7-32               | 7, 32  |
| CA_7-40               | 7, 40  |
| CA_7-42               | 7, 42  |
| CA_7-42-42            | 7, 42  |
| CA_7-46               | 7, 46  |
| CA_7-7-46             | 7, 46  |
| CA_7-66               | 7, 66  |
| CA_7-7-66             | 7, 66  |
| CA_7-7-66-66          | 7, 66  |
| CA_7-66-66            | 7, 66  |
| CA_8-11               | 8, 11  |
| CA_8-20               | 8, 20  |
| CA_8-27               | 8, 27  |
| CA_8-28               | 8, 28  |
| CA_8-32               | 8, 32  |
| CA_8-38               | 8, 38  |
| CA_8-39               | 8, 39  |
| CA_8-40               | 8, 40  |
| CA_8-41               | 8, 41  |
| CA_8-42               | 8, 42  |
| CA_8-46               | 8, 46  |
| CA_11-18              | 11, 18 |
| CA_11-26              | 11, 26 |
| CA_11-28              | 11, 28 |
| CA_11-41              | 11, 41 |
| CA_11-42              | 11, 42 |
| CA_11-46              | 11, 46 |
| CA_12-25              | 12, 25 |
| CA_12-30              | 12, 30 |
| CA_12-46              | 12, 46 |
| CA_12-48              | 12, 48 |
| CA_12-66              | 12, 66 |
| CA_12-66-66           | 12, 66 |
| CA_13-46              | 13, 46 |
| CA_13-46-46           | 13, 46 |
| CA_13-48              | 13, 48 |
| CA_13-48-48           | 13, 48 |
| CA_13-66              | 13, 66 |
| CA_13-66-66           | 13, 66 |
| CA_14-66              | 14, 66 |
| CA_14-66-66           | 14, 66 |
| CA_14-66-66-66        | 14, 66 |
| CA_14-30              | 14, 30 |
| CA_18-28 <sup>1</sup> | 18, 28 |
| CA_18-41              | 18, 41 |
| CA_18-42              | 18, 42 |
| CA_19-21              | 19, 21 |
| CA_19-28 <sup>2</sup> | 19, 28 |
| CA_19-42              | 19, 42 |
| CA_19-46              | 19, 46 |
| CA_20-28 <sup>1</sup> | 20, 28 |
| CA_20-31              | 20, 31 |
| CA_20-32              | 20, 32 |
| CA_20-38              | 20, 38 |

|             |        |
|-------------|--------|
| CA_20-40    | 20, 40 |
| CA_20-40-40 | 20, 40 |
| CA_20-41    | 20, 41 |
| CA_20-42    | 20, 42 |
| CA_20-42-42 | 20, 42 |
| CA_20-43    | 20, 43 |
| CA_20-67    | 20, 67 |
| CA_20-75    | 20, 75 |
| CA_20-76    | 20, 76 |
| CA_21-28    | 21, 28 |
| CA_21-42    | 21, 42 |
| CA_21-46    | 21, 46 |
| CA_23-29    | 23, 29 |
| CA_25-26    | 25, 26 |
| CA_25-25-26 | 25, 26 |
| CA_25-41    | 25, 41 |
| CA_25-25-41 | 25, 41 |
| CA_25-46    | 25, 46 |
| CA_26-41    | 26, 41 |
| CA_26-46    | 26, 46 |
| CA_26-48    | 26,48  |
| CA_26-48-48 | 26,48  |
| CA_26-66    | 26, 66 |
| CA_28-32    | 28, 32 |
| CA_28-38    | 28,38  |
| CA_28-40    | 28, 40 |
| CA_28-41    | 28, 41 |
| CA_28-42    | 28, 42 |
| CA_28-42-42 | 28, 42 |
| CA_28-46    | 28, 46 |
| CA_28-66    | 28, 66 |
| CA_29-30    | 29, 30 |
| CA_29-66    | 29, 66 |
| CA_29-66-66 | 29, 66 |
| CA_29-70    | 29, 70 |
| CA_30-66    | 30, 66 |
| CA_30-66-66 | 30, 66 |
| CA_32-42    | 32, 42 |
| CA_32-43    | 32, 43 |
| CA_34-39    | 34, 39 |
| CA_34-41    | 34, 41 |
| CA_38-40    | 38, 40 |
| CA_38-40-40 | 38, 40 |
| CA_39-41    | 39, 41 |
| CA_39-40    | 39, 40 |
| CA_39-42    | 39, 42 |
| CA_39-46    | 39, 46 |
| CA_40-41    | 40, 41 |
| CA_40-42    | 40, 42 |
| CA_40-43    | 40, 43 |
| CA_40-46    | 40, 46 |
| CA_41-42    | 41, 42 |
| CA_41-42-42 | 41, 42 |
| CA_41-46    | 41, 46 |
| CA_41-48    | 41, 48 |
| CA_42-43    | 42, 43 |
| CA_42-46    | 42, 46 |

|   |        |
|---|--------|
| CA_46-48  | 46, 48 |
| CA_46-48-48   | 46, 48 |
| CA_46-66  | 46, 66 |
| CA_46-46-66   | 46, 66 |
| CA_46-66-66   | 46, 66 |
| CA_46-70  | 46, 70 |
| CA_46-71  | 46, 71 |
| CA_48-66  | 48, 66 |
| CA_48-66-66   | 48, 66 |
| CA_48-48-66-66  | 48, 66 |
| CA_48-48-66   | 48, 66 |
| CA_48-71  | 48, 71 |
| CA_48-48-71   | 48, 71 |
| CA_66-70  | 66,70  |
| CA_66-66-70   | 66,70  |
| CA_66-71  | 66, 71 |
| CA_66-66-71   | 66, 71 |
| CA_70-71  | 70, 71 |
| NOTE 1: The frequency range in band 28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL. This restriction also apply for any band combinations when CA_20-28 is a subset of a higher order band combination. |        |
| NOTE 2: The frequency range in band 28 is restricted for this CA band combination to 718-748 MHz for the UL and 773-803 MHz for the DL  |        |

Table 5.5A-2a: Inter-band CA operating bands (three bands)

| E-UTRA CA Band | E-UTRA Band<br>(Table 5.5-1) |
|----------------|------------------------------|
| CA_1-3-5       | 1, 3, 5                      |
| CA_1-3-3-5     | 1, 3, 5                      |
| CA_1-1-3-5     | 1, 3, 5                      |
| CA_1-1-3-7     | 1, 3, 7                      |
| CA_1-1-3-3-7   | 1, 3, 7                      |
| CA_1-3-7       | 1, 3, 7                      |
| CA_1-3-3-7     | 1, 3, 7                      |
| CA_1-3-3-7-7   | 1, 3, 7                      |
| CA_1-3-7-7     | 1, 3, 7                      |
| CA_1-3-8       | 1, 3, 8                      |
| CA_1-3-3-8     | 1, 3, 8                      |
| CA_1-3-3-43    | 1, 3, 43                     |
| CA_1-3-11      | 1, 3, 11                     |
| CA_1-3-18      | 1, 3, 18                     |
| CA_1-3-19      | 1, 3, 19                     |
| CA_1-3-3-19    | 1, 3, 19                     |
| CA_1-3-20      | 1, 3, 20                     |
| CA_1-3-3-20    | 1, 3, 20                     |
| CA_1-3-21      | 1, 3, 21                     |
| CA_1-3-3-21    | 1, 3, 21                     |
| CA_1-3-26      | 1, 3, 26                     |
| CA_1-3-28      | 1, 3, 28                     |
| CA_1-3-3-28    | 1, 3, 28                     |
| CA_1-1-3-28    | 1, 3, 28                     |
| CA_1-1-3-3-28  | 1, 3, 28                     |
| CA_1-3-32      | 1, 3, 32                     |
| CA_1-3-38      | 1, 3, 38                     |
| CA_1-3-40      | 1, 3, 40                     |

|                         |           |
|-------------------------|-----------|
| CA_1-3-41               | 1, 3, 41  |
| CA_1-3-42               | 1, 3, 42  |
| CA_1-3-3-42             | 1, 3, 42  |
| CA_1-3-42-42            | 1, 3, 42  |
| CA_1-3-43               | 1, 3, 43  |
| CA_1-3-46               | 1, 3, 46  |
| CA_1-5-7                | 1, 5, 7   |
| CA_1-5-7-7              | 1, 5, 7   |
| CA_1-5-28 <sup>2</sup>  | 1, 5, 28  |
| CA_1-5-40               | 1, 5, 40  |
| CA_1-5-41               | 1, 5, 41  |
| CA_1-5-46               | 1, 5, 46  |
| CA_1-7-8                | 1, 7, 8   |
| CA_1-7-7-8              | 1, 7, 8   |
| CA_1-7-20               | 1, 7, 20  |
| CA_1-7-7-20             | 1, 7, 20  |
| CA_1-7-26               | 1, 7, 26  |
| CA_1-7-7-26             | 1, 7, 26  |
| CA_1-7-28               | 1, 7, 28  |
| CA_1-7-32               | 1, 7, 32  |
| CA_1-7-38               | 1, 7, 38  |
| CA_1-7-40               | 1, 7, 40  |
| CA_1-7-42               | 1, 7, 42  |
| CA_1-7-46               | 1, 7, 46  |
| CA_1-8-11               | 1, 8, 11  |
| CA_1-8-20               | 1, 8, 20  |
| CA_1-8-28               | 1, 8, 28  |
| CA_1-8-38               | 1, 8, 38  |
| CA_1-8-40               | 1, 8, 40  |
| CA_1-8-42               | 1, 8, 42  |
| CA_1-11-18              | 1, 11, 18 |
| CA_1-11-28              | 1, 11, 28 |
| CA_1-11-42              | 1, 11, 42 |
| CA_1-18-28 <sup>1</sup> | 1, 18, 28 |
| CA_1-18-41              | 1, 18, 41 |
| CA_1-18-42              | 1, 18, 42 |
| CA_1-19-21              | 1, 19, 21 |
| CA_1-19-28 <sup>2</sup> | 1, 19, 28 |
| CA_1-19-42              | 1, 19, 42 |
| CA_1-20-28              | 1, 20, 28 |
| CA_1-20-32              | 1, 20, 32 |
| CA_1-20-38              | 1, 20, 38 |
| CA_1-20-42              | 1, 20, 42 |
| CA_1-20-43              | 1, 20, 43 |
| CA_1-21-28              | 1, 21, 28 |
| CA_1-21-42              | 1, 21, 42 |
| CA_1-28-40              | 1, 28, 40 |
| CA_1-28-42              | 1, 28, 42 |
| CA_1-32-42              | 1, 32, 42 |
| CA_1-32-43              | 1, 32, 43 |
| CA_1-41-42              | 1, 41, 42 |
| CA_1-42-42              | 1, 42, 42 |
| CA_1-42-43              | 1, 42, 43 |
| CA_2-4-5                | 2, 4, 5   |
| CA_2-2-4-5              | 2, 4, 5   |
| CA_2-4-4-5              | 2, 4, 5   |
| CA_2-4-12-12            | 2, 4, 12  |
| CA_2-5-12-12            | 2, 5, 12  |
| CA_2-2-5-30             | 2, 5, 30  |
| CA_2-5-46               | 2, 5, 46  |
| CA_2-2-5-66             | 2, 5, 66  |
| CA_2-2-7-12             | 2, 7, 12  |
| CA_2-2-7-66             | 2, 7, 66  |
| CA_2-7-66-66            | 2, 7, 66  |
| CA_2-2-12-30            | 2, 12, 30 |

|                  |           |
|------------------|-----------|
| CA_2-2-12-66     | 2, 12, 66 |
| CA_2-2-12-66-66  | 2, 12, 66 |
| CA_2-2-13-66     | 2, 13, 66 |
| CA_2-2-14-66-66  | 2, 14, 66 |
| CA_2-2-30-66     | 2, 30, 66 |
| CA_2-4-7         | 2, 4, 7   |
| CA_2-4-7-7       | 2, 4, 7   |
| CA_2-4-12        | 2, 4, 12  |
| CA_2-2-4-12      | 2, 4, 12  |
| CA_2-2-5-66-66   | 2, 5, 66  |
| CA_2-4-4-12      | 2, 4, 12  |
| CA_2-4-13        | 2, 4, 13  |
| CA_2-4-28        | 2, 4, 28  |
| CA_2-4-29        | 2, 4, 29  |
| CA_2-4-30        | 2, 4, 30  |
| CA_2-4-71        | 2, 4, 71  |
| CA_2-2-4-71      | 2, 4, 71  |
| CA_2-5-7         | 2, 5, 7   |
| CA_2-5-12        | 2, 5, 12  |
| CA_2-2-5-12      | 2, 5, 12  |
| CA_2-5-13        | 2, 5, 13  |
| CA_2-5-28        | 2, 5, 28  |
| CA_2-5-29        | 2, 5, 29  |
| CA_2-5-30        | 2, 5, 30  |
| CA_2-5-46        | 2, 5, 46  |
| CA_2-5-66        | 2, 5, 66  |
| CA_2-5-66-66     | 2, 5, 66  |
| CA_2-7-12        | 2, 7, 12  |
| CA_2-7-13        | 2, 7, 13  |
| CA_2-7-26        | 2, 7, 26  |
| CA_2-7-28        | 2, 7, 28  |
| CA_2-7-29        | 2, 7, 29  |
| CA_2-7-30        | 2, 7, 30  |
| CA_2-7-46        | 2, 7, 46  |
| CA_2-7-66        | 2, 7, 66  |
| CA_2-7-7-66      | 2, 7, 66  |
| CA_2-7-66-66     | 2, 7, 66  |
| CA_2-7-7-66-66   | 2, 7, 66  |
| CA_2-12-30       | 2, 12, 30 |
| CA_2-12-66       | 2, 12, 66 |
| CA_2-12-66-66    | 2, 12, 66 |
| CA_2-13-46       | 2, 13, 46 |
| CA_2-13-48       | 2, 13, 48 |
| CA_2-13-48-48    | 2, 13, 48 |
| CA_2-13-66       | 2, 13, 66 |
| CA_2-13-66-66    | 2, 13, 66 |
| CA_2-14-30       | 2, 14, 30 |
| CA_2-2-14-30     | 2, 14, 30 |
| CA_2-14-66       | 2, 14, 66 |
| CA_2-2-14-66     | 2, 14, 66 |
| CA_2-14-66-66    | 2, 14, 66 |
| CA_2-14-66-66-66 | 2, 14, 66 |
| CA_2-26-66       | 2, 26, 66 |
| CA_2-28-66       | 2, 28, 66 |
| CA_2-2-29-30     | 2, 29, 30 |
| CA_2-29-30       | 2, 29, 30 |
| CA_2-29-66       | 2, 29, 66 |
| CA_2-30-66       | 2, 30, 66 |
| CA_2-30-66-66    | 2, 30, 66 |
| CA_2-46-48       | 2, 46, 48 |
| CA_2-46-66       | 2, 46, 66 |
| CA_2-46-46-66    | 2, 46, 66 |
| CA_2-48-66       | 2, 48, 66 |
| CA_2-48-48-66    | 2, 48, 66 |
| CA_2-66-71       | 2, 66, 71 |

|                          |           |
|--------------------------|-----------|
| CA_2-2-66-71             | 2, 66, 71 |
| CA_2-66-66-71            | 2, 66, 71 |
| CA_3-5-7                 | 3, 5, 7   |
| CA_3-5-7-7               | 3, 5, 7   |
| CA_3-5-28                | 3, 5, 28  |
| CA_3-3-5-28 <sup>2</sup> | 3, 5, 28  |
| CA_3-5-40                | 3, 5, 40  |
| CA_3-5-40-40             | 3, 5, 40  |
| CA_3-5-41                | 3, 5, 41  |
| CA_3-3-7-8               | 3, 7, 8   |
| CA_3-3-7-7-8             | 3, 7, 8   |
| CA_3-7-7-8               | 3, 7, 8   |
| CA_3-7-8                 | 3, 7, 8   |
| CA_3-7-20                | 3, 7, 20  |
| CA_3-3-7-20              | 3, 7, 20  |
| CA_3-7-7-20              | 3, 7, 20  |
| CA_3-7-26                | 3, 7, 26  |
| CA_3-7-7-26              | 3, 7, 26  |
| CA_3-7-28                | 3, 7, 28  |
| CA_3-3-7-28              | 3, 7, 28  |
| CA_3-7-32                | 3, 7, 32  |
| CA_3-7-38                | 3, 7, 38  |
| CA_3-7-40                | 3, 7, 40  |
| CA_3-7-42                | 3, 7, 42  |
| CA_3-7-46                | 3, 7, 46  |
| CA_3-8-11                | 3, 8, 11  |
| CA_3-8-20                | 3, 8, 20  |
| CA_3-8-28                | 3, 8, 28  |
| CA_3-8-32                | 3, 8, 32  |
| CA_3-8-38                | 3, 8, 38  |
| CA_3-8-40                | 3, 8, 40  |
| CA_3-8-42                | 3, 8, 42  |
| CA_3-11-18               | 3, 11, 18 |
| CA_3-11-26               | 3, 11, 26 |
| CA_3-11-28               | 3, 11, 28 |
| CA_3-18-42               | 3, 18, 42 |
| CA_3-19-21               | 3, 19, 21 |
| CA_3-3-19-21             | 3, 19, 21 |
| CA_3-19-42               | 3, 19, 42 |
| CA_3-20-28               | 3, 20, 28 |
| CA_3-3-20-28             | 3, 20, 28 |
| CA_3-20-32               | 3, 20, 32 |
| CA_3-20-42               | 3, 20, 42 |
| CA_3-20-43               | 3, 20, 43 |
| CA_3-21-28               | 3, 21, 28 |
| CA_3-21-42               | 3, 21, 42 |
| CA_3-28-38               | 3, 28, 38 |
| CA_3-28-40               | 3, 28, 40 |
| CA_3-28-41               | 3, 28, 41 |
| CA_3-28-42               | 3, 28, 42 |
| CA_3-28-42-42            | 3, 28, 42 |
| CA_3-32-42               | 3, 32, 42 |
| CA_3-32-43               | 3, 32, 43 |
| CA_3-32-46               | 3, 32, 46 |
| CA_3-41-42               | 3, 41, 42 |
| CA_3-41-42-42            | 3, 41, 42 |
| CA_3-42-43               | 3, 42, 43 |
| CA_4-5-12                | 4, 5, 12  |
| CA_4-4-5-12              | 4, 5, 12  |
| CA_4-5-12-12             | 4, 5, 12  |
| CA_4-5-13                | 4, 5, 13  |
| CA_4-5-29                | 4, 5, 29  |
| CA_4-5-30                | 4, 5, 30  |
| CA_4-4-5-30              | 4, 5, 30  |
| CA_4-7-12                | 4, 7, 12  |

|                |              |
|----------------|--------------|
| CA_4-7-28      | 4, 7, 28     |
| CA_4-12-30     | 4, 12, 30    |
| CA_4-4-12-30   | 4, 12, 30    |
| CA_4-29-30     | 4, 29, 30    |
| CA_4-4-29-30   | 4, 29, 30    |
| CA_5-7-28      | 5, 7, 28     |
| CA_5-7-46      | 5, 7, 46     |
| CA_5-7-66      | 5, 7, 66     |
| CA_5-7-66-66   | 5, 7, 66, 66 |
| CA_5-12-46     | 5, 12, 46    |
| CA_5-12-48     | 5, 12, 48    |
| CA_5-12-66     | 5, 12, 66    |
| CA_5-30-66     | 5, 30, 66    |
| CA_5-30-66-66  | 5, 30, 66    |
| CA_5-40-41     | 5, 40, 41    |
| CA_5-46-66     | 5, 46, 66    |
| CA_5-46-66-66  | 5, 46, 66    |
| CA_5-48-66     | 5, 48, 66    |
| CA_5-48-66-66  | 5, 48, 66    |
| CA_7-8-20      | 7, 8, 20     |
| CA_7-8-38      | 7, 8, 38     |
| CA_7-8-40      | 7, 8, 40     |
| CA_7-12-66     | 7, 12, 66    |
| CA_7-13-66     | 7, 13, 66    |
| CA_7-20-28     | 7, 20, 28    |
| CA_7-20-32     | 7, 20, 32    |
| CA_7-20-38     | 7, 20, 38    |
| CA_7-20-42     | 7, 20, 42    |
| CA_7-26-66     | 7, 26, 66    |
| CA_7-28-38     | 7, 28, 38    |
| CA_7-28-40     | 7, 28, 40    |
| CA_7-29-66     | 7, 29, 66    |
| CA_7-7-29-66   | 7, 29, 66    |
| CA_7-30-66     | 7, 30, 66    |
| CA_7-32-46     | 7, 32, 46    |
| CA_7-46-66     | 7, 46, 66    |
| CA_8-11-28     | 8, 11, 28    |
| CA_8-11-42     | 8, 11, 42    |
| CA_8-20-28     | 8, 20, 28    |
| CA_8-28-41     | 8, 28, 41    |
| CA_8-39-41     | 8, 39, 41    |
| CA_12-30-66    | 12, 30, 66   |
| CA_12-30-66-66 | 12, 30, 66   |
| CA_13-46-66    | 13, 46, 66   |
| CA_13-48-66    | 13, 48, 66   |
| CA_13-48-48-66 | 13, 48, 66   |
| CA_14-30-66    | 14, 30, 66   |
| CA_14-30-66-66 | 14, 30, 66   |
| CA_19-21-42    | 19, 21, 42   |
| CA_20-32-42    | 20, 32, 42   |
| CA_20-32-43    | 20, 32, 43   |
| CA_20-38-40    | 20, 38, 40   |
| CA_25-26-41    | 25, 26, 41   |
| CA_25-25-26-41 | 25, 26, 41   |
| CA_20-38-40-40 | 20, 38, 40   |
| CA_21-28-42    | 21, 28, 42   |
| CA_29-30-66-66 | 29, 30, 66   |
| CA_28-41-42    | 28, 41, 42   |
| CA_28-41-42-42 | 28, 41, 42   |
| CA_29-30-66    | 29, 30, 66   |
| CA_29-46-66    | 29, 46, 66   |
| CA_29-66-70    | 29, 66, 70   |
| CA_29-66-66-70 | 29, 66, 70   |
| CA_32-42-43    | 32, 42, 43   |
| CA_46-48-66    | 46, 48, 66   |



|  |            |
|--|------------|
| CA_46-48-71  | 46, 48, 71 |
| CA_46-48-48-71   | 46, 48, 71 |
| CA_66-70-71  | 66, 70, 71 |
| CA_66-66-70-71   | 66, 70, 71 |
| NOTE 1: The frequency range in band 28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL |            |
| NOTE 2: The frequency range in band 28 is restricted for this CA band combination to 718-748 MHz for the UL and 773-803 MHz for the DL |            |

**Table 5.5A-2b: Inter-band CA operating bands (four bands)**

| E-UTRA CA Band           | E-UTRA Band<br>(Table 5.5-1) |
|--------------------------|------------------------------|
| CA_1-3-5-7               | 1, 3, 5, 7                   |
| CA_1-3-3-5-7             | 1, 3, 5, 7                   |
| CA_1-3-5-7-7             | 1, 3, 5, 7                   |
| CA_1-3-5-28 <sup>2</sup> | 1, 3, 5, 28                  |
| CA_1-3-5-40              | 1, 3, 5, 40                  |
| CA_1-3-5-41              | 1, 3, 5, 41                  |
| CA_1-3-7-7-26            | 1, 3, 7, 26                  |
| CA_1-3-7-8               | 1, 3, 7, 8                   |
| CA_1-3-3-7-8             | 1, 3, 7, 8                   |
| CA_1-3-7-7-8             | 1, 3, 7, 8                   |
| CA_1-3-3-7-7-8           | 1, 3, 7, 8                   |
| CA_1-3-7-20              | 1, 3, 7, 20                  |
| CA_1-3-7-7-20            | 1, 3, 7, 20                  |
| CA_1-3-3-7-20            | 1, 3, 7, 20                  |
| CA_1-3-7-26              | 1, 3, 7, 26                  |
| CA_1-3-7-28              | 1, 3, 7, 28                  |
| CA_1-1-3-7-28            | 1, 3, 7, 28                  |
| CA_1-3-3-7-28            | 1, 3, 7, 28                  |
| CA_1-1-3-3-7-28          | 1, 3, 7, 28                  |
| CA_1-3-7-7-28            | 1, 3, 7, 28                  |
| CA_1-3-7-32              | 1, 3, 7, 32                  |
| CA_1-3-7-40              | 1, 3, 7, 40                  |
| CA_1-3-7-42              | 1, 3, 7, 42                  |
| CA_1-3-7-46              | 1, 3, 7, 46                  |
| CA_1-3-8-11              | 1, 3, 8, 11                  |
| CA_1-3-8-20              | 1, 3, 8, 20                  |
| CA_1-3-8-28              | 1, 3, 8, 28                  |
| CA_1-3-8-38              | 1, 3, 8, 38                  |
| CA_1-3-11-28             | 1, 3, 11, 28                 |
| CA_1-3-8-40              | 1, 3, 8, 40                  |
| CA_1-3-8-42              | 1, 3, 8, 42                  |
| CA_1-3-18-42             | 1, 3, 18, 42                 |
| CA_1-3-19-21             | 1, 3, 19, 21                 |
| CA_1-3-3-19-21           | 1, 3, 19, 21                 |
| CA_1-3-19-42             | 1, 3, 19, 42                 |
| CA_1-3-20-28             | 1, 3, 20, 28                 |
| CA_1-3-3-20-28           | 1, 3, 20, 28                 |
| CA_1-3-20-32             | 1, 3, 20, 32                 |
| CA_1-3-20-42             | 1, 3, 20, 42                 |
| CA_1-3-20-43             | 1, 3, 20, 43                 |
| CA_1-3-21-28             | 1, 3, 21, 28                 |
| CA_1-3-21-42             | 1, 3, 21, 42                 |
| CA_1-3-28-40             | 1, 3, 28, 40                 |
| CA_1-3-28-42             | 1, 3, 28, 42                 |
| CA_1-3-32-42             | 1, 3, 32, 42                 |
| CA_1-3-32-43             | 1, 3, 32, 43                 |

|                            |               |
|----------------------------|---------------|
| CA_1-3-41-42               | 1, 3, 41, 42  |
| CA_1-3-42-43               | 1, 3, 42, 43  |
| CA_1-5-7-28 <sup>2</sup>   | 1, 5, 7, 28   |
| CA_1-5-7-46                | 1, 5, 7, 46   |
| CA_1-7-8-20                | 1, 7, 8, 20   |
| CA_1-7-8-40                | 1, 7, 8, 40   |
| CA_1-7-20-28               | 1, 7, 20, 28  |
| CA_1-7-20-32               | 1, 7, 20, 32  |
| CA_1-7-20-42               | 1, 7, 20, 42  |
| CA_1-7-28-40               | 1, 7, 28, 40  |
| CA_1-8-11-28               | 1, 8, 11, 28  |
| CA_1-8-11-42               | 1, 8, 11, 42  |
| CA_1-8-20-28               | 1, 8, 20, 28  |
| CA_1-19-21-42              | 1, 19, 21, 42 |
| CA_1-20-32-42              | 1, 20, 32, 42 |
| CA_1-20-32-43              | 1, 20, 32, 43 |
| CA_1-21-28-42              | 1, 21, 28, 42 |
| CA_1-32-42-43              | 1, 32, 42, 43 |
| CA_2-2-5-12-66             | 2, 5, 12, 66  |
| CA_2-2-5-30-66             | 2, 5, 30, 66  |
| CA_2-2-7-12-66             | 2, 7, 12, 66  |
| CA_2-2-12-30-66            | 2, 12, 30, 66 |
| CA_2-2-14-30-66            | 2, 14, 30, 66 |
| CA_2-4-5-12                | 2, 4, 5, 12   |
| CA_2-4-5-29                | 2, 4, 5, 29   |
| CA_2-4-5-30                | 2, 4, 5, 30   |
| CA_2-4-7-12                | 2, 4, 7, 12   |
| CA_2-4-12-30               | 2, 4, 12, 30  |
| CA_2-4-29-30               | 2, 4, 29, 30  |
| CA_2-5-7-28                | 2, 5, 7, 28   |
| CA_2-5-12-66               | 2, 5, 12, 66  |
| CA_2-5-30-66               | 2, 5, 30, 66  |
| CA_2-5-30-66-66            | 2, 5, 30, 66  |
| CA_2-7-12-66               | 2, 7, 12, 66  |
| CA_2-7-13-66               | 2, 7, 13, 66  |
| CA_2-7-26-66               | 2, 7, 26, 66  |
| CA_2-7-29-66               | 2, 7, 29, 66  |
| CA_2-7-7-29-66             | 2, 7, 29, 66  |
| CA_2-7-46-66               | 2, 7, 46, 66  |
| CA_2-12-30-66              | 2, 12, 30, 66 |
| CA_2-12-30-66-66           | 2, 12, 30, 66 |
| CA_2-13-48-66              | 2, 13, 48, 66 |
| CA_2-13-48-48-66           | 2, 13, 48, 66 |
| CA_2-14-30-66              | 2, 14, 30, 66 |
| CA_2-14-30-66-66           | 2, 14, 30, 66 |
| CA_2-29-30-66              | 2, 29, 30, 66 |
| CA_2-46-48-66              | 2, 46, 48, 66 |
| CA_3-5-7-28 <sup>2</sup>   | 3, 5, 7, 28   |
| CA_3-3-5-7-28 <sup>2</sup> | 3, 5, 7, 28   |
| CA_3-7-8-20                | 3, 7, 8, 20   |
| CA_3-7-8-38                | 3, 7, 8, 38   |
| CA_3-7-8-40                | 3, 7, 8, 40   |
| CA_3-7-20-28               | 3, 7, 20, 28  |
| CA_3-7-20-32               | 3, 7, 20, 32  |
| CA_3-7-20-42               | 3, 7, 20, 42  |
| CA_3-7-28-38               | 3, 7, 28, 38  |
| CA_3-7-28-40               | 3, 7, 28, 40  |
| CA_3-7-32-46               | 3, 7, 32, 46  |
| CA_3-8-11-28               | 3, 8, 11, 28  |
| CA_3-8-20-28               | 3, 8, 20, 28  |

|  |               |
|--|---------------|
| CA_3-19-21-42  | 3, 19, 21, 42 |
| CA_3-20-32-42  | 3, 20, 32, 42 |
| CA_3-20-32-43  | 3, 20, 32, 43 |
| CA_3-21-28-42  | 3, 21, 28, 42 |
| CA_3-28-41-42  | 3, 28, 41, 42 |
| CA_3-32-42-43  | 3, 32, 42, 43 |
| NOTE 1: The frequency range in band 28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL |               |
| NOTE 2: The frequency range in band 28 is restricted for this CA band combination to 718-748 MHz for the UL and 773-803 MHz for the DL |               |

**Table 5.5A-2c: Inter-band CA operating bands (five bands)**

| E-UTRA CA Band   | E-UTRA Band (Table 5.5-1) |
|--|---------------------------|
| CA_1-3-5-7-28 <sup>2</sup>   | 1, 3, 5, 7, 28            |
| CA_1-3-7-8-20  | 1, 3, 7, 8, 20            |
| CA_1-3-7-20-28   | 1, 3, 7, 20, 28           |
| CA_1-3-7-20-32   | 1, 3, 7, 20, 32           |
| CA_1-3-7-20-42   | 1, 3, 7, 20, 42           |
| CA_1-3-8-11-28   | 1, 3, 8, 11, 28           |
| CA_1-3-20-32-42  | 1, 3, 20, 32, 42          |
| CA_1-3-20-32-43  | 1, 3, 20, 32, 43          |
| CA_1-3-32-42-43  | 1, 3, 32, 42, 43          |
| NOTE 1: The frequency range in band 28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL |                           |
| NOTE 2: The frequency range in band 28 is restricted for this CA band combination to 718-748 MHz for the UL and 773-803 MHz for the DL |                           |

**Table 5.5A-3: Intra-band non-contiguous CA operating bands (with two sub-blocks)**

| E-UTRA CA Band | E-UTRA Band (Table 5.5-1) |
|----------------|---------------------------|
| CA_1-1         | 1                         |
| CA_2-2         | 2                         |
| CA_3-3         | 3                         |
| CA_4-4         | 4                         |
| CA_5-5         | 5                         |
| CA_7-7         | 7                         |
| CA_12-12       | 12                        |
| CA_23-23       | 23                        |
| CA_25-25       | 25                        |
| CA_40-40       | 40                        |
| CA_41-41       | 41                        |
| CA_42-42       | 42                        |
| CA_43-43       | 43                        |
| CA_48-48       | 48                        |
| CA_66-66       | 66                        |

**Table 5.5A-4: Intra-band non-contiguous CA operating bands (with three sub-blocks)**

| E-UTRA CA Band | E-UTRA Band (Table 5.5-1) |
|----------------|---------------------------|
|----------------|---------------------------|

|             |    |
|-------------|----|
| CA_25-25-25 | 25 |
| CA_41-41-41 | 41 |
| CA_48-48-48 | 48 |
| CA_66-66-66 | 66 |

**Table 5.5A-5: Intra-band non-contiguous CA operating bands (with four sub-blocks)**

| E-UTRA CA Band | E-UTRA Band<br>(Table 5.5-1) |
|----------------|------------------------------|
| CA_48-48-48-48 | 48                           |

## 5.5B Operating bands for UL-MIMO

E-UTRA UL-MIMO is designed to operate in the operating bands defined in Table 5.5B-1.

**Table 5.5B-1: Void**

## 5.5C Operating bands for Dual Connectivity

E-UTRA dual connectivity is designed to operate in the operating bands defined in Table 5.5C-1.

**Table 5.5C-1: Inter-band dual connectivity operating bands (two bands)**

| E-UTRA DC Band | E-UTRA Band<br>(Table 5.5) |
|----------------|----------------------------|
| DC_1-3         | 1, 3                       |
| DC_1-5         | 1, 5                       |
| DC_1-7         | 1, 7                       |
| DC_1-8         | 1, 8                       |
| DC_1-11        | 1, 11                      |
| DC_1-19        | 1, 19                      |
| DC_1-20        | 1, 20                      |
| DC_1-21        | 1, 21                      |
| DC_1-42        | 1, 42                      |
| DC_2-4         | 2, 4                       |
| DC_2-5         | 2, 5                       |
| DC_2-7         | 2, 7                       |
| DC_2-12        | 2, 12                      |
| DC_2-13        | 2, 13                      |
| DC_2-14        | 2, 14                      |
| DC_2-30        | 2, 30                      |
| DC_2-48        | 2, 48                      |
| DC_2-66        | 2, 66                      |
| DC_3-5         | 3, 5                       |
| DC_3-7         | 3, 7                       |
| DC_3-8         | 3, 8                       |
| DC_3-11        | 3, 11                      |
| DC_3-18        | 3, 18                      |
| DC_3-19        | 3, 19                      |
| DC_3-20        | 3, 20                      |
| DC_3-21        | 3, 21                      |
| DC_3-26        | 3, 26                      |
| DC_3-28        | 3, 28                      |
| DC_3-40        | 3, 40                      |
| DC_3-42        | 3, 42                      |
| DC_4-5         | 4, 5                       |
| DC_4-7         | 4, 7                       |

|          |        |
|----------|--------|
| DC_4-12  | 4, 12  |
| DC_4-13  | 4, 13  |
| DC_4-17  | 4, 17  |
| DC_4-28  | 4, 28  |
| DC_5-7   | 5, 7   |
| DC_5-12  | 5, 12  |
| DC_5-17  | 5, 17  |
| DC_5-30  | 5, 30  |
| DC_5-40  | 5, 40  |
| DC_5-66  | 5, 66  |
| DC_7-8   | 7, 8   |
| DC_7-20  | 7, 20  |
| DC_7-26  | 7, 26  |
| DC_7-28  | 7, 28  |
| DC_8-39  | 8, 39  |
| DC_8-41  | 8, 41  |
| DC_11-18 | 11, 18 |
| DC_11-26 | 11, 26 |
| DC_12-30 | 12, 30 |
| DC_12-66 | 12, 66 |
| DC_13-66 | 13, 66 |
| DC_14-30 | 14, 30 |
| DC_14-66 | 14, 66 |
| DC_19-21 | 19, 21 |
| DC_19-42 | 19, 42 |
| DC_21-42 | 21, 42 |
| DC_21-28 | 21, 28 |
| DC_25-26 | 25, 26 |
| DC_25-41 | 25, 41 |
| DC_26-46 | 26, 46 |
| DC_26-48 | 26, 48 |
| DC_28-41 | 28, 41 |
| DC_28-42 | 28, 42 |
| DC_30-66 | 30, 66 |
| DC_39-41 | 39, 41 |
| DC_40-42 | 40, 42 |
| DC_41-42 | 41, 42 |

Table 5.5C-2: Inter-band dual connectivity operating bands (three bands)

| E-UTRA DC Band | E-UTRA Band<br>(Table 5.5) |
|----------------|----------------------------|
| DC_1-3-19      | 1, 3, 19                   |
| DC_1-19-21     | 1, 19, 21                  |

## 5.5D Operating bands for ProSe

E-UTRA ProSe is designed to operate in the operating bands defined in Table 5.5D-1.

Table 5.5D-1 E-UTRA ProSe operating band

| E-UTRA ProSe Band | E-UTRA Operating Band | ProSe UE transmit   |                      | ProSe UE receive    |                      | ProSe Duplex Mode | ProSe Direct |       |
|-------------------|-----------------------|---------------------|----------------------|---------------------|----------------------|-------------------|--------------|-------|
|                   |                       | F <sub>UL_low</sub> | F <sub>UL_high</sub> | F <sub>DL_low</sub> | F <sub>DL_high</sub> |                   | Disc.        | Comm. |
| 2                 | 2                     | 1850 MHz            | 1910 MHz             | 1850 MHz            | 1910 MHz             | HD                | Yes          |       |
| 3                 | 3                     | 1710 MHz            | 1785 MHz             | 1710 MHz            | 1785 MHz             | HD                | Yes          | Yes   |
| 4                 | 4                     | 1710 MHz            | 1755 MHz             | 1710 MHz            | 1755 MHz             | HD                | Yes          |       |
| 7                 | 7                     | 2500 MHz            | 2570 MHz             | 2500 MHz            | 2570 MHz             | HD                | Yes          | Yes   |

|    |    |                       |                       |    |     |     |
|----|----|-----------------------|-----------------------|----|-----|-----|
| 14 | 14 | 788 MHz – 798 MHz     | 788 MHz – 798 MHz     | HD | Yes | Yes |
| 20 | 20 | 832 MHz – 862 MHz     | 832 MHz – 862 MHz     | HD | Yes | Yes |
| 26 | 26 | 814 MHz – 849 MHz     | 814 MHz – 849 MHz     | HD | Yes | Yes |
| 28 | 28 | 703 MHz – 748 MHz     | 703 MHz – 748 MHz     | HD | Yes | Yes |
| 31 | 31 | 452.5 MHz – 457.5 MHz | 452.5 MHz – 457.5 MHz | HD | Yes | Yes |
| 41 | 41 | 2496 MHz – 2690 MHz   | 2496 MHz – 2690 MHz   | HD | Yes |     |
| 68 | 68 | 698 MHz – 728 MHz     | 698 MHz – 728 MHz     | HD | Yes | Yes |
| 72 | 72 | 451 MHz – 456 MHz     | 451 MHz – 456 MHz     | HD | Yes | Yes |

E-UTRA ProSe is designed to operate concurrent with E-UTRA uplink/downlink on the operating bands combinations listed in Table 5.5D-2.

**Table 5.5D-2 Inter-band E-UTRA ProSe / E-UTRA operating bands**

| E-UTRA ProSe Band <sup>Note 1</sup>   | E-UTRA band / E-UTRA CA band <sup>Note 2</sup> |
|---|--|
| 2   | 4  |
|   | CA_2-4 <sup>Note 3</sup>                       |
| 28  | 1  |
|   | CA_1-28 <sup>Note 3</sup>                      |
| NOTE 1: As specified in Table 5.5D-1<br>NOTE 2: As specified in Table 5.5-1 and Table 5.5A-2<br>NOTE 3: Applies when E-UTRA uplink is assigned to one E-UTRA band and ProSe operation is restricted to the uplink frequencies paired with either PCC or SCC.<br>NOTE 4: The concurrency for E-UTRA ProSe Direct Discovery with E-UTRA uplink/downlink applies after allowing for any transmission and/or reception gap requested by the UE. |  |

## 5.5E Operating bands for UE category 0, UE category M1 and M2 and UE category 1bis

UE category 0 is designed to operate in the E-UTRA operating bands 2, 3, 4, 5, 8, 13, 20, 25, 26 and 28 in both half duplex FDD mode and full-duplex FDD mode and in bands 39, 40 and 41 in TDD mode. The E-UTRA bands are defined in Table 5.5-1.

UE category M1 and M2 is designed to operate in the E-UTRA operating bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 18, 19, 20, 21, 25, 26, 27, 28, 31, 66, 71, 72, 73, 74, 85, 87 and 88 in both half duplex FDD mode and full-duplex FDD mode, and in bands 39, 40, 41, 42 and 43 in TDD mode. The E-UTRA bands are defined in Table 5.5-1.

UE category 1bis is designed to operate in the E-UTRA operating bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 18, 20, 26, 28, 31, 66 and 72 in full duplex FDD mode and in bands 34, 39, 40 and 41 in TDD mode. The E-UTRA bands are defined in Table 5.5-1

## 5.5F Operating bands for category NB1 and NB2

Category NB1 and NB2 are designed to operate in the E-UTRA operating bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 31, 41, 42, 43, 65, 66, 70, 71, 72, 73, 74, 85, 87 and 88 which are defined in Table 5.5-1.

Category NB1 and NB2 are designed to operate in the NR operating bands n1, n2, n3, n5, n7, n8, n12, n14, n18, n20, n25, n26, n28, n41, n65, n66, n70, n71, n74, n90.

Category NB1 and NB2 systems operate in HD-FDD duplex mode or in TDD mode.

In case UE receives network signaling value NS\_04 on any of the operating bands listed in Table 5.5F-1 then the lower and upper limit of those bands are shown in Table 5.5F-1 to account for the USA emission requirements.

Table 5.5F-1 E-UTRA operating bands for NB-IoT in the USA

| E-UTRA Operating Band | Uplink (UL) operating band<br>BS receive<br>UE transmit |                      | Downlink (DL) operating band<br>BS transmit<br>UE receive |                      | Duplex Mode |
|-----------------------|---|----------------------|---|----------------------|-------------|
|                       | F <sub>UL_low</sub>                                     | F <sub>UL_high</sub> | F <sub>DL_low</sub>                                       | F <sub>DL_high</sub> |             |
| 2                     | 1850.1 MHz  | 1909.9 MHz           | 1930.1 MHz  | 1989.9 MHz           | FDD         |
| 4                     | 1710.1 MHz  | 1754.9 MHz           | 2110.1 MHz  | 2154.9 MHz           | FDD         |
| 5                     | 824.1 MHz   | 848.9 MHz            | 869.1 MHz   | 893.9 MHz            | FDD         |
| 12                    | 699 MHz   | 715.9 MHz            | 729 MHz   | 745.9 MHz            | FDD         |
| 13                    | 777 MHz   | 786.9 MHz            | 746 MHz   | 755.9 MHz            | FDD         |
| 17                    | 704.1 MHz   | 715.9 MHz            | 734.1 MHz   | 745.9 MHz            | FDD         |
| 25                    | 1850.1 MHz  | 1914.9 MHz           | 1930.1 MHz  | 1994.9 MHz           | FDD         |
| 26                    | 814.1 MHz   | 848.9 MHz            | 859.1 MHz   | 893.9 MHz            | FDD         |
| 66                    | 1710.1 MHz  | 1779.9 MHz           | 2110.1 MHz  | 2199.9 MHz           | FDD         |
| 70                    | 1695.1 MHz  | 1709.9 MHz           | 1995.1 MHz  | 2019.9 MHz           | FDD         |
| 71                    | 663.1 MHz   | 697.9 MHz            | 617.1 MHz   | 651.9 MHz            | FDD         |
| 85                    | 698.1 MHz   | 715.9 MHz            | 728.1 MHz   | 745.9 MHz            | FDD         |

## 5.5G Operating bands for V2X Communication

E-UTRA V2X Communication is designed to operate in the the operating bands defined in Table 5.5G-1.

Table 5.5G-1 V2X operating band

| E-UTRA Operating Band | E-UTRA V2X Operating Band | V2X UE transmit     |                      | V2X UE receive      |                      | Duplex Mode | Interface |
|-----------------------|---------------------------|---------------------|----------------------|---------------------|----------------------|-------------|-----------|
|                       |                           | F <sub>UL_low</sub> | F <sub>UL_high</sub> | F <sub>DL_low</sub> | F <sub>DL_high</sub> |             |           |
| 47                    | 47                        | 5855 MHz            | 5925 MHz             | 5855 MHz            | 5925 MHz             | HD          | PC5       |

E-UTRA V2X communication is designed to operate concurrent with E-UTRA uplink/downlink on the operating bands combinations listed in Table 5.5G-2.

Table 5.5G-2 Inter-band concurrent V2X operating bands

| V2X concurrent band configuration | E-UTRA or V2X Operating Band | Interface | Uplink (UL) operating band<br>BS receive<br>UE transmit |                      | Downlink (DL) operating band<br>BS transmit<br>UE receive |                      | Duplex Mode |
|-----------------------------------|------------------------------|-----------|---|----------------------|---|----------------------|-------------|
|                                   |                              |           | F <sub>UL_low</sub>                                     | F <sub>UL_high</sub> | F <sub>DL_low</sub>                                       | F <sub>DL_high</sub> |             |
| V2X_3-47                          | 3                            | Uu        | 1710 MHz  | 1785 MHz             | 1805 MHz  | 1880 MHz             | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_5-47                          | 5                            | Uu        | 824 MHz   | 849 MHz              | 869 MHz   | 894 MHz              | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_7-47                          | 7                            | Uu        | 2500 MHz  | 2570 MHz             | 2620 MHz  | 2690 MHz             | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_8-47                          | 8                            | Uu        | 880 MHz   | 915 MHz              | 925 MHz   | 960 MHz              | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_20-47                         | 20                           | Uu        | 832 MHz   | 862 MHz              | 791 MHz   | 821 MHz              | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_28-47                         | 28                           | Uu        | 703 MHz   | 748 MHz              | 758 MHz   | 803 MHz              | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_34-47                         | 34                           | Uu        | 2010 MHz  | 2025 MHz             | 2010 MHz  | 2025 MHz             | TDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_39-47                         | 39                           | Uu        | 1880 MHz  | 1920 MHz             | 1880 MHz  | 1920 MHz             | TDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_41-47                         | 41                           | Uu        | 2496 MHz  | 2690 MHz             | 2496 MHz  | 2690 MHz             | TDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |
| V2X_71-47                         | 71                           | Uu        | 663 MHz   | 698 MHz              | 617 MHz   | 652 MHz              | FDD         |
|                                   | 47                           | PC5       | 5855 MHz  | 5925 MHz             | 5855 MHz  | 5925 MHz             | HD          |

E-UTRA V2X communication is also designed to operate for intra-band multi-carrier operation in the operating bands defined in Table 5.5G-3.

**Table 5.5G-3: V2X intra-band multi-carrier operation**

| V2X multi-carrier Band configuration | V2X operating Band | Interface |
|--------------------------------------|--------------------|-----------|
| V2X_47                               | 47                 | PC5       |

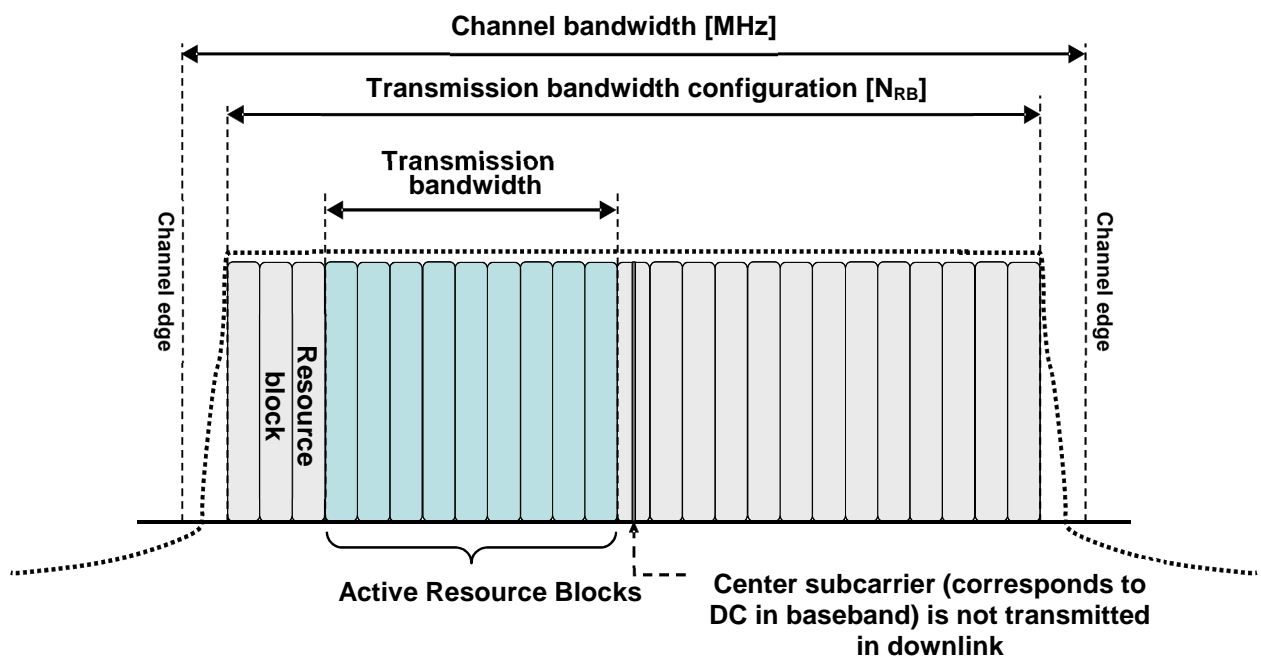
## 5.6 Channel bandwidth

Requirements in present document are specified for the channel bandwidths listed in Table 5.6-1.

**Table 5.6-1: Transmission bandwidth configuration  $N_{RB}$  in E-UTRA channel bandwidths**

| Channel bandwidth $BW_{Channel}$ [MHz]        | 1.4 | 3  | 5  | 10 | 15 | 20  |
|---|-----|----|----|----|----|-----|
| Transmission bandwidth configuration $N_{RB}$ | 6   | 15 | 25 | 50 | 75 | 100 |

Figure 5.6-1 shows the relation between the Channel bandwidth ( $BW_{Channel}$ ) and the Transmission bandwidth configuration ( $N_{RB}$ ). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at  $F_C \pm BW_{Channel} / 2$ .



**Figure 5.6-1: Definition of channel bandwidth and transmission bandwidth configuration for one E-UTRA carrier**



## 5.6.1 Channel bandwidths per operating band

a) The requirements in this specification apply to the combination of channel bandwidths and operating bands shown in Table 5.6.1-1. The transmission bandwidth configuration in Table 5.6.1-1 shall be supported for each of the specified channel bandwidths. The same (symmetrical) channel bandwidth is specified for both the TX and RX path.

**Table 5.6.1-1: E-UTRA channel bandwidth**

| E-UTRA band / Channel bandwidth |         |                  |                  |                  |                  |                    |
|---------------------------------|---------|------------------|------------------|------------------|------------------|--------------------|
| E-UTRA Band                     | 1.4 MHz | 3 MHz            | 5 MHz            | 10 MHz           | 15 MHz           | 20 MHz             |
| 1                               |         |                  | Yes              | Yes              | Yes              | Yes                |
| 2                               | Yes     | Yes              | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 3                               | Yes     | Yes              | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 4                               | Yes     | Yes              | Yes              | Yes              | Yes              | Yes                |
| 5                               | Yes     | Yes              | Yes              | Yes <sup>1</sup> |                  |                    |
| 6                               |         |                  | Yes              | Yes <sup>1</sup> |                  |                    |
| 7                               |         |                  | Yes              | Yes              | Yes <sup>3</sup> | Yes <sup>1,3</sup> |
| 8                               | Yes     | Yes              | Yes              | Yes <sup>1</sup> |                  |                    |
| 9                               |         |                  | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 10                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 11                              |         |                  | Yes              | Yes <sup>1</sup> |                  |                    |
| 12                              | Yes     | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                    |
| 13                              |         |                  | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                    |
| 14                              |         |                  | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                    |
| ...                             |         |                  |                  |                  |                  |                    |
| 17                              |         |                  | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                    |
| 18                              |         |                  | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> |                    |
| 19                              |         |                  | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> |                    |
| 20                              |         |                  | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 21                              |         |                  | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> |                    |
| 22                              |         |                  | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 23                              | Yes     | Yes              | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 24                              |         |                  | Yes              | Yes              |                  |                    |
| 25                              | Yes     | Yes              | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 26                              | Yes     | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> |                    |
| 27                              | Yes     | Yes              | Yes              | Yes <sup>1</sup> |                  |                    |
| 28                              |         | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> | Yes <sup>1,2</sup> |
| 30                              |         |                  | Yes              | Yes <sup>1</sup> |                  |                    |
| 31                              | Yes     | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                  |                    |
| ...                             |         |                  |                  |                  |                  |                    |
| 33                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 34                              |         |                  | Yes              | Yes              | Yes              |                    |
| 35                              | Yes     | Yes              | Yes              | Yes              | Yes              | Yes                |
| 36                              | Yes     | Yes              | Yes              | Yes              | Yes              | Yes                |
| 37                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 38                              |         |                  | Yes              | Yes              | Yes <sup>3</sup> | Yes <sup>3</sup>   |
| 39                              |         |                  | Yes              | Yes              | Yes <sup>3</sup> | Yes <sup>3</sup>   |
| 40                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 41                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 42                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 43                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 44                              |         | Yes              | Yes              | Yes              | Yes              | Yes                |
| 45                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 46                              |         |                  |                  | Yes              |                  | Yes                |
| 47                              |         |                  |                  | Yes              |                  | Yes                |
| 48                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 49                              |         |                  |                  | Yes              |                  | Yes                |
| 50                              |         | Yes              | Yes              | Yes              | Yes              | Yes                |
| 51                              |         | Yes              | Yes              |                  |                  |                    |
| 52                              |         |                  | Yes              | Yes              | Yes              | Yes                |
| 53                              | Yes     | Yes              | Yes              | Yes              |                  |                    |
| ...                             |         |                  |                  |                  |                  |                    |

|    |          |                  |                  |                  |                  |                    |
|----|----------|------------------|------------------|------------------|------------------|--------------------|
| 64 | Reserved |                  |                  |                  |                  |                    |
| 65 | Yes      | Yes              | Yes              | Yes              | Yes              | Yes                |
| 66 | Yes      | Yes              | Yes              | Yes              | Yes              | Yes                |
| 68 |          |                  | Yes              | Yes              | Yes <sup>5</sup> |                    |
| 70 |          |                  | Yes              | Yes              | Yes              | Yes <sup>4</sup>   |
| 71 |          |                  | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> | Yes <sup>1,6</sup> |
| 72 | Yes      | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                  |                    |
| 73 | Yes      | Yes              | Yes              |                  |                  |                    |
| 74 | Yes      | Yes              | Yes              | Yes <sup>1</sup> | Yes <sup>1</sup> | Yes <sup>1</sup>   |
| 85 |          |                  | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                    |
| 87 | Yes      | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                  |                    |
| 88 | Yes      | Yes <sup>1</sup> | Yes <sup>1</sup> |                  |                  |                    |

NOTE 1: <sup>1</sup> refers to the bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (subclause 7.3) is allowed.

NOTE 2: <sup>2</sup> For the 20 MHz bandwidth, the minimum requirements are specified for E-UTRA UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz

NOTE 3: <sup>3</sup> refers to the bandwidth for which the uplink transmission bandwidth can be restricted by the network for some channel assignments in FDD/TDD co-existence scenarios in order to meet unwanted emissions requirements (Clause 6.6.3.2).

NOTE 4: <sup>4</sup> For the 20 MHz bandwidth, the minimum requirements are restricted to E-UTRA operation when carrier aggregation is configured.

NOTE 5: <sup>5</sup> For the 15 MHz bandwidth, the minimum requirements are specified for E-UTRA UL carrier frequencies confined to either 705.5 MHz or 710.5-720.5 MHz

NOTE 6: <sup>6</sup> For the 20MHz bandwidth, the minimum requirements are specified for E-UTRA UL carrier frequencies confined to either 673-678 MHz or 683-688MHz.

b) The use of different (asymmetrical) channel bandwidth for the TX and RX is not precluded and is intended to form part of a later release.

### 5.6A Channel bandwidth for CA

For intra-band contiguous carrier aggregation *Aggregated Channel Bandwidth*, *Aggregated Transmission Bandwidth Configuration* and *Guard Bands* are defined as follows, see Figure 5.6A-1.

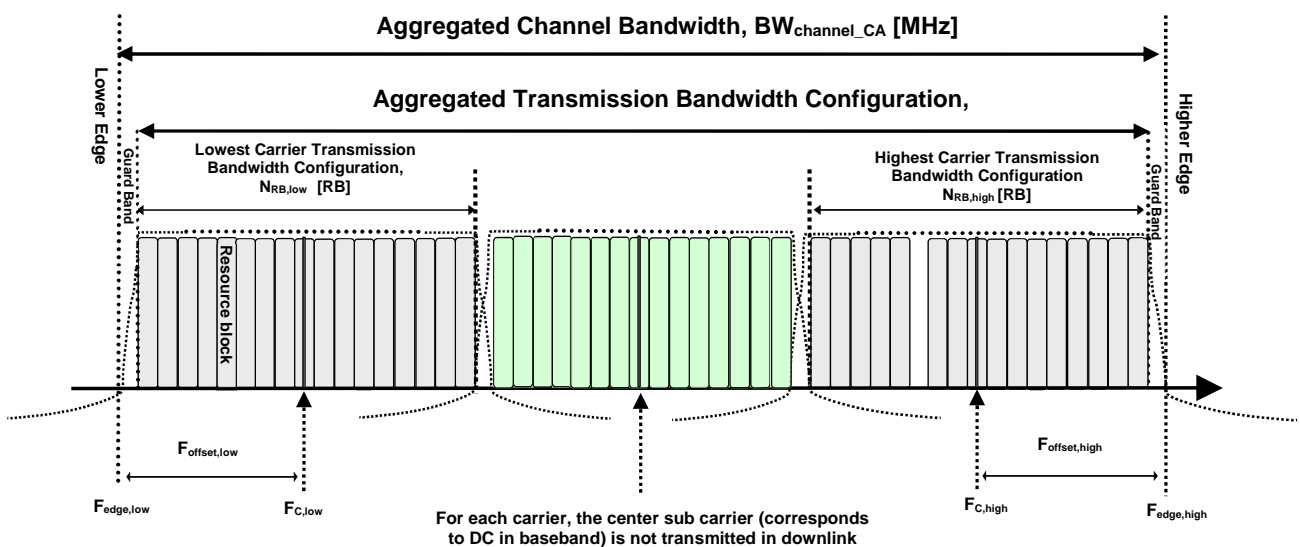


Figure 5.6A-1. Definition of Aggregated channel bandwidth and aggregated channel bandwidth edges

The *aggregated channel bandwidth*,  $BW_{Channel\_CA}$ , is defined as

$$BW_{Channel\_CA} = F_{edge,high} - F_{edge,low} \text{ [MHz]}.$$

The lower bandwidth edge  $F_{edge,low}$  and the upper bandwidth edge  $F_{edge,high}$  of the aggregated channel bandwidth are used as frequency reference points for transmitter and receiver requirements and are defined by

$$F_{edge,low} = F_{C,low} - F_{offset,low}$$

$$F_{edge,high} = F_{C,high} + F_{offset,high}$$

The lower and upper frequency offsets depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carrier and are defined as

$$F_{offset,low} = (0.18N_{RB,low} + \Delta f_1)/2 + BW_{GB} \text{ [MHz]}$$

$$F_{offset,high} = (0.18N_{RB,high} + \Delta f_1)/2 + BW_{GB} \text{ [MHz]}$$

where  $\Delta f_1 = \Delta f$  for the downlink with  $\Delta f$  the subcarrier spacing and  $\Delta f_1 = 0$  for the uplink, while  $N_{RB,low}$  and  $N_{RB,high}$  are the transmission bandwidth configurations according to Table 5.6-1 for the lowest and highest assigned component carrier, respectively.  $BW_{GB}$  denotes the *Nominal Guard Band* and is defined in Table 5.6A-1, and the factor 0.18 is the PRB bandwidth in MHz.

NOTE: The values of  $BW_{Channel\_CA}$  for UE and BS are the same if the lowest and the highest component carriers are identical.

Aggregated Transmission Bandwidth Configuration is the number of the aggregated RBs within the fully allocated Aggregated Channel bandwidth and is defined per CA Bandwidth Class (Table 5.6A-1).

For intra-band non-contiguous carrier aggregation *Sub-block Bandwidth* and *Sub-block edges* are defined as follows, see Figure 5.6A-2.

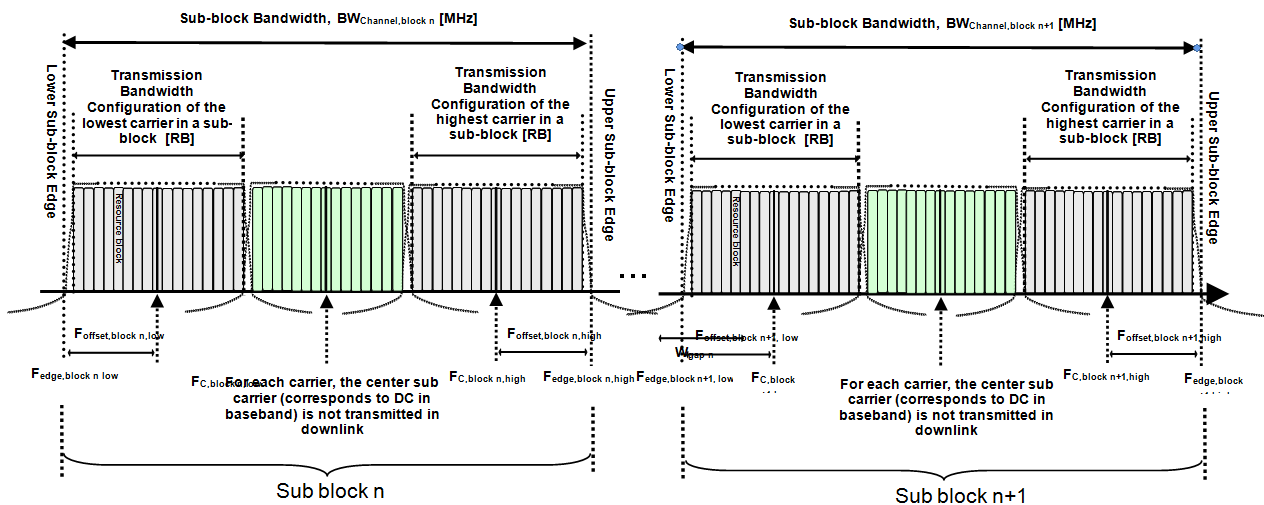


Figure 5.6A-2. Non-contiguous intraband CA terms and definitions

The lower sub-block edge of the Sub-block Bandwidth ( $BW_{Channel,block}$ ) is defined as

$$F_{edge,block,low} = F_{C,block,low} - F_{offset,block,low}.$$

The upper sub-block edge of the Sub-block Bandwidth is defined as

$$F_{edge,block,high} = F_{C,block,high} + F_{offset,block,high}.$$

The Sub-block Bandwidth,  $BW_{Channel,block}$ , is defined as follows:

$$BW_{Channel,block} = F_{edge,block,high} - F_{edge,block,low} \text{ [MHz]}$$

The lower and upper frequency offsets  $F_{\text{offset,block,low}}$  and  $F_{\text{offset,block,high}}$  depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carriers within a sub-block and are defined as

$$F_{\text{offset,block,low}} = (0.18N_{\text{RB,low}} + \Delta f_1)/2 + \text{BW}_{\text{GB}} \text{ [MHz]}$$

$$F_{\text{offset,block,high}} = (0.18N_{\text{RB,high}} + \Delta f_1)/2 + \text{BW}_{\text{GB}} \text{ [MHz]}$$

where  $\Delta f_1 = \Delta f$  for the downlink with  $\Delta f$  the subcarrier spacing and  $\Delta f_1 = 0$  for the uplink, while  $N_{\text{RB,low}}$  and  $N_{\text{RB,high}}$  are the transmission bandwidth configurations according to Table 5.6-1 for the lowest and highest assigned component carrier within a sub-block, respectively.  $\text{BW}_{\text{GB}}$  denotes the *Nominal Guard Band* and is defined in Table 5.6A-1, and the factor 0.18 is the PRB bandwidth in MHz.

The sub-block gap size between two consecutive sub-blocks  $W_{\text{gap}}$  is defined as

$$W_{\text{gap}} = F_{\text{edge,block } n+1,\text{low}} - F_{\text{edge,block } n,\text{high}} \text{ [MHz]}$$

**Table 5.6A-1: CA bandwidth classes and corresponding nominal guard bands**

| CA Bandwidth Class   | Aggregated Transmission Bandwidth Configuration | Number of contiguous CC | Nominal Guard Band $\text{BW}_{\text{GB}}$   |
|--|---|-------------------------|--|
| A  | $N_{\text{RB,agg}} \leq 100$                    | 1                       | $a_1 \text{BW}_{\text{Channel}(1)} - 0.5\Delta f_1$ (NOTE 2)   |
| B  | $25 < N_{\text{RB,agg}} \leq 100$               | 2                       | $0.05 \max(\text{BW}_{\text{Channel}(1)}, \text{BW}_{\text{Channel}(2)}) - 0.5\Delta f_1$  |
| C  | $100 < N_{\text{RB,agg}} \leq 200$              | 2                       | $0.05 \max(\text{BW}_{\text{Channel}(1)}, \text{BW}_{\text{Channel}(2)}) - 0.5\Delta f_1$  |
| D  | $200 < N_{\text{RB,agg}} \leq 300$              | 3                       | $0.05 \max(\text{BW}_{\text{Channel}(1)}, \text{BW}_{\text{Channel}(2)}, \text{BW}_{\text{Channel}(3)}) - 0.5\Delta f_1$   |
| E  | $300 < N_{\text{RB,agg}} \leq 400$              | 4                       | $0.05 \max(\text{BW}_{\text{Channel}(1)}, \text{BW}_{\text{Channel}(2)}, \text{BW}_{\text{Channel}(3)}, \text{BW}_{\text{Channel}(4)}) - 0.5\Delta f_1$                                |
| F  | $400 < N_{\text{RB,agg}} \leq 500$              | 5                       | $0.05 \max(\text{BW}_{\text{Channel}(1)}, \text{BW}_{\text{Channel}(2)}, \text{BW}_{\text{Channel}(3)}, \text{BW}_{\text{Channel}(4)}, \text{BW}_{\text{Channel}(5)}) - 0.5\Delta f_1$ |
| I  | $700 < N_{\text{RB,agg}} \leq 800$              | 8                       | NOTE 3   |
| NOTE 1: $\text{BW}_{\text{Channel}(j)}$ , $j = 1, 2, 3, 4$ is the channel bandwidth of an E-UTRA component carrier according to Table 5.6-1 and $\Delta f_1 = \Delta f$ for the downlink with $\Delta f$ the subcarrier spacing while $\Delta f_1 = 0$ for the uplink. |   |                         |  |
| NOTE 2: $a_1 = 0.16/1.4$ for $\text{BW}_{\text{Channel}(1)} = 1.4$ MHz whereas $a_1 = 0.05$ for all other channel bandwidths.  |   |                         |  |
| NOTE 3: Applicable for later releases.   |   |                         |  |

The channel spacing between centre frequencies of contiguously aggregated component carriers is defined in subclause 5.7.1A.

## 5.6A.1 Channel bandwidths per operating band for CA

The requirements for carrier aggregation in this specification are defined for carrier aggregation configurations with associated bandwidth combination sets. For inter-band carrier aggregation, a *carrier aggregation configuration* is a combination of operating bands, each supporting a carrier aggregation bandwidth class. For intra-band contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting a carrier aggregation bandwidth class.

For each carrier aggregation configuration, requirements are specified for all bandwidth combinations contained in a *bandwidth combination set*, which is indicated per supported band combination in the UE radio access capability. A UE can indicate support of several bandwidth combination sets per band combination.

Requirements for intra-band contiguous carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-1. Requirements for inter-band carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-2, Table 5.6A.1-2a, Table 5.6A.1-2b and Table 5.6A.1-2c. Requirements for intra-band non-contiguous carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-3.

The DL component carrier combinations for a given CA configuration shall be symmetrical in relation to channel centre unless stated otherwise in Table 5.6A.1-1, Table 5.6A.1-2, Table 5.6A.1-2a, Table 5.6A.1-2b and Table 5.6A.1-2c.

**Table 5.6A.1-1: E-UTRA CA configurations and bandwidth combination sets defined for intra-band contiguous CA**

| E-UTRA CA configuration | Uplink CA configurations (NOTE 3) | E-UTRA CA configuration / Bandwidth combination set         |                                      |                                      |                                      |                                      |                                    |                           |
|-------------------------|-----------------------------------|---|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|---------------------------|
|                         |                                   | Component carriers in order of increasing carrier frequency |                                      |                                      |                                      |                                      | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
|                         |                                   | Channel bandwidths for carrier [MHz]                        | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |                                    |                           |
| CA_1C                   | CA_1C                             | 15  | 15                                   |                                      |                                      |                                      | 40                                 | 0                         |
|                         |                                   | 20  | 20                                   |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 5, 10, 15   | 20                                   |                                      |                                      |                                      | 40                                 | 1                         |
|                         |                                   | 20  | 5, 10, 15, 20                        |                                      |                                      |                                      |                                    |                           |
| CA_2C                   |                                   | 5   | 20                                   |                                      |                                      |                                      | 40                                 | 0                         |
|                         |                                   | 10  | 15, 20                               |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 15  | 10, 15, 20                           |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 20  | 5, 10, 15, 20                        |                                      |                                      |                                      |                                    |                           |
| CA_3B                   |                                   | 5   | 3                                    |                                      |                                      |                                      | 10                                 | 0                         |
|                         |                                   | 3, 5  | 5                                    |                                      |                                      |                                      |                                    |                           |
| CA_3C                   | CA_3C                             | 5, 10, 15   | 20                                   |                                      |                                      |                                      | 40                                 | 0                         |
|                         |                                   | 20  | 5, 10, 15, 20                        |                                      |                                      |                                      |                                    |                           |
| CA_5B                   | CA_5B                             | 5, 10   | 10                                   |                                      |                                      |                                      | 20                                 | 0                         |
|                         |                                   | 10  | 5                                    |                                      |                                      |                                      |                                    |                           |
|                         |                                   |   |                                      |                                      |                                      |                                      |                                    |                           |
| CA_7B                   |                                   | 15  | 5                                    |                                      |                                      |                                      | 20                                 | 0                         |
| CA_7C                   | CA_7C                             | 15  | 15                                   |                                      |                                      |                                      | 40                                 | 0                         |
|                         |                                   | 20  | 20                                   |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 10  | 20                                   |                                      |                                      |                                      | 40                                 | 1                         |
|                         |                                   | 15  | 15, 20                               |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 20  | 10, 15, 20                           |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 15  | 10, 15                               |                                      |                                      |                                      | 40                                 | 2                         |
|                         |                                   | 20  | 15, 20                               |                                      |                                      |                                      |                                    |                           |
| CA_8B                   | CA_8B                             | 5,10  | 10                                   |                                      |                                      |                                      | 20                                 | 0                         |
|                         |                                   | 10  | 5                                    |                                      |                                      |                                      |                                    |                           |
| CA_12B                  | -                                 | 5   | 5, 10                                |                                      |                                      |                                      | 15                                 | 0                         |
| CA_23B                  | -                                 | 10  | 10                                   |                                      |                                      |                                      | 20                                 | 0                         |
|                         |                                   | 5   | 15                                   |                                      |                                      |                                      |                                    |                           |
| CA_27B                  | -                                 | 1.4, 3, 5   | 5                                    |                                      |                                      |                                      | 13                                 | 0                         |
|                         |                                   | 1.4, 3  | 10                                   |                                      |                                      |                                      |                                    |                           |
| CA_28C                  | -                                 | 5   | 20                                   |                                      |                                      |                                      | 30                                 | 0                         |
|                         |                                   | 10  | 15, 20                               |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 15  | 10, 15                               |                                      |                                      |                                      |                                    |                           |
|                         |                                   | 20  | 5, 10                                |                                      |                                      |                                      |                                    |                           |
| CA_38C                  | CA_38C                            | 15  | 15                                   |                                      |                                      |                                      | 40                                 | 0                         |
|                         |                                   | 20  | 20                                   |                                      |                                      |                                      |                                    |                           |

|                     |                   |               |               |         |         |                  |     |   |
|---------------------|-------------------|---------------|---------------|---------|---------|------------------|-----|---|
| CA_39C              | CA_39C            | 5,10,15       | 20            |         |         |                  | 35  | 0 |
|                     |                   | 20            | 5, 10, 15     |         |         |                  |     |   |
| CA_40C              | CA_40C            | 10            | 20            |         |         |                  | 40  | 0 |
|                     |                   | 15            | 15            |         |         |                  |     |   |
|                     |                   | 20            | 10, 20        |         |         |                  |     |   |
|                     |                   | 10, 15        | 20            |         |         |                  | 40  | 1 |
|                     |                   | 15            | 15            |         |         |                  |     |   |
|                     |                   | 20            | 10, 15, 20    |         |         |                  |     |   |
| CA_40D              | CA_40C,<br>CA_40D | 10, 15, 20    | 20            | 20      |         |                  | 60  | 0 |
|                     |                   | 20            | 10, 15        | 20      |         |                  |     |   |
|                     |                   | 20            | 20            | 10, 15  |         |                  | 60  | 1 |
|                     |                   | 15, 20        | 15, 20        | 15, 20  |         |                  |     |   |
| CA_40E              | -                 | 15, 20        | 15, 20        | 15, 20  | 20      |                  | 80  | 0 |
| CA_40F              | -                 | 15, 20        | 15, 20        | 15, 20  | 20      | 20               | 100 | 0 |
| CA_41C <sup>5</sup> | CA_41C            | 10            | 20            |         |         |                  | 40  | 0 |
|                     |                   | 15            | 15, 20        |         |         |                  |     |   |
|                     |                   | 20            | 10, 15, 20    |         |         |                  |     |   |
|                     |                   | 5, 10         | 20            |         |         |                  | 40  | 1 |
|                     |                   | 15            | 15, 20        |         |         |                  |     |   |
|                     |                   | 20            | 5, 10, 15, 20 |         |         |                  |     |   |
|                     |                   | 10            | 15, 20        |         |         |                  | 40  | 2 |
|                     |                   | 15            | 10, 15, 20    |         |         |                  |     |   |
|                     |                   | 20            | 10, 15, 20    |         |         |                  |     |   |
|                     |                   | 10            | 20            |         |         |                  | 40  | 3 |
| 20                  | 20                |               |               |         |         |                  |     |   |
| CA_41D              | CA_41C,<br>CA_41D | 10            | 20            | 15      |         |                  | 60  | 0 |
|                     |                   | 10            | 15, 20        | 20      |         |                  |     |   |
|                     |                   | 15            | 20            | 10, 15  |         |                  |     |   |
|                     |                   | 15            | 10, 15, 20    | 20      |         |                  |     |   |
|                     |                   | 20            | 15, 20        | 10      |         |                  |     |   |
|                     |                   | 20            | 10, 15, 20    | 15, 20  |         |                  |     |   |
| CA_41E              | CA_41C,<br>CA_41D | 15, 20        | 15, 20        | 15, 20  | 20      |                  | 80  | 0 |
| CA_41F              | CA_41C,<br>CA_41D | 10,15, 20     | 15, 20        | 20      | 20      | 20               | 100 | 0 |
| CA_42C <sup>5</sup> | CA_42C            | 5, 10, 15, 20 | 20            |         |         |                  | 40  | 0 |
|                     |                   | 20            | 5, 10, 15     |         |         |                  |     |   |
|                     |                   | 10, 15, 20    | 20            |         |         |                  | 40  | 1 |
|                     |                   | 20            | 10, 15        |         |         |                  |     |   |
| CA_42D              | CA_42C            | 5,10,15,20    | 20            | 20      |         |                  | 60  | 0 |
|                     |                   | 20            | 20            | 5,10,15 |         |                  |     |   |
|                     |                   | 10, 15, 20    | 20            | 20      |         |                  | 60  | 1 |
|                     |                   | 20            | 20            | 10, 15  |         |                  |     |   |
| CA_42E              | CA_42C            | 5,10,15,20    | 20            | 20      | 20      |                  | 80  | 0 |
|                     |                   | 20            | 20            | 20      | 5,10,15 |                  |     |   |
| CA_42F              | CA_42C            | 5, 10, 15, 20 | 20            | 20      | 20      | 20               | 100 | 0 |
|                     |                   | 20            | 20            | 20      | 20      | 5, 10, 15,<br>20 |     |   |
| CA_43C              | -                 | 5             | 20            |         |         |                  | 40  | 0 |
|                     |                   | 10            | 15, 20        |         |         |                  |     |   |

|                     |        |               |               |         |         |               |     |   |
|---------------------|--------|---------------|---------------|---------|---------|---------------|-----|---|
|                     |        | 15            | 10, 15, 20    |         |         |               |     |   |
|                     |        | 20            | 5, 10, 15, 20 |         |         |               |     |   |
| CA_46C <sup>4</sup> | -      | 20            | 20            |         |         |               | 40  | 0 |
|                     |        | 20            | 10, 20        |         |         |               | 40  | 1 |
|                     |        | 10, 20        | 20            |         |         |               |     |   |
| CA_46D <sup>4</sup> | -      | 20            | 20            | 20      |         |               | 60  | 0 |
|                     |        | 20            | 20            | 10, 20  |         |               | 60  | 1 |
|                     |        | 10, 20        | 20            | 20      |         |               |     |   |
| CA_46E <sup>4</sup> | -      | 20            | 20            | 20      | 20      |               | 80  | 0 |
|                     |        | 20            | 20            | 20      | 10, 20  |               | 80  | 1 |
|                     |        | 10            | 20            | 20      | 20      |               |     |   |
| CA_48B              | CA_48B | 10            | 10            |         |         |               | 20  | 0 |
| CA_48C              | CA_48C | 5, 10, 15, 20 | 20            |         |         |               | 40  | 0 |
|                     |        | 20            | 5, 10, 15     |         |         |               |     |   |
| CA_48D              | CA_48C | 5,10,15,20    | 20            | 20      |         |               | 60  | 0 |
|                     |        | 20            | 20            | 5,10,15 |         |               |     |   |
| CA_48E              | CA_48C | 5,10,15,20    | 20            | 20      | 20      |               | 80  | 0 |
|                     |        | 20            | 20            | 20      | 5,10,15 |               |     |   |
| CA_48F              | -      | 5, 10, 15, 20 | 20            | 20      | 20      | 20            | 100 | 0 |
|                     |        | 20            | 20            | 20      | 20      | 5, 10, 15, 20 |     |   |
| CA_66B              | CA_66B | 5             | 5, 10, 15     |         |         |               | 20  | 0 |
|                     |        | 10            | 5, 10         |         |         |               |     |   |
|                     |        | 15            | 5             |         |         |               |     |   |
| CA_66C              | CA_66C | 5             | 20            |         |         |               | 40  | 0 |
|                     |        | 10            | 15, 20        |         |         |               |     |   |
|                     |        | 15            | 10, 15, 20    |         |         |               |     |   |
|                     |        | 20            | 5, 10, 15, 20 |         |         |               |     |   |
| CA_66D              | -      | 5             | 20            | 20      |         |               | 60  | 0 |
|                     |        | 20            | 5             | 20      |         |               |     |   |
|                     |        | 20            | 20            | 5       |         |               |     |   |
|                     |        | 10            | 20            | 15      |         |               |     |   |
|                     |        | 15            | 20            | 10      |         |               |     |   |
|                     |        | 10, 15, 20    | 15, 20        | 20      |         |               |     |   |
|                     |        | 15, 20        | 10            | 20      |         |               |     |   |
|                     |        | 15            | 15, 20        | 15      |         |               |     |   |
|                     |        | 20            | 15, 20        | 10, 15  |         |               |     |   |
|                     |        | 20            | 10            | 15      |         |               |     |   |
| CA_70C              | -      | 5             | 20            |         |         |               | 25  | 0 |
|                     |        | 10            | 15            |         |         |               |     |   |
|                     |        | 15            | 10            |         |         |               |     |   |

IOTE 1: The CA configuration refers to an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

IOTE 2: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

IOTE 3: Uplink CA configurations are the configurations supported by the present release of specifications.

IOTE 4: Restricted to E-UTRA operation when inter-band carrier aggregation is configured. The downlink operating band is paired with the uplink operating band (external) of the carrier aggregation configuration that is supporting the configured Pcell.

IOTE 5: 8Rx Requirements are applicable for this band configuration if UE supports 8Rx.

**Table 5.6A.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (two bands)**

| E-UTRA CA configuration / Bandwidth combination set |                                   |                 |   |  |       |        |        |        |                                    |                           |   |
|---|-----------------------------------|-----------------|---|--|-------|--------|--------|--------|------------------------------------|---------------------------|---|
| E-UTRA CA Configuration                             | Uplink CA configurations (NOTE 4) | E-UTRA Bands    | 1.4 MHz   | 3 MHz  | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |   |
| CA_1A-3A  | CA_1A-3A                          | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 40                                 | 0                         |   |
|   |                                   | 3               |   |  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
|   |                                   | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 40                                 | 1                         |   |
|   |                                   | 3               |   | Yes  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
| CA_1A-1A-3A   | -                                 | 1               | See CA_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3        |  |       |        |        |        | 60                                 | 0                         |   |
|   |                                   | 3               |   |  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
| CA_1A-1A-7A   | CA_1A-7A                          | 1               | See CA_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3        |  |       |        |        |        | 60                                 | 0                         |   |
|   |                                   | 7               |   |  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
| CA_1A-1A-7C   | CA_7C                             | 1               | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |  |       |        |        |        | 80                                 | 0                         |   |
|   |                                   | 7               | See CA_7C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 2 |  |       |        |        |        |                                    |                           |   |
| CA_1A-3A-3A   | CA_1A-3A                          | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 60                                 | 0                         |   |
|   |                                   | 3               | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |  |       |        |        |        |                                    |                           |   |
| CA_1A-1A-3A-3A                                      | -                                 | 1               | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |  |       |        |        |        | 80                                 | 0                         |   |
|   |                                   | 3               | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |  |       |        |        |        |                                    |                           |   |
| CA_1A-3C  | CA_1A-3A, CA_3C                   | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 60                                 | 0                         |   |
|   |                                   | 3               | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |  |       |        |        |        |                                    |                           |   |
| CA_1A-1A-3C   | CA_3C                             | 1               | See CA_1A-1A Bandwidth Combination Set 0 in the Table 5.6A.1-3    |  |       |        |        |        | 80                                 | 0                         |   |
|   |                                   | 3               | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1           |  |       |        |        |        |                                    |                           |   |
| CA_1A-5A  | CA_1A-5A                          | 1               |   |  |       | Yes    |        |        | 20                                 | 0                         |   |
|   |                                   | 5               |   |  |       | Yes    |        |        |                                    |                           |   |
|   |                                   | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 30                                 | 1                         |   |
|   |                                   | 5               |   |  | Yes   | Yes    |        |        |                                    |                           |   |
| CA_1A-1A-5A   | -                                 | 1               | See CA_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3        |  |       |        |        |        | 50                                 | 0                         |   |
|   |                                   | 5               |   |  | Yes   | Yes    |        |        |                                    |                           |   |
| CA_1C-5A  | -                                 | 1               | See CA_1C Bandwidth Combination Set 1 in Table 5.6A.1-1           |  |       |        |        |        | 50                                 | 0                         |   |
|   |                                   | 5               |   |  | Yes   | Yes    |        |        |                                    |                           |   |
| CA_1A-7A  | CA_1A-7A                          | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 40                                 | 0                         |   |
|   |                                   | 7               |   |  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
|   |                                   | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 40                                 | 1                         |   |
|   |                                   | 7               |   |  | Yes   | Yes    | Yes    | Yes    |                                    |                           |   |
| CA_1A-7A-7A   | CA_1A-7A                          | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 60                                 | 0                         |   |
|   |                                   | 7               | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3        |  |       |        |        |        |                                    |                           |   |
|   | CA_1A-7A                          | CA_1A-7A        | 1   |  |       | Yes    | Yes    | Yes    | Yes                                | 60                        | 1 |
|   |                                   |                 | 7   | See CA_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3 |       |        |        |        |                                    |                           |   |
| CA_1A-7C  | CA_1A-7A, CA_7C                   | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 60                                 | 0                         |   |
|   |                                   | 7               | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1           |  |       |        |        |        |                                    |                           |   |
|   | CA_1A-7A, CA_7C                   | CA_1A-7A, CA_7C | 1   |  |       | Yes    | Yes    | Yes    | Yes                                | 60                        | 1 |
|   |                                   |                 | 7   | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1    |       |        |        |        |                                    |                           |   |
| CA_1A-8A  | CA_1A-8A                          | 1               |   |  | Yes   | Yes    | Yes    | Yes    | 30                                 | 0                         |   |
|   |                                   | 8               |   |  | Yes   | Yes    |        |        |                                    |                           |   |
|   |                                   | 1               |   |  | Yes   | Yes    |        |        | 20                                 | 1                         |   |



|                        |                                    |    |  |     |     |     |     |     |     |   |
|------------------------|------------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
|                        |                                    | 8  |  |     | Yes | Yes |     |     |     |   |
|                        |                                    | 1  |  |     | Yes | Yes | Yes | Yes |     |   |
|                        |                                    | 8  |  | Yes | Yes | Yes |     |     | 30  | 2 |
| CA_1A-11A              | CA_1A-11A                          | 1  |  |     | Yes | Yes | Yes | Yes | 30  | 0 |
|                        |                                    | 11 |  |     | Yes | Yes |     |     |     |   |
| CA_1A-18A              | CA_1A-18A                          | 1  |  |     | Yes | Yes | Yes | Yes | 35  | 0 |
|                        |                                    | 18 |  |     | Yes | Yes | Yes |     |     |   |
|                        |                                    | 1  |  |     | Yes | Yes |     |     | 20  | 1 |
|                        |                                    | 18 |  |     | Yes | Yes |     |     |     |   |
| CA_1A-19A              | CA_1A-19A                          | 1  |  |     | Yes | Yes | Yes | Yes | 35  | 0 |
|                        |                                    | 19 |  |     | Yes | Yes | Yes |     |     |   |
| CA_1A-20A              | CA_1A-20A                          | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-21A              | CA_1A-21A                          | 1  |  |     | Yes | Yes | Yes | Yes | 35  | 0 |
|                        |                                    | 21 |  |     | Yes | Yes | Yes |     |     |   |
| CA_1A-26A              | CA_1A-26A                          | 1  |  |     | Yes | Yes | Yes | Yes | 35  | 0 |
|                        |                                    | 26 |  |     | Yes | Yes | Yes |     |     |   |
|                        |                                    | 1  |  |     | Yes | Yes |     |     | 20  | 1 |
|                        |                                    | 26 |  |     | Yes | Yes |     |     |     |   |
| CA_1A-28A              | CA_1A-28A                          | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
|                        |                                    | 1  |  |     | Yes | Yes |     |     | 20  | 1 |
|                        |                                    | 28 |  |     | Yes | Yes |     |     |     |   |
| CA_1A-1A-28A           | -                                  | 1  | See CA_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|                        |                                    | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-32A              | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-38A              | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-40A              | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-40C              | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                        |                                    | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_1A-41A              | CA_1A-41A                          | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 1 |
|                        |                                    | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-41A <sup>8</sup> | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-41C <sup>8</sup> | CA_1A-41A<br>CA_1A-41C             | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                        |                                    | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_1A-41D <sup>8</sup> | -                                  | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                        |                                    | 41 | See CA_41D Bandwidth combination set 0 at Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_1A-42A              | CA_1A-42A                          | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                        |                                    | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-42A-42A          | CA_1A-42A                          | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                        |                                    | 42 | See CA_42A-42A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_1A-42C              | CA_1A-42A,<br>CA_1A-42C,<br>CA_42C | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                        |                                    | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_1A-42A-42C          | CA_1A-42A                          | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                        |                                    | 42 | See CA_42A-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_1A-42C-42C          | CA_1A-42A                          | 1  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                        |                                    | 42 | See CA_42C-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_1A-42D              | CA_1A-42A                          | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                        |                                    | 42 | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |

|                |           |    |  |     |     |     |     |     |     |     |
|----------------|-----------|----|--|-----|-----|-----|-----|-----|-----|-----|
| CA_1A-42E      | CA_1A-42A | 1  |  |     | Yes | Yes | Yes | Yes | 100 | 0   |
|                |           | 42 | See CA_42E Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
| CA_1A-43A      | -         | 1  |  |     | Yes | Yes | Yes |     | 35  | 0   |
|                |           | 43 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_1A-46A      | -         | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 0   |
|                |           | 46 |  |     |     |     |     | Yes |     |     |
|                |           | 1  |  |     | Yes | Yes | Yes | Yes | 40  | 1   |
|                |           | 46 |  |     |     | Yes |     | Yes |     |     |
| CA_1A-46C      | -         | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0   |
|                |           | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
|                | -         | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 1   |
|                |           | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
| CA_1A-46D      | -         | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0   |
|                |           | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
|                |           | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 1   |
|                |           | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
| CA_1A-46E      | -         | 1  |  |     | Yes | Yes | Yes | Yes | 100 | 0   |
|                |           | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
|                |           | 1  |  |     | Yes | Yes | Yes | Yes | 100 | 1   |
|                |           | 46 | See CA_46E Bandwidth Combination Set 1 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
| CA_1C-3A       | -         | 1  | See CA_1C Bandwidth combination set 1 in Table 5.6A.1-1    |     |     |     | 60  | 0   |     |     |
|                |           | 3  |  |     | Yes | Yes |     |     | Yes | Yes |
| CA_2A-4A       | CA_2A-4A  | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 40  | 0   |
|                |           | 4  |  |     | Yes | Yes | Yes | Yes |     |     |
|                |           | 2  |  |     | Yes | Yes |     |     | 20  | 1   |
|                |           | 4  |  |     | Yes | Yes |     |     |     |     |
|                |           | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 2   |
|                |           | 4  |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-2A-4A    | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 60  | 0   |     |     |
|                |           | 4  |  |     | Yes | Yes |     |     | Yes | Yes |
| CA_2A-4A-4A    | -         | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0   |
|                |           | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |     |
| CA_2A-2A-4A-4A | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 80  | 0   |     |     |
|                |           | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |     |
| CA_2A-5A       | CA_2A-5A  | 2  |  |     | Yes | Yes | Yes | Yes | 30  | 0   |
|                |           | 5  |  |     | Yes | Yes |     |     |     |     |
|                |           | 2  |  |     | Yes | Yes |     |     | 20  | 1   |
|                |           | 5  |  |     | Yes | Yes |     |     |     |     |
| CA_2A-2A-5A    | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 50  | 0   |     |     |
|                |           | 5  |  |     | Yes | Yes |     |     |     |     |
| CA_2A-2A-46D   | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 100 | 0   |     |     |
|                |           | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |     |
| CA_2C-5A       | -         | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     | 50  | 0   |     |     |
|                |           | 5  |  |     | Yes | Yes |     |     |     |     |
| CA_2A-5B       | CA_2A-5A  | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 0   |
|                |           | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     |     |     |     |     |

|                  |           |    |  |     |     |     |     |     |    |   |
|------------------|-----------|----|--|-----|-----|-----|-----|-----|----|---|
| CA_2A-2A-5B      | -         | 2  | See CA_2A-2A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     | 60 | 0 |
|                  |           | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |    |   |
| CA_2C-5B         | -         | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1        |     |     |     |     |     | 60 | 0 |
|                  |           | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |    |   |
| CA_2A-2A-7A      | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 60 | 0 |
| CA_2A-7A         | CA_2A-7A  | 2  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                  |           | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_2A-7A-7A      | -         | 2  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                  |           | 7  | See the CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_2A-7C         | -         | 2  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                  |           | 7  | See the CA_7C Bandwidth combination set 1 in Table 5.6A.1-1    |     |     |     |     |     |    |   |
| CA_2A-12A        | CA_2A-12A | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 0 |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |
|                  |           | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 1 |
|                  |           | 12 |  | Yes | Yes | Yes |     |     |    |   |
|                  |           | 2  |  |     | Yes | Yes |     |     | 20 | 2 |
| 12               |           |    | Yes  | Yes |     |     |     |     |    |   |
| CA_2A-2A-12A     | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 50 | 0 |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |
| CA_2A-12A-12A    | -         | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 0 |
|                  |           | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     |    |   |
| CA_2A-2A-12A-12A | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 50 | 0 |
|                  |           | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     |    |   |
| CA_2A-12B        | CA_2A-12A | 2  |  |     | Yes | Yes | Yes | Yes | 35 | 0 |
|                  |           | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1       |     |     |     |     |     |    |   |
| CA_2A-2A-12B     | -         | 2  | See CA_2A-2A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     | 55 | 0 |
|                  |           | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1       |     |     |     |     |     |    |   |
| CA_2C-12A        | -         | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1        |     |     |     |     |     | 50 | 0 |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |
| CA_2A-13A        | CA_2A-13A | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 0 |
|                  |           | 13 |  |     |     | Yes |     |     |    |   |
|                  |           | 2  |  |     | Yes | Yes |     |     | 20 | 1 |
|                  |           | 13 |  |     |     | Yes |     |     |    |   |
|                  |           | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 2 |
| 13               |           |    | Yes  | Yes |     |     |     |     |    |   |
| CA_2A-2A-13A     | CA_2A-13A | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 50 | 0 |
|                  |           | 13 |  |     |     | Yes |     |     |    |   |
| CA_2A-14A        | CA_2A-14A | 2  |  |     | Yes | Yes | Yes | Yes | 30 | 0 |
|                  |           | 14 |  |     | Yes | Yes |     |     |    |   |
| CA_2A-2A-14A     | CA_2A-14A | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 50 | 0 |
|                  |           | 14 |  |     | Yes | Yes |     |     |    |   |
| CA_2A-17A        | -         | 2  |  |     | Yes | Yes |     |     | 20 | 0 |
|                  |           | 17 |  |     | Yes | Yes |     |     |    |   |
| CA_2A-26A        | -         | 2  |  |     | Yes | Yes | Yes | Yes | 35 | 0 |
|                  |           | 26 |  |     | Yes | Yes | Yes |     |    |   |
| CA_2A-28A        | -         | 2  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |

|               |                   |    |  |     |     |     |     |     |     |   |
|---------------|-------------------|----|--|-----|-----|-----|-----|-----|-----|---|
|               |                   | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-29A     | -                 | 2  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |                   | 29 |  | Yes | Yes | Yes |     |     |     |   |
|               |                   | 2  |  |     | Yes | Yes |     |     | 20  | 1 |
|               |                   | 29 |  |     | Yes | Yes |     |     |     |   |
|               |                   | 2  |  |     | Yes | Yes | Yes | Yes | 30  | 2 |
| 29            |                   |    | Yes  | Yes |     |     |     |     |     |   |
| CA_2A-2A-29A  | -                 | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3           |     |     |     |     |     | 50  | 0 |
| 29            |                   |    | Yes  | Yes |     |     |     |     |     |   |
| CA_2C-29A     | -                 | 2  | See CA_2C Bandwidth Combination Set 0 in table 5.6A.1-1              |     |     |     |     |     | 50  | 0 |
|               |                   | 29 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-30A     | CA_2A-30A         | 2  |  |     | Yes | Yes | Yes | Yes | 30  | 0 |
|               |                   | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-2A-30A  | -                 | 2  | See CA_2A-2A Bandwidth Combination Set 0 in table 5.6A.1-3           |     |     |     |     |     | 50  | 0 |
|               |                   | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_2C-30A     | -                 | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1              |     |     |     |     |     | 50  | 0 |
|               |                   | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-46A     | CA_2A-46A         | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                   | 46 |  |     |     |     |     | Yes |     |   |
| CA_2A-2A-46A  | -                 | 2  | See CA_2A-2A Bandwidth Combination Set 0 in table 5.6A.1-3           |     |     |     |     |     | 60  | 0 |
|               |                   | 46 |  |     |     |     |     | Yes |     |   |
| CA_2A-46A-46C | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |                   | 46 | See CA_46A-46C Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |     |     |   |
| CA_2A-46C     | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |     |     |   |
| CA_2A-2A-46C  | -                 | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3           |     |     |     |     |     | 80  | 0 |
|               |                   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |     |     |   |
| CA_2A-46D     | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |                   | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |     |     |   |
| CA_2A-46E     | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |                   | 46 | See CA_46E Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-46A-46A | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                   | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3         |     |     |     |     |     |     |   |
| CA_2A-46A-46D | -                 | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |                   | 46 | See CA_46A-46D Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |     |     |   |
| CA_2A-48A     | CA_2A-48A         | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                   | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48A-48A | CA_2A-48A         | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                   | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-48C     | CA_2A-48A, CA_48C | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                   | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |     |     |   |
| CA_2A-48A-48C | CA_2A-48A         | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |                   | 48 | See the CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-48A-48D | CA_2A-48A         | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |                   | 48 | See CA_48A-48D Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |     |     |   |
|               | CA_2A-48A         | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |

|                   |           |    |  |     |     |     |     |     |     |   |
|-------------------|-----------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_2A-48C-48C     |           | 48 | See CA_48C-48C Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-48D         | CA_2A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |           | 48 | See the CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_2A-48E         | CA_2A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |           | 48 | See CA_48E Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-49A         | CA_2A-49A | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                   |           | 49 |  |     |     | Yes |     | Yes |     |   |
| CA_2A-66A         | CA_2A-66A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 40  | 0 |
|                   |           | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |           | 2  |  |     | Yes | Yes |     |     | 20  | 1 |
|                   |           | 66 |  |     | Yes | Yes |     |     |     |   |
|                   |           | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 2 |
|                   |           | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-66B         | CA_66B    | 2  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                   |           | 66 | See CA_66B Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-66C         | -         | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |           | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-66D         | -         | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |           | 66 | See CA_66D Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-2A-66A      | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 60  | 0 |
|                   |           | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-2A-66A-66A  | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 80  | 0 |
|                   |           | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-2A-66A-66B  | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 80  | 0 |
|                   |           | 66 | See CA_66A-66B Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-2A-66A-66C  | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 100 | 0 |
|                   |           | 66 | See CA_66A-66C Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-66A-66A     | -         | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |           | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-66A-66A-66A | -         | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |           | 66 | See CA_66A-66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-4 |     |     |     |     |     |     |   |
| CA_2A-66A-66B     | CA_66B    | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |           | 66 | See CA_66A-66B Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-66A-66C     |           | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |           | 66 | See CA_66A-66C Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-2A-66B      | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 60  | 0 |
|                   |           | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-2A-66C      | -         | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 80  | 0 |
|                   |           | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-2A-66D      |           | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 100 | 0 |
|                   |           | 66 | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |

|                |           |     |   |     |     |     |     |    |     |
|----------------|-----------|-----|---|-----|-----|-----|-----|----|-----|
| CA_2C-66A      | -         | 2   | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1           |     |     |     | 60  | 0  |     |
|                |           | 66  |   | Yes | Yes | Yes |     |    | Yes |
| CA_2C-66A-66A  |           | 2   | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1           |     |     |     | 80  | 0  |     |
|                |           | 66  | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3      |     |     |     |     |    |     |
| CA_2A-71A      | -         | 2   |   | Yes | Yes | Yes | Yes | 40 | 0   |
|                |           | 71  |   | Yes | Yes | Yes | Yes |    |     |
|                |           | 2   |   | Yes | Yes |     |     | 20 | 1   |
|                |           | 71  |   | Yes | Yes |     |     |    |     |
| CA_2A-2A-71A   | -         | 2   | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     | 60  | 0  |     |
|                |           | 71  |   | Yes | Yes | Yes |     |    | Yes |
| CA_3A-5A       | CA_3A-5A  | 3   |   |     | Yes | Yes | Yes | 30 | 0   |
|                |           | 5   |   | Yes | Yes |     |     |    |     |
|                |           | 3   |   |     | Yes |     |     | 20 | 1   |
|                |           | 5   |   | Yes | Yes |     |     |    |     |
|                |           | 3   |   | Yes | Yes | Yes | Yes | 30 | 2   |
|                |           | 5   |   | Yes | Yes |     |     |    |     |
|                |           | 3   |   | Yes | Yes | Yes | Yes | 30 | 3   |
|                |           | 5   | Yes   | Yes | Yes |     |     |    |     |
|                |           | 3   | Yes   | Yes | Yes |     |     | 20 | 4   |
| 5              | Yes       | Yes | Yes   |     |     |     |     |    |     |
| CA_3A-3A-5A    | -         | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     | 50  | 0  |     |
|                |           | 5   |   | Yes | Yes |     |     |    |     |
| CA_3C-5A       | -         | 3   | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     | 50  | 0  |     |
|                |           | 5   |   | Yes | Yes |     |     |    |     |
| CA_3A-7A       | CA_3A-7A  | 3   |   | Yes | Yes | Yes | Yes | 40 | 0   |
|                |           | 7   |   |     | Yes | Yes | Yes |    |     |
|                |           | 3   |   | Yes | Yes | Yes | Yes | 40 | 1   |
|                |           | 7   |   | Yes | Yes | Yes | Yes |    |     |
| CA_3A-3A-7A    | CA_3A-7A  | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     | 60  | 0  |     |
|                |           | 7   |   | Yes | Yes | Yes |     |    | Yes |
|                |           | 3   | See CA_3A-3A Bandwidth Combination Set 1 in Table 5.6A.1-3        |     |     |     | 50  | 1  |     |
|                |           | 7   |   | Yes | Yes | Yes |     |    | Yes |
| CA_3A-3A-7A-7A | CA_3A-7A  | 3   | See CA_3A-3A Bandwidth Combination Set 0 in table 5.6A.1-3        |     |     |     | 80  | 0  |     |
|                |           | 7   | See CA_7A-7A Bandwidth Combination Set 1 in table 5.6A.1-3        |     |     |     |     |    |     |
|                |           | 3   | See CA_3A-3A Bandwidth Combination Set 1 in table 5.6A.1-3        |     |     |     | 60  | 1  |     |
|                |           | 7   | See CA_7A-7A Bandwidth Combination Set 2 in table 5.6A.1-3        |     |     |     |     |    |     |
| CA_3A-3A-7C    | 7C        | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     | 80  | 0  |     |
|                |           | 7   | See CA_7C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 2 |     |     |     |     |    |     |
| CA_3A-3A-42D   | CA_3A-42A | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     | 100 | 0  |     |
|                |           | 42  | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1:         |     |     |     |     |    |     |
| CA_3A-7A-7A    | CA_3A-7A  | 3   |   | Yes | Yes | Yes | Yes | 60 | 0   |
|                |           | 7   | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3        |     |     |     |     |    |     |
|                |           | 3   |   | Yes | Yes | Yes | Yes | 50 | 1   |
|                |           | 7   | See CA_7A-7A Bandwidth combination set 2 in table 5.6A.1-3        |     |     |     |     |    |     |
| CA_3A-7B       | -         | 3   |   | Yes | Yes | Yes | Yes | 40 | 0   |

|              |                              |     |  |     |     |     |     |    |     |
|--------------|------------------------------|-----|--|-----|-----|-----|-----|----|-----|
|              |                              | 7   | See CA_7B bandwidth combination set 0 in table 5.6A.1-1    |     |     |     |     |    |     |
| CA_3A-7C     | CA_3A-7A<br>CA_7C            | 3   |  | Yes | Yes | Yes | Yes | 60 | 0   |
|              |                              | 7   | See CA_7C Bandwidth combination set 1 in table 5.6A.1-1    |     |     |     |     |    |     |
|              |                              | 3   |  | Yes | Yes | Yes | Yes | 60 | 1   |
|              |                              | 7   | See CA_7C Bandwidth combination set 2 in table 5.6A.1-1    |     |     |     |     |    |     |
| CA_3C-7A     | CA_3A-7A<br>CA_3C            | 3   | See CA_3C Bandwidth Combination Set 0 in table 5.6A.1-1    |     |     |     | 60  | 0  |     |
|              |                              | 7   |  | Yes | Yes | Yes |     |    | Yes |
| CA_3C-7C     | CA_3A-7A,<br>CA_3C,<br>CA_7C | 3   | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     | 80  | 0  |     |
|              |                              | 7   | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |     |     |     |     |    |     |
|              |                              | 3   | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     | 80  | 1  |     |
|              |                              | 7   | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1    |     |     |     |     |    |     |
| CA_3A-8A     | CA_3A-8A                     | 3   |  |     | Yes | Yes | Yes | 30 | 0   |
|              |                              | 8   |  | Yes | Yes |     |     |    |     |
|              |                              | 3   |  |     | Yes |     |     | 20 | 1   |
|              |                              | 8   |  | Yes | Yes |     |     |    |     |
|              |                              | 3   |  | Yes | Yes | Yes | Yes | 30 | 2   |
|              |                              | 8   | Yes  | Yes | Yes |     |     |    |     |
|              |                              | 3   |  | Yes | Yes | Yes | Yes | 30 | 3   |
| 8            |                              | Yes | Yes  |     |     |     |     |    |     |
| CA_3A-3A-8A  | CA_3A-8A                     | 3   | See CA_3A-3A Bandwidth Combination Set 0 in table 5.6A.1-3 |     |     |     | 50  | 0  |     |
|              |                              | 8   |  | Yes | Yes |     |     |    |     |
|              |                              | 3   | See CA_3A-3A Bandwidth Combination Set 1 in table 5.6A.1-3 |     |     |     | 40  | 1  |     |
|              |                              | 8   |  | Yes | Yes |     |     |    |     |
| CA_3C-8A     | CA_3A-8A,<br>CA_3C           | 3   | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     | 50  | 0  |     |
|              |                              | 8   |  | Yes | Yes | Yes |     |    |     |
| CA_3A-11A    | CA_3A-11A                    | 3   |  | Yes | Yes | Yes | Yes | 30 | 0   |
|              |                              | 11  |  | Yes | Yes |     |     |    |     |
| CA_3A-18A    | CA_3A-18A                    | 3   |  | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                              | 18  |  | Yes | Yes | Yes |     |    |     |
| CA_3A-19A    | CA_3A-19A                    | 3   |  | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                              | 19  |  | Yes | Yes | Yes |     |    |     |
| CA_3A-3A-19A | CA_3A-19A                    | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 55  | 0  |     |
|              |                              | 19  |  | Yes | Yes | Yes |     |    |     |
| CA_3A-20A    | CA_3A-20A                    | 3   |  | Yes | Yes | Yes | Yes | 30 | 0   |
|              |                              | 20  |  | Yes | Yes |     |     |    |     |
|              |                              | 3   |  | Yes | Yes | Yes | Yes | 40 | 1   |
|              |                              | 20  |  | Yes | Yes | Yes | Yes |    |     |
| CA_3A-3A-20A | -                            | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 60  | 0  |     |
|              |                              | 20  |  | Yes | Yes | Yes |     |    | Yes |
| CA_3C-20A    | -                            | 3   | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     | 60  | 0  |     |
|              |                              | 20  |  | Yes | Yes | Yes |     |    | Yes |
| CA_3A-21A    | CA_3A-21A                    | 3   |  | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                              | 21  |  | Yes | Yes | Yes |     |    |     |
| CA_3A-3A-21A | CA_3A-21A                    | 3   | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 55  | 0  |     |
|              |                              | 21  |  | Yes | Yes | Yes |     |    |     |
| CA_3A-26A    | CA_3A-26A                    | 3   |  | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                              | 26  |  | Yes | Yes | Yes |     |    |     |
|              |                              | 3   |  | Yes | Yes |     |     | 20 | 1   |

|               |                              |    |  |     |     |     |     |     |     |   |
|---------------|------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
|               |                              | 26 |  |     | Yes | Yes |     |     |     |   |
| CA_3A-27A     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 30  | 0 |
|               |                              | 27 |  |     | Yes | Yes |     |     |     |   |
| CA_3A-28A     | CA_3A-28A                    | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                              | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
|               |                              | 3  |  | Yes | Yes | Yes | Yes | Yes | 40  | 1 |
|               |                              | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-28A  | -                            | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-1   |     |     |     |     |     | 60  | 0 |
|               |                              | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-28A     | CA_3C                        | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 60  | 0 |
|               |                              | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-31A     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 25  | 0 |
|               |                              | 31 |  | Yes | Yes |     |     |     |     |   |
| CA_3A-32A     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                              | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-32A     | -                            | 3  | See the CA_3C Bandwidth combination Set 0 in Table 5.6A.1-1  |     |     |     |     |     | 60  | 0 |
|               |                              | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-38A     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                              | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-38A     | -                            | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 60  | 0 |
|               |                              | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-40A     | CA_3A-40A                    | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                              | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
|               |                              | 3  | Yes  | Yes | Yes | Yes | Yes | Yes | 40  | 1 |
|               |                              | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-40A-40A | -                            | 3  |  |     | Yes | Yes |     |     | 50  | 0 |
|               |                              | 40 | See CA_40A-40A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_3A-40C     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                              | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-40D     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |                              | 40 | See CA_40D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-40E     | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |                              | 40 | See CA_40E Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3C-40A     | -                            | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 60  | 0 |
|               |                              | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-40C     | -                            | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 80  | 0 |
|               |                              | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-41A     | CA_3A-41A                    | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |                              | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
|               |                              | 3  |  | Yes | Yes | Yes | Yes | Yes | 40  | 1 |
|               |                              | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-41A  | -                            | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                              | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|               |                              | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-41C     | CA_3A-41A, CA_3A-41C, CA_41C | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |                              | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-41D     | CA_3A-41A, CA_41C            | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |                              | 41 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3C-41A     | -                            | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 60  | 0 |



|               |  |    |  |     |     |     |     |     |     |   |
|---------------|--|----|--|-----|-----|-----|-----|-----|-----|---|
|               |  | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-41C     | -  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 80  | 0 |
|               |  | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3C-41D     | -  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 100 | 0 |
|               |  | 41 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-42A     | CA_3A-42A  | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |  | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-42A  | CA_3A-42A  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|               |  | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-42C     | CA_3A-42A,<br>CA_42C<br>CA_3A-42C                        | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-42D     | CA_3A-42A  | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |  | 42 | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-3A-42C  | CA_3A-42A  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 80  | 0 |
|               |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-42A-42A | CA_3A-42A  | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |  | 42 | See CA_42A-42A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_3A-42A-42C | CA_3A-42A,<br>CA_42C                                     | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |  | 42 | See CA_42A-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_3A-42C-42C | CA_3A-42A,<br>CA_42C                                     | 3  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |  | 42 | See CA_42C-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_3A-42E     | CA_3A-42A  | 3  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |  | 42 | See CA_42E Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-43A     | -  | 3  |  |     | Yes | Yes | Yes |     | 35  | 0 |
|               |  | 43 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-46A     | -  | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |  | 46 |  |     |     |     |     | Yes |     |   |
|               |  | 3  |  | Yes | Yes | Yes | Yes | Yes | 40  | 1 |
|               |  | 46 |  |     |     | Yes |     | Yes |     |   |
| CA_3A-46C     | -  | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|               |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|               | -  | 3  |  | Yes | Yes | Yes | Yes | Yes | 60  | 1 |
| 46            | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1 |    |  |     |     |     |     |     |     |   |
| CA_3A-46D     | -  | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |  | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|               |  | 3  |  | Yes | Yes | Yes | Yes | Yes | 80  | 1 |
|               |  | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-46E     | -  | 3  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |  | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|               |  | 3  |  |     | Yes | Yes | Yes | Yes | 100 | 1 |
|               |  | 46 | See CA_46E Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_3A-3A-46A  |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|               |  | 46 |  |     |     |     |     | Yes |     |   |
| CA_3A-3A-46C  | -  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 80  | 0 |

|               |                    |    |  |     |     |     |     |     |    |   |
|---------------|--------------------|----|--|-----|-----|-----|-----|-----|----|---|
|               |                    | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1       |     |     |     |     |     |    |   |
| CA_3C-46A     | -                  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     | 60  | 0  |   |
|               |                    | 46 |  |     |     |     | Yes |     |    |   |
| CA_3C-46C     | -                  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     | 80  | 0  |   |
|               |                    | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1       |     |     |     |     |     |    |   |
| CA_3C-46D     | -                  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     | 100 | 0  |   |
|               |                    | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1       |     |     |     |     |     |    |   |
| CA_3A-69A     | -                  | 3  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|               |                    | 69 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_4A-5A      | CA_4A-5A           | 4  |  |     | Yes | Yes |     |     | 20 | 0 |
|               |                    | 5  |  |     | Yes | Yes |     |     |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes | 30 | 1 |
|               |                    | 5  |  |     | Yes | Yes |     |     |    |   |
| CA_4A-4A-5A   | -                  | 4  | See CA_4A-4A Bandwidth Combination Set 0 in table 5.6A.1-3     |     |     |     |     | 50  | 0  |   |
|               |                    | 5  |  |     | Yes | Yes |     |     |    |   |
| CA_4A-5B      | CA_5B              | 4  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|               |                    | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |    |   |
| CA_4A-4A-5B   | CA_4A-5A,<br>CA_5B | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     | 60  | 0  |   |
|               |                    | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |    |   |
| CA_4A-7A      | CA_4A-7A           | 4  |  |     | Yes | Yes |     |     | 30 | 0 |
|               |                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes | 40 | 1 |
|               |                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_4A-4A-7A   | -                  | 4  |  |     | Yes | Yes |     |     | 40 | 0 |
|               |                    | 4  |  |     | Yes | Yes |     |     |    |   |
|               |                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes | 60 | 1 |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes |    |   |
|               |                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_4A-7A-7A   | -                  | 4  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|               |                    | 7  | See the CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_4A-7C      | CA_4A-7A           | 4  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|               |                    | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1        |     |     |     |     |     |    |   |
| CA_4A-12A     | CA_4A-12A          | 4  | Yes  | Yes | Yes | Yes |     |     | 20 | 0 |
|               |                    | 12 |  |     | Yes | Yes |     |     |    |   |
|               |                    | 4  | Yes  | Yes | Yes | Yes | Yes | Yes | 30 | 1 |
|               |                    | 12 |  |     | Yes | Yes |     |     |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes | 30 | 2 |
|               |                    | 12 |  | Yes | Yes | Yes |     |     |    |   |
|               |                    | 4  |  |     | Yes | Yes |     |     | 20 | 3 |
|               |                    | 12 |  |     | Yes | Yes |     |     |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes | Yes | 30 | 4 |
|               |                    | 12 |  |     | Yes | Yes |     |     |    |   |
|               |                    | 4  |  |     | Yes | Yes | Yes |     | 20 | 5 |
| 12            |                    |    | Yes  |     |     |     |     |     |    |   |
| CA_4A-4A-12A  | -                  | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     | 50  | 0  |   |
|               |                    | 12 |  |     | Yes | Yes |     |     |    |   |
| CA_4A-12A-12A | -                  | 4  |  |     | Yes | Yes | Yes | Yes | 30 | 0 |
|               |                    | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     |    |   |

|                  |           |    |  |     |     |     |     |     |   |
|------------------|-----------|----|--|-----|-----|-----|-----|-----|---|
| CA_4A-4A-12A-12A | -         | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     | 50  | 0   |   |
|                  |           | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |   |
| CA_4A-4A-12B     | -         | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     | 55  | 0   |   |
|                  |           | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |
| CA_4A-12B        | CA_4A-12A | 4  |  | Yes | Yes | Yes | Yes | 35  | 0 |
|                  |           | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |
| CA_4A-13A        | CA_4A-13A | 4  |  | Yes | Yes | Yes | Yes | 30  | 0 |
|                  |           | 13 |  |     | Yes |     |     |     |   |
|                  |           | 4  |  | Yes | Yes |     |     | 20  | 1 |
|                  |           | 13 |  |     | Yes |     |     |     |   |
| CA_4A-4A-13A     | -         | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     | 50  | 0   |   |
|                  |           | 13 |  |     | Yes |     |     |     |   |
| CA_4A-17A        | CA_4A-17A | 4  |  | Yes | Yes |     |     | 20  | 0 |
|                  |           | 17 |  | Yes | Yes |     |     |     |   |
| CA_4A-27A        | -         | 4  |  | Yes | Yes | Yes | Yes | 30  | 0 |
|                  |           | 27 | Yes  | Yes | Yes |     |     |     |   |
| CA_4A-28A        | CA_4A-28A | 4  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                  |           | 28 |  | Yes | Yes | Yes | Yes |     |   |
| CA_4A-29A        | -         | 4  |  | Yes | Yes |     |     | 20  | 0 |
|                  |           | 29 | Yes  | Yes | Yes |     |     |     |   |
|                  |           | 4  |  | Yes | Yes |     |     | 20  | 1 |
|                  |           | 29 |  | Yes | Yes |     |     |     |   |
|                  |           | 4  |  | Yes | Yes | Yes | Yes | 30  | 2 |
|                  |           | 29 |  | Yes | Yes |     |     |     |   |
| CA_4A-4A-29A     | -         | 4  | See CA_4A-4A Bandwidth combination set 0 in Table 5.6A.1-3   |     |     |     | 50  | 0   |   |
|                  |           | 29 |  | Yes | Yes |     |     |     |   |
| CA_4A-30A        | -         | 4  |  | Yes | Yes | Yes | Yes | 30  | 0 |
|                  |           | 30 |  | Yes | Yes |     |     |     |   |
| CA_4A-4A-30A     | -         | 4  | See CA_4A-4A Bandwidth combination set 0 in Table 5.6A.1-3   |     |     |     | 50  | 0   |   |
|                  |           | 30 |  | Yes | Yes |     |     |     |   |
| CA_4A-46A        | -         | 4  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                  |           | 46 |  |     |     |     | Yes |     |   |
| CA_4A-46A-46A    | -         | 4  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                  |           | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |   |
| CA_4A-46A-46C    | -         | 4  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                  |           | 46 | See CA_46A-46C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |   |
| CA_4A-46C        | -         | 4  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                  |           | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |
| CA_4A-46D        | -         | 4  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                  |           | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |
| CA_4A-46A-46D    | -         | 4  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                  |           | 46 | See CA_46A-46D Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |   |
| CA_4A-48A        | -         | 4  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                  |           | 48 |  | Yes | Yes | Yes | Yes |     |   |
| CA_4A-48C        | -         | 4  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                  |           | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |
| CA_4A-48D        | -         | 4  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                  |           | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |   |

|               |           |    |  |     |     |     |     |     |     |   |
|---------------|-----------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_4A-48E     | -         | 4  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |           | 48 | See CA_48E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_4A-71A     | -         | 4  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |           | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_4A-4A-71A  | -         | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|               |           | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-7A      | CA_5A-7A  | 5  | Yes  | Yes | Yes | Yes |     |     | 30  | 0 |
|               |           | 7  |  |     |     | Yes | Yes | Yes |     |   |
|               |           | 5  |  |     | Yes | Yes |     |     | 30  | 1 |
|               |           | 7  |  |     |     | Yes | Yes | Yes |     |   |
| CA_5A-7A-7A   | CA_5A-7A  | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|               |           | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3   |     |     |     |     |     |     |   |
| CA_5A-7C      | -         | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|               |           | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     |     |   |
| CA_5A-12A     | CA_5A-12A | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 12 |  |     | Yes | Yes |     |     |     |   |
| CA_5A-12A-12A | -         | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-12B     | -         | 5  |  |     | Yes | Yes |     |     | 25  | 0 |
|               |           | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-13A     | -         | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 13 |  |     |     | Yes |     |     |     |   |
| CA_5A-17A     | CA_5A-17A | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 17 |  |     | Yes | Yes |     |     |     |   |
| CA_5A-25A     | -         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 25 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-28A     | -         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-29A     | -         | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 29 |  |     | Yes | Yes |     |     |     |   |
| CA_5A-30A     | CA_5A-30A | 5  |  |     | Yes | Yes |     |     | 20  | 0 |
|               |           | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_5B-30A     | -         | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 30  | 0 |
|               |           | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_5A-38A     | -         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-40A     | CA_5A-40A | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
|               |           | 5  |  | Yes | Yes | Yes |     |     | 30  | 1 |
|               |           | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-5A-40A  | -         | 5  | See CA_5A-5A Bandwidth Combination Set 0 in table 6.140.2-2  |     |     |     |     |     | 40  | 0 |
|               |           | 40 |  |     |     | Yes |     | Yes |     |   |
| CA_5A-40A-40A | -         | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|               |           | 40 | See CA_40A-40A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-40C     | -         | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|               |           | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|               |           | 5  |  | Yes | Yes | Yes |     |     | 50  | 1 |
|               |           | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-41A     | -         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 41 |  |     |     |     |     | Yes |     |   |
| CA_5A-46A     | -         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|               |           | 46 |  |     |     |     |     | Yes |     |   |

|                  |                   |    |  |     |     |     |     |     |     |   |
|------------------|-------------------|----|--|-----|-----|-----|-----|-----|-----|---|
|                  |                   | 5  |  | Yes | Yes | Yes |     |     | 30  | 1 |
|                  |                   | 46 |  |     |     | Yes |     | Yes |     |   |
| CA_5A-46C        | -                 | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|                  |                   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                  |                   | 5  |  |     | Yes | Yes |     |     | 50  | 1 |
|                  |                   | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-46D        | -                 | 5  |  |     | Yes | Yes |     |     | 70  | 0 |
|                  |                   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                  |                   | 5  |  |     | Yes | Yes |     |     | 70  | 1 |
|                  |                   | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-46E        | -                 | 5  |  |     | Yes | Yes |     |     | 90  | 0 |
|                  |                   | 46 | See CA_46E of Bandwidth Combination Set 0 in Table 5.6A.1-1  |     |     |     |     |     |     |   |
|                  |                   | 5  |  |     | Yes | Yes |     |     | 90  | 1 |
|                  |                   | 46 | See CA_46E of Bandwidth Combination Set 1 in Table 5.6A.1-1  |     |     |     |     |     |     |   |
| CA_5B-46A        | -                 | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 40  | 0 |
|                  |                   | 46 |  |     |     |     | Yes |     |     |   |
| CA_5B-46C        | -                 | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 60  | 0 |
|                  |                   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5B-46D        | -                 | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 80  | 0 |
|                  |                   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5B-46E        | -                 | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 100 | 0 |
|                  |                   | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-48A        | -                 | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|                  |                   | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-48C        | -                 | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|                  |                   | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_5A-48D        | -                 | 5  |  |     | Yes | Yes |     |     | 70  | 0 |
|                  |                   | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_5A-66A        | CA_5A-66A         | 5  |  |     | Yes | Yes |     |     | 30  | 0 |
|                  |                   | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-5A-66A     | CA_5A-66A         | 5  | See CA_5A-5A Bandwidth combination set 0 in Table 5.6A.1-3   |     |     |     |     |     | 40  | 0 |
|                  |                   | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-5A-66A-66A | CA_5A-66A         | 5  | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|                  |                   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-5A-66A-66B | CA_5A-66A, CA_66B | 5  | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60  | 0 |
|                  |                   | 66 | See CA_66A-66B Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-5A-66A-66C | CA_5A-66A         | 5  | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 80  | 0 |
|                  |                   | 66 | See CA_66A-66C Bandwidth Combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-5A-66B     | CA_5A-66A, CA_66B | 5  | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 40  | 0 |
|                  |                   | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |

|               |               |     |  |     |     |     |     |     |    |     |   |
|---------------|---------------|-----|--|-----|-----|-----|-----|-----|----|-----|---|
| CA_5A-5A-66C  | CA_5A-66A     | 5   | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     | 60  | 0  |     |   |
|               |               | 66  | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5A-5A-66D  | CA_5A-66A     | 5   | See CA_5A-5A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     | 80  | 0  |     |   |
|               |               | 66  | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5A-66A-66A | CA_5A-66A     | 5   |  |     | Yes | Yes |     | 50  | 0  |     |   |
|               |               | 66  | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5A-66A-66C | CA_5A-66A     | 5   |  |     | Yes | Yes |     | 70  | 0  |     |   |
|               |               | 66  | See CA_66A-66C Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5A-66B     | CA_66B        | 5   |  |     | Yes | Yes |     | 30  | 0  |     |   |
|               |               | 66  | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5A-66C     | -             | 5   |  |     | Yes | Yes |     | 50  | 0  |     |   |
|               |               | 66  | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5A-66D     | -             | 5   |  |     | Yes | Yes |     | 70  | 0  |     |   |
|               |               | 66  | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5B-66A     | CA_5B         | 5   | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     | 40  | 0  |     |   |
|               |               | 66  |  |     | Yes | Yes | Yes |     |    | Yes |   |
| CA_5B-66A-66A | -             | 5   | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     | 60  | 0  |     |   |
|               |               | 66  | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5A-66A-66B | CA_66B        | 5   |  |     | Yes | Yes |     | 50  | 0  |     |   |
|               |               | 66  | See CA_66A-66B Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5B-66A-66B | -             | 5   | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     | 60  | 0  |     |   |
|               |               | 66  | See CA_66A-66B Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5B-66A-66C | -             | 5   | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     | 80  | 0  |     |   |
|               |               | 66  | See CA_66A-66C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |     |   |
| CA_5B-66B     | CA_5B, CA_66B | 5   | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     | 40  | 0  |     |   |
|               |               | 66  | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_5B-66C     | -             | 5   | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     | 60  | 0  |     |   |
|               |               | 66  | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |     |   |
| CA_7A-8A      | CA_7A-8A      | 7   |  |     | Yes | Yes | Yes | 30  | 0  |     |   |
|               |               | 8   |  | Yes | Yes | Yes |     |     |    |     |   |
|               |               | 7   |  |     | Yes | Yes | Yes |     |    | 30  | 1 |
|               |               | 8   |  | Yes | Yes |     |     |     |    |     |   |
|               |               | 7   |  | Yes | Yes | Yes | Yes |     |    |     |   |
| 8             |               | Yes | Yes  |     |     | 30  | 2   |     |    |     |   |
| CA_7A-7A-8A   | CA_7A-8A      | 7   | See CA_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3   |     |     |     |     | 50  | 0  |     |   |
|               |               | 8   |  |     | Yes | Yes |     |     |    |     |   |
|               |               | 7   | See CA_7A-7A Bandwidth Combination Set 2 in Table 5.6A.1-3   |     |     |     |     | 40  | 1  |     |   |
|               |               | 8   |  |     | Yes | Yes |     |     |    |     |   |
| CA_7A-12A     | -             | 7   |  |     | Yes | Yes | Yes | Yes | 30 | 0   |   |
|               |               | 12  |  |     | Yes | Yes |     |     |    |     |   |
| CA_7A-12B     | -             | 7   |  |     | Yes | Yes | Yes | Yes | 35 | 0   |   |

|              |                    |    |  |     |     |     |     |     |    |     |
|--------------|--------------------|----|--|-----|-----|-----|-----|-----|----|-----|
|              |                    | 12 | See CA_12B Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |     |    |     |
| CA_7A-13A    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 30 | 0   |
|              |                    | 13 |  |     | Yes | Yes |     |     |    |     |
| CA_7C-13A    | -                  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1              |     |     |     |     | 50  | 0  |     |
|              |                    | 13 |  |     | Yes | Yes |     |     |    |     |
| CA_7A-7A-13A | -                  | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3           |     |     |     |     | 50  | 0  |     |
|              |                    | 13 |  |     | Yes | Yes |     |     |    |     |
| CA_7A-20A    | CA_7A-20A          | 7  |  |     |     | Yes | Yes | Yes | 30 | 0   |
|              |                    | 20 |  |     | Yes | Yes |     |     |    |     |
|              |                    | 7  |  |     |     | Yes | Yes | Yes | 40 | 1   |
|              |                    | 20 |  |     | Yes | Yes | Yes | Yes |    |     |
|              |                    | 7  |  |     | Yes | Yes | Yes | Yes | 40 | 2   |
| 20           |                    |    | Yes  | Yes | Yes | Yes |     |     |    |     |
| CA_7A-7A-20A | -                  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3           |     |     |     |     | 60  | 0  |     |
|              |                    | 20 |  |     | Yes | Yes | Yes |     |    | Yes |
| CA_7C-20A    | -                  | 7  | See CA_7C Bandwidth Combination Set 1 in table 5.6A.1-1              |     |     |     |     | 60  | 0  |     |
|              |                    | 20 |  |     | Yes | Yes | Yes |     |    | Yes |
| CA_7A-22A    | -                  | 7  |  |     |     | Yes | Yes | Yes | 40 | 0   |
|              |                    | 22 |  |     | Yes | Yes | Yes | Yes |    |     |
| CA_7A-26A    | CA_7A-26A          | 7  |  |     | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                    | 26 |  |     | Yes | Yes | Yes |     |    |     |
| CA_7A-7A-26A | CA_7A-26A          | 7  | See CA_7A-7A bandwidth combination set 3 in table 5.6A.1-3           |     |     |     |     | 55  | 0  |     |
|              |                    | 26 |  |     | Yes | Yes | Yes |     |    |     |
| CA_7A-28A    | CA_7A-28A          | 7  |  |     | Yes | Yes | Yes | Yes | 35 | 0   |
|              |                    | 28 |  |     | Yes | Yes | Yes |     |    |     |
|              |                    | 7  |  |     | Yes | Yes | Yes | Yes | 40 | 1   |
|              |                    | 28 |  |     | Yes | Yes | Yes | Yes |    |     |
| CA_7A-7A-28A | -                  | 7  | See CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3           |     |     |     |     | 60  | 0  |     |
|              |                    | 28 |  |     |     | Yes | Yes |     |    | Yes |
| CA_7B-28A    | -                  | 7  | See CA_7B bandwidth combination set 0 in table 5.6A.1-1              |     |     |     |     | 40  | 0  |     |
|              |                    | 28 |  |     | Yes | Yes | Yes |     |    | Yes |
| CA_7C-28A    | CA_7A-28A<br>CA_7C | 7  | See CA_7C bandwidth combination set 2 in table 5.6A.1-1              |     |     |     |     | 60  | 0  |     |
|              |                    | 28 |  |     | Yes | Yes | Yes |     |    | Yes |
|              |                    | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1              |     |     |     |     | 60  | 1  |     |
|              |                    | 28 |  |     | Yes | Yes | Yes |     |    | Yes |
| CA_7A-29A    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 30 | 0   |
|              |                    | 29 |  |     | Yes | Yes |     |     |    |     |
| CA_7A-7A-29A | -                  | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3 of 36.101 |     |     |     |     | 50  | 0  |     |
|              |                    | 29 |  |     | Yes | Yes |     |     |    |     |
| CA_7C-29A    | -                  | 7  | See CA_7C Bandwidth combination set 2 in table 5.6A.1-1 of 36.101    |     |     |     |     | 50  | 0  |     |
|              |                    | 29 |  |     | Yes | Yes |     |     |    |     |
| CA_7A-30A    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 30 | 0   |
|              |                    | 30 |  |     | Yes | Yes |     |     |    |     |
| CA_7A-32A    | -                  | 7  |  |     |     | Yes | Yes | Yes | 40 | 0   |
|              |                    | 32 |  |     | Yes | Yes | Yes | Yes |    |     |
| CA_7A-40A    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 40 | 0   |
|              |                    | 40 |  |     | Yes | Yes | Yes | Yes |    |     |
| CA_7A-40C    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 60 | 0   |
|              |                    | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1             |     |     |     |     |     |    |     |
| CA_7A-40D    | -                  | 7  |  |     | Yes | Yes | Yes | Yes | 80 | 0   |

|                  |   |    |  |  |     |     |     |     |
|------------------|---|----|--|--|-----|-----|-----|-----|
|                  |   | 40 | See CA_40D Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7A-40E        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 40 | See CA_40E Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     | 100 | 0   |
| CA_7A-42A        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 42 |  | Yes  | Yes | Yes | Yes |     |
| CA_7A-42A-42A    | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 42 | See CA_42A-42A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     | 60  | 0   |
| CA_7A-46A        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 |  |  |     |     | Yes |     |
|                  |   | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 |  |  | Yes |     | Yes |     |
| CA_7A-7A-46C     | - | 7  | See CA_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3           |  |     |     | 80  | 0   |
|                  |   | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7A-46C        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     | 60  | 0   |
|                  | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1             |  |     |     | 60  | 1   |
| CA_7A-46D        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     | 80  | 0   |
|                  |   | -  | 7  |  | Yes | Yes | Yes | Yes |
|                  |   |    | 46   | See CA_46D Bandwidth Combination Set 1 in Table 5.6A.1-1 |     |     |     | 80  |
| CA_7A-46E        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     | 100 | 0   |
| CA_7A-7A-46E     | - | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3 of 36.101 |  |     |     | 120 | 0   |
|                  |   | 46 | See CA_46E Bandwidth combination set 0 in table 5.6A.1-3 of 36.101   |  |     |     |     |     |
| CA_7C-46C        | - | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1              |  |     |     | 80  | 0   |
|                  |   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7C-46D        | - | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1              |  |     |     | 100 | 0   |
|                  |   | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7C-46E        | - | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1              |  |     |     | 120 | 0   |
|                  |   | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7A-7A-46A     | - | 7  | See CA_7A-7A Bandwidth Combination Set 1 in table 5.6A.1-3           |  |     |     | 60  | 0   |
|                  |   | 46 |  |  |     |     |     |     |
| CA_7A-7A-46D     | - | 7  | See CA_7A-7A Bandwidth Combination Set 1 in table 5.6A.1-3           |  |     |     | 100 | 0   |
|                  |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |
| CA_7A-66A        | - | 7  |  | Yes  | Yes | Yes | Yes |     |
|                  |   | 66 |  | Yes  | Yes | Yes | Yes |     |
| CA_7A-7A-66A-66A | - | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3           |  |     |     | 80  | 0   |
|                  |   | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |
| CA_7C-66A        | - | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1              |  |     |     | 60  | 0   |
|                  |   | 66 |  | Yes  | Yes | Yes |     |     |



|               |           |    |  |     |     |     |     |     |    |   |
|---------------|-----------|----|--|-----|-----|-----|-----|-----|----|---|
| CA_7C-46A     | -         | 7  | See CA_7C Bandwidth Combination set 2 in Table 5.6A.1-1      |     |     |     |     |     | 60 | 0 |
|               |           | 46 |  |     |     |     | Yes |     |    |   |
| CA_7A-7A-66A  | -         | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3   |     |     |     |     |     | 60 | 0 |
|               |           | 66 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_7A-66A-66A | -         | 7  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|               |           | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_7C-66A-66A | -         | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     | 80 | 0 |
|               |           | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_8A-11A     | -         | 8  |  |     | Yes | Yes |     |     | 20 | 0 |
|               |           | 11 |  |     | Yes | Yes |     |     |    |   |
| CA_8A-20A     | -         | 8  |  |     | Yes | Yes |     |     | 20 | 0 |
|               |           | 20 |  |     | Yes | Yes |     |     |    |   |
|               |           | 8  |  | Yes | Yes | Yes |     |     | 20 | 1 |
|               |           | 20 |  |     | Yes | Yes |     |     |    |   |
|               |           | 8  |  |     | Yes | Yes |     |     | 30 | 2 |
| 20            |           |    |  | Yes | Yes | Yes |     |     |    |   |
| CA_8A-27A     | -         | 8  |  |     | Yes | Yes |     |     | 20 | 0 |
|               |           | 27 |  |     | Yes | Yes |     |     |    |   |
| CA_8A-28A     | -         | 8  |  | Yes | Yes | Yes |     |     | 30 | 0 |
|               |           | 28 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8A-32A     | -         | 8  |  | Yes | Yes | Yes |     |     | 30 | 0 |
|               |           | 32 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8A-38A     | -         | 8  |  |     | Yes | Yes |     |     | 30 | 0 |
|               |           | 38 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8A-39A     | CA_8A-39A | 8  | Yes  | Yes | Yes | Yes |     |     | 30 | 0 |
|               |           | 39 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8A-39C     | -         | 8  | Yes  | Yes | Yes | Yes |     |     | 45 | 0 |
|               |           | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_8B-39A     | -         | 8  | See CA_8B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 40 | 0 |
|               |           | 39 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8B-39C     | -         | 8  | See CA_8B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     | 55 | 0 |
|               |           | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_8A-40A     | -         | 8  |  |     | Yes | Yes |     |     | 30 | 0 |
|               |           | 40 |  |     | Yes | Yes | Yes | Yes |    |   |
|               | -         | 8  |  | Yes | Yes | Yes |     |     | 30 | 1 |
| CA_8A-40C     | -         | 8  |  |     | Yes | Yes |     |     | 50 | 0 |
|               |           | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_8A-41A     | CA_8A-41A | 8  | Yes  | Yes | Yes | Yes |     |     | 30 | 0 |
|               |           | 41 |  |     |     | Yes |     | Yes |    |   |
|               |           | 8  |  |     | Yes | Yes |     |     | 30 | 1 |
| CA_8A-41C     | -         | 8  | Yes  | Yes | Yes | Yes |     |     | 50 | 0 |
|               |           | 41 | See CA_41C bandwidth combination set 3 in table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_8A-41D     | -         | 8  | Yes  | Yes | Yes | Yes |     |     | 70 | 0 |
|               |           | 41 | See CA_41D bandwidth combination set 0 in table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_8B-41A     | -         | 8  | See CA_8B Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 40 | 0 |
|               |           | 41 |  |     |     |     |     | Yes |    |   |
| CA_8B-41C     | -         | 8  | See CA_8B bandwidth combination set 0 in table 5.6A.1-1      |     |     |     |     |     | 60 | 0 |

|            |            |    |  |     |     |     |     |     |    |   |
|------------|------------|----|--|-----|-----|-----|-----|-----|----|---|
|            |            | 41 | See CA_41C bandwidth combination set 3 in table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8B-41D  | -          | 8  | See CA_8B bandwidth combination set 0 in table 5.6A.1-1  |     |     |     |     |     | 80 | 0 |
|            |            | 41 | See CA_41D bandwidth combination set 0 in table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8A-42A  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 30 | 0 |
|            |            | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_8A-42C  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 50 | 0 |
|            |            | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8A-46A  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 30 | 0 |
|            |            | 46 |  |     |     |     |     | Yes |    |   |
| CA_8A-46C  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 50 | 0 |
|            |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8A-46D  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 70 | 0 |
|            |            | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8A-46E  | -          | 8  | Yes  | Yes | Yes | Yes |     |     | 90 | 0 |
|            |            | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8B-46A  | -          | 8  | See CA_8B Bandwidth Combination Set 0 in Table 5.6A.1-1  |     |     |     |     |     | 40 | 0 |
|            |            | 46 |  |     |     |     |     | Yes |    |   |
| CA_8B-46C  | -          | 8  | See CA_8B bandwidth combination set 0 in table 5.6A.1-1  |     |     |     |     |     | 60 | 0 |
|            |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_8B-46D  | -          | 8  | See CA_8B Bandwidth Combination Set 0 in Table 5.6A.1-1  |     |     |     |     |     | 80 | 0 |
|            |            | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_11A-18A | CA_11A-18A | 11 |  |     | Yes | Yes |     |     | 25 | 0 |
|            |            | 18 |  |     | Yes | Yes | Yes |     |    |   |
| CA_11A-26A | CA_11A-26A | 11 |  |     | Yes | Yes |     |     | 25 | 0 |
|            |            | 26 |  |     | Yes | Yes | Yes |     |    |   |
| CA_11A-28A | -          | 11 |  |     | Yes | Yes |     |     | 30 | 0 |
|            |            | 28 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_11A-41A | -          | 11 |  |     | Yes | Yes |     |     | 30 | 0 |
|            |            | 41 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_11A-41C | -          | 11 |  |     | Yes | Yes |     |     | 50 | 0 |
|            |            | 41 | See CA_41C bandwidth combination set 0 in table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_11A-42A | -          | 11 |  |     | Yes | Yes |     |     | 30 | 0 |
|            |            | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_11A-42C | -          | 11 |  |     | Yes | Yes |     |     | 50 | 0 |
|            |            | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_11A-46A | -          | 11 |  |     | Yes | Yes |     |     | 30 | 0 |
|            |            | 46 |  |     |     |     |     | Yes |    |   |
| CA_11A-46C | -          | 11 |  |     | Yes | Yes |     |     | 50 | 0 |
|            |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_11A-46D | -          | 11 |  |     | Yes | Yes |     |     | 70 | 0 |
|            |            | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_11A-46E | -          | 11 |  |     | Yes | Yes |     |     | 90 | 0 |
|            |            | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_12A-25A | -          | 12 |  |     | Yes | Yes |     |     | 30 | 0 |
|            |            | 25 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_12A-30A | CA_12A-30A | 12 |  |     | Yes | Yes |     |     | 20 | 0 |
|            |            | 30 |  |     | Yes | Yes |     |     |    |   |

|                |  |    |  |     |     |     |     |     |    |   |
|----------------|--|----|--|-----|-----|-----|-----|-----|----|---|
| CA_12A-46A     | -  | 12 |  |     | Yes | Yes |     |     | 30 | 0 |
|                |  | 46 |  |     |     |     |     | Yes |    |   |
| CA_12A-48A     |  | 12 |  |     | Yes | Yes |     |     | 30 | 0 |
|                |  | 48 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_12A-46C     | -  | 12 |  |     | Yes | Yes |     |     | 50 | 0 |
|                |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_12A-46D     | -  | 12 |  |     | Yes | Yes |     |     | 70 | 0 |
|                |  | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_12A-46E     | -  | 12 |  |     | Yes | Yes |     |     | 90 | 0 |
|                |  | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_12A-48C     | -  | 12 |  |     | Yes | Yes |     |     | 50 | 0 |
|                |  | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_12A-48D     | -  | 12 |  |     | Yes | Yes |     |     | 70 | 0 |
|                |  | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_12A-48E     | -  | 12 |  |     | Yes | Yes |     |     | 90 | 0 |
|                |  | 48 | See CA_48E Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     |    |   |
| CA_12A-66A     | CA_12A-66A   | 12 |  |     | Yes | Yes |     |     | 20 | 0 |
|                |  | 66 | Yes  | Yes | Yes | Yes |     |     |    |   |
|                |  | 12 |  |     | Yes | Yes |     |     | 30 | 1 |
|                |  | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |    |   |
|                |  | 12 |  | Yes | Yes | Yes |     |     | 30 | 2 |
|                |  | 66 |  |     | Yes | Yes | Yes | Yes |    |   |
|                |  | 12 |  |     | Yes | Yes |     |     | 20 | 3 |
|                |  | 66 |  |     | Yes | Yes |     |     |    |   |
|                |  | 12 |  |     | Yes | Yes |     |     | 30 | 4 |
|                |  | 66 |  |     | Yes | Yes | Yes | Yes |    |   |
| 12             |  |    | Yes  |     |     |     | 20  | 5   |    |   |
| 66             |  |    | Yes  | Yes | Yes |     |     |     |    |   |
| CA_12A-66A-66A | -  | 12 |  |     | Yes | Yes |     | 50  | 0  |   |
| 66             | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |    |  |     |     |     |     |     |    |   |
| CA_12A-66C     | -  | 12 |  |     | Yes | Yes |     | 50  | 0  |   |
|                |  | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_12B-66A     | -  | 12 | See CA_12B bandwidth combination set 0 in table 5.6A.1-1     |     |     |     |     |     | 35 | 0 |
|                |  | 66 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_12B-66A-66A | -  | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     | 55 | 0 |
|                |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_13A-46A     | -  | 13 |  |     | Yes | Yes |     | 30  | 0  |   |
|                |  | 46 |  |     |     |     | Yes |     |    |   |
| CA_13A-46A-46A | -  | 13 |  |     | Yes | Yes |     | 50  | 0  |   |
|                |  | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_13A-46A-46C | -  | 13 |  |     | Yes | Yes |     | 70  | 0  |   |
|                |  | 46 | See CA_46A-46C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_13A-46A-46D | -  | 13 |  |     | Yes | Yes |     | 90  | 0  |   |
|                |  | 46 | See CA_46A-46D Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_13A-46C     | -  | 13 |  |     | Yes | Yes |     | 50  | 0  |   |
|                |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |
| CA_13A-46D     | -  | 13 |  |     | Yes | Yes |     | 70  | 0  |   |
|                |  | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |    |   |

|                    |            |    |  |  |     |     |     |     |    |   |
|--------------------|------------|----|--|--|-----|-----|-----|-----|----|---|
| CA_13A-46E         | -          | 13 |  |  | Yes | Yes |     |     | 90 | 0 |
|                    |            | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_13A-48A         | -          | 13 |  |  | Yes | Yes |     |     | 30 | 0 |
|                    |            | 48 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_13A-48A-48A     | -          | 13 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-48A-48C     | -          | 13 |  |  | Yes | Yes |     |     | 70 | 0 |
|                    |            | 48 | See the CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |    |   |
| CA_13A-48A-48D     | -          | 13 |  |  | Yes | Yes |     |     | 90 | 0 |
|                    |            | 48 | See CA_48A-48D Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-48C-48C     | -          | 13 |  |  | Yes | Yes |     |     | 90 | 0 |
|                    |            | 48 | See CA_48C-48C Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-48C         | -          | 13 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_13A-48D         | -          | 13 |  |  | Yes | Yes |     |     | 70 | 0 |
|                    |            | 48 | See the CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     |    |   |
| CA_13A-48E         | -          | 13 |  |  | Yes | Yes |     |     | 90 | 0 |
|                    |            | 48 | See CA_48E Bandwidth Combination Set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_13A-66A         | CA_13A-66A | 13 |  |  | Yes | Yes |     |     | 30 | 0 |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_13A-66A-66A     | CA_13A-66A | 13 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-66A-66B     | -          | 13 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 66 | See CA_66A-66B Bandwidth combination set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-66A-66C     | -          | 13 |  |  | Yes | Yes |     |     | 70 | 0 |
|                    |            | 66 | See CA_66A-66C Bandwidth combination set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_13A-66B         | CA_13A-66A | 13 |  |  | Yes | Yes |     |     | 30 | 0 |
|                    |            | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_13A-66C         | CA_13A-66A | 13 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_13A-66D         | -          | 13 |  |  | Yes | Yes |     |     | 70 | 0 |
|                    |            | 66 | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_14A-30A         | CA_14A-30A | 14 |  |  | Yes | Yes |     |     | 20 | 0 |
|                    |            | 30 |  |  | Yes | Yes |     |     |    |   |
| CA_14A-66A         | CA_14A-66A | 14 |  |  | Yes | Yes |     |     | 30 | 0 |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_14A-66A-66A     | CA_14A-66A | 14 |  |  | Yes | Yes |     |     | 50 | 0 |
|                    |            | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |    |   |
| CA_14A-66A-66A-66A | CA_14A-66A | 14 |  |  | Yes | Yes |     |     | 70 | 0 |
|                    |            | 66 | See CA_66A-66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-4     |  |     |     |     |     |    |   |
| CA_18A-28A         | CA_18A-28A | 18 |  |  | Yes | Yes | Yes |     | 25 | 0 |
|                    |            | 28 |  |  | Yes | Yes |     |     |    |   |
| CA_18A-41A         | -          | 18 |  |  | Yes | Yes | Yes |     | 35 | 0 |
|                    |            | 41 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_18C-41C         | CA_18C-41C | 18 |  |  | Yes | Yes | Yes |     | 55 | 0 |
|                    |            | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1             |  |     |     |     |     |    |   |
| CA_18A-41A         | CA_18A-41A | 18 |  |  | Yes | Yes | Yes |     | 35 | 0 |

|                         |                          |    |  |     |     |     |     |     |    |   |
|-------------------------|--------------------------|----|--|-----|-----|-----|-----|-----|----|---|
|                         |                          | 41 |  |     | Yes | Yes | Yes | Yes |    |   |
|                         |                          | 18 |  |     | Yes | Yes | Yes |     |    |   |
| CA_18A-41C              | CA_18A-41A<br>CA_18A-41C | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1           |     |     |     |     |     | 55 | 0 |
|                         |                          | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_18A-42C              | -                        | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                         |                          | 42 | See the CA_42C Bandwidth combination set 0 in Table 5.6A.1-1       |     |     |     |     |     | 55 | 0 |
| CA_19A-21A              | CA_19A-21A               | 19 |  |     | Yes | Yes | Yes |     | 30 | 0 |
|                         |                          | 21 |  |     | Yes | Yes | Yes |     |    |   |
| CA_19A-28A              | -                        | 19 |  |     | Yes | Yes | Yes |     | 25 | 0 |
|                         |                          | 28 |  |     | Yes | Yes |     |     |    |   |
| CA_19A-42A              | CA_19A-42A               | 19 |  |     | Yes | Yes | Yes |     | 35 | 0 |
|                         |                          | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_19A-42C              | CA_19A-42A               | 19 |  |     | Yes | Yes | Yes |     | 55 | 0 |
|                         |                          | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_19A-42D              | -                        | 19 |  |     | Yes | Yes | Yes |     | 75 | 0 |
|                         |                          | 42 | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_19A-46A              | -                        | 19 |  |     | Yes | Yes | Yes |     | 35 | 0 |
|                         |                          | 46 |  |     |     |     |     | Yes |    |   |
| CA_19A-46C              | -                        | 19 |  |     | Yes | Yes | Yes |     | 55 | 0 |
|                         |                          | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_19A-46D              | -                        | 19 |  |     | Yes | Yes | Yes |     | 75 | 0 |
|                         |                          | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_19A-46E              | -                        | 19 |  |     | Yes | Yes | Yes |     | 95 | 0 |
|                         |                          | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_20A-28A <sup>7</sup> | -                        | 20 |  |     |     | Yes | Yes | Yes | 40 | 0 |
|                         |                          | 28 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-31A              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 25 | 0 |
|                         |                          | 31 | Yes  | Yes |     |     |     |     |    |   |
| CA_20A-32A              | -                        | 20 |  |     | Yes | Yes |     |     | 30 | 0 |
|                         |                          | 32 |  |     | Yes | Yes | Yes | Yes |    |   |
|                         |                          | 20 |  |     | Yes | Yes | Yes | Yes | 40 | 1 |
|                         |                          | 32 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-38A              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                         |                          | 38 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-38C              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                         |                          | 38 | See CA_38C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_20A-40A              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                         |                          | 40 |  |     | Yes | Yes | Yes | Yes |    |   |
|                         |                          | 20 |  |     | Yes | Yes | Yes |     | 35 | 1 |
|                         |                          | 40 |  |     |     | Yes | Yes | Yes |    |   |
| CA_20A-40A-40A          | -                        | 20 |  |     | Yes | Yes | Yes |     | 55 | 0 |
|                         |                          | 40 | See CA_40A-40A Bandwidth Combination Set 1 in Table 5.6A.1-3       |     |     |     |     |     |    |   |
| CA_20A-40C              | -                        | 20 |  |     | Yes | Yes | Yes |     | 55 | 0 |
|                         |                          | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_20A-40D              | -                        | 20 |  |     | Yes | Yes | Yes |     | 75 | 0 |
|                         |                          | 40 | See CA_40D Bandwidth Combination Set 1 in Table 5.6A.1-1           |     |     |     |     |     |    |   |
| CA_20A-41A              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                         |                          | 41 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-41C              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                         |                          | 41 | See CA_41C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 1 |     |     |     |     |     |    |   |
| CA_20A-41D              | -                        | 20 |  |     | Yes | Yes | Yes | Yes | 80 | 0 |

|                |            |    |   |     |     |     |     |     |    |   |
|----------------|------------|----|---|-----|-----|-----|-----|-----|----|---|
|                |            | 41 | See CA_41D in Table 5.6A.1-1 of 36.101<br>Bandwidth combination set 0 |     |     |     |     |     |    |   |
| CA_20A-42A     | -          | 20 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                |            | 42 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-42A-42A | -          | 20 |   |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                |            | 42 | See CA_42A-42A Bandwidth Combination Set 0 in Table 5.6A.1-3          |     |     |     |     |     |    |   |
| CA_20A-43A     | -          | 20 |   |     | Yes |     |     |     | 25 | 0 |
|                |            | 43 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-67A     | -          | 20 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                |            | 67 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-75A     | -          | 20 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                |            | 75 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_20A-76A     | -          | 20 |   |     | Yes | Yes | Yes | Yes | 25 | 0 |
|                |            | 76 |   |     | Yes |     |     |     |    |   |
| CA_21A-28A     | CA_21A-28A | 21 |   |     | Yes | Yes | Yes |     | 25 | 0 |
|                |            | 28 |   |     | Yes | Yes |     |     |    |   |
| CA_21A-42A     | CA_21A-42A | 21 |   |     | Yes | Yes | Yes |     | 35 | 0 |
|                |            | 42 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_21A-42C     | CA_21A-42A | 21 |   |     | Yes | Yes | Yes |     | 55 | 0 |
|                |            | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_21A-42D     | -          | 21 |   |     | Yes | Yes | Yes |     | 75 | 0 |
|                |            | 42 | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_21A-42E     | -          | 21 |   |     | Yes | Yes | Yes |     | 95 | 0 |
|                |            | 42 | See CA_42E Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_21A-46A     | -          | 21 |   |     | Yes | Yes | Yes |     | 35 | 0 |
|                |            | 46 |   |     |     |     |     | Yes |    |   |
| CA_21A-46C     | -          | 21 |   |     | Yes | Yes | Yes |     | 55 | 0 |
|                |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_21A-46D     | -          | 21 |   |     | Yes | Yes | Yes |     | 75 | 0 |
|                |            | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_21A-46E     | -          | 21 |   |     | Yes | Yes | Yes |     | 95 | 0 |
|                |            | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |
| CA_23A-29A     | -          | 23 |   |     | Yes | Yes | Yes | Yes | 30 | 0 |
|                |            | 29 |   | Yes | Yes | Yes |     |     |    |   |
|                |            | 23 |   |     | Yes | Yes |     |     |    |   |
| CA_25A-26A     | CA_25A-26A | 25 |   | Yes | Yes | Yes | Yes | Yes | 35 | 0 |
|                |            | 26 | Yes   | Yes | Yes | Yes | Yes |     |    |   |
|                |            | 25 |   | Yes | Yes | Yes |     |     |    |   |
|                |            | 26 |   | Yes | Yes | Yes |     |     |    |   |
|                |            | 25 |   |     | Yes | Yes |     |     |    |   |
| CA_25A-25A-26A | CA_25A-26A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3          |     |     |     |     |     | 45 | 0 |
|                |            | 26 |   | Yes | Yes |     |     |     |    |   |
| CA_25A-41A     | CA_25A-41A | 25 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|                |            | 41 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_25A-25A-41A | CA_25A-41A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3          |     |     |     |     |     | 60 | 0 |
|                |            | 41 |   |     | Yes | Yes | Yes | Yes |    |   |
| CA_25A-41C     | CA_25A-41A | 25 |   |     | Yes | Yes | Yes | Yes | 60 | 0 |
| CA_25A-25A-41C | CA_25A-41A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3          |     |     |     |     |     | 80 | 0 |
|                |            | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |    |   |

|                |            |    |  |     |     |     |     |     |     |   |
|----------------|------------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_25A-41D     | CA_25A-41A | 25 |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                |            | 41 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-25A-41D | CA_25A-41A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3     |     |     |     | 100 | 0   |     |   |
|                |            | 41 | See CA_41D bandwidth combination set 0 in table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-41E     | CA_25A-41A | 25 |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                |            | 41 | See CA_41E Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-25A-41E | CA_25A-41A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3     |     |     |     | 120 | 0   |     |   |
|                |            | 41 | See CA_41E bandwidth combination set 0 in table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-41F     | CA_25A-41A | 25 |  |     | Yes | Yes | Yes | Yes | 120 | 0 |
|                |            | 41 | See CA_41F Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-25A-41F | CA_25A-41A | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3     |     |     |     | 140 | 0   |     |   |
|                |            | 41 | See CA_41F bandwidth combination set 0 in table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-46A     | -          | 25 |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                |            | 46 |  |     |     | Yes |     | Yes |     |   |
| CA_25A-46C     | -          | 25 |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                |            | 46 | See CA_46C Bandwidth combination set 1 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_25A-46D     | -          | 25 |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                |            | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_26A-41A     | -          | 26 |  |     | Yes | Yes | Yes |     | 35  | 0 |
|                |            | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_26A-41C     | -          | 26 |  |     | Yes | Yes | Yes |     | 55  | 0 |
|                |            | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_26A-46A     | CA_26A-46A | 26 |  | Yes | Yes | Yes |     |     | 30  | 0 |
|                |            | 46 |  |     |     |     |     | Yes |     |   |
| CA_26A-48A     | CA_26A-48A | 26 |  | Yes | Yes | Yes |     |     | 30  | 0 |
|                |            | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_26A-48C     | CA_26A-48A | 26 |  | Yes | Yes | Yes |     |     | 50  | 0 |
|                |            | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_26A-48A-48A | CA_26A-48A | 26 |  | Yes | Yes | Yes |     |     | 50  | 0 |
|                |            | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_26A-66A     | -          | 26 |  |     | Yes | Yes | Yes |     | 35  | 0 |
|                |            | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_28A-32A     | -          | 28 |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                |            | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_28A-38A     | -          | 28 |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                |            | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_28A-40A     | -          | 28 |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                |            | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_28A-40C     | -          | 28 |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                |            | 40 | See CA_40C Bandwidth Combination set 1 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_28A-40D     | -          | 28 |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                |            | 40 | See CA_40D Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_28A-41A     | CA_28A-41A | 28 |  |     | Yes | Yes |     |     | 30  | 0 |
|                |            | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
|                |            | 28 |  |     | Yes | Yes | Yes | Yes | 40  | 1 |
|                |            | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_28A-41C     |            | 28 |  |     | Yes | Yes |     | 50  | 0   |   |

|                |                       |    |  |  |     |     |     |     |     |   |
|----------------|-----------------------|----|--|--|-----|-----|-----|-----|-----|---|
|                |                       | 41 | See CA_41C Bandwidth Combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-42A     | CA_28A-42A            | 28 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                |                       | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_28A-42C     | CA_28A-42A,<br>CA_42C | 28 |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                |                       | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-42A-42A | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                |                       | 42 | See CA_42A-42A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_28A-42D     | -                     | 28 |  |  | Yes | Yes |     |     | 70  | 0 |
|                |                       | 42 | See CA_42D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-42A-42C | CA_42C                | 28 |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                |                       | 42 | See CA_42A-42C Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_28A-42C-42C | CA_42C                | 28 |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                |                       | 42 | See CA_42C-42C Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_28A-46A     | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                |                       | 46 |  |  |     | Yes |     | Yes |     |   |
| CA_28A-46C     | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                |                       | 46 | See CA_46C Bandwidth Combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-46D     | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                |                       | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-46E     | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                |                       | 46 | See CA_46E Bandwidth Combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_28A-66A     | -                     | 28 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                |                       | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_29A-30A     | -                     | 29 |  |  | Yes | Yes |     |     | 20  | 0 |
|                |                       | 30 |  |  | Yes | Yes |     |     |     |   |
| CA_29A-66A     | -                     | 29 |  |  | Yes | Yes |     |     | 30  | 0 |
|                |                       | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_29A-66C     |                       | 29 |  |  | Yes | Yes |     |     | 50  | 0 |
|                |                       | 66 | See CA_66C Bandwidth Combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_29A-66A-66A |                       | 29 |  |  | Yes | Yes |     |     | 50  | 0 |
|                |                       | 66 | See CA_66A-66A Bandwidth Combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_29A-70A     | -                     | 29 |  |  | Yes | Yes |     |     | 25  | 0 |
|                |                       | 70 |  |  | Yes | Yes | Yes |     |     |   |
| CA_29A-70C     | -                     | 29 |  |  | Yes | Yes |     |     | 35  | 0 |
|                |                       | 70 | See CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_30A-66A     | CA_30A-66A            | 30 |  |  | Yes | Yes |     |     | 30  | 0 |
|                |                       | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_30A-66A-66A |                       | 30 |  |  | Yes | Yes |     |     | 50  | 0 |
|                |                       | 66 | See CA_66A-66A Bandwidth Combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_32A-42A     | -                     | 32 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                |                       | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_32A-43A     | -                     | 32 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|                |                       | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_34A-39A     |                       | 34 |  |  | Yes | Yes | Yes |     | 35  | 0 |
|                |                       | 39 |  |  |     | Yes | Yes | Yes |     |   |
| CA_34A-41A     |                       | 34 |  |  | Yes | Yes | Yes |     | 35  | 0 |
|                |                       | 41 |  |  |     |     |     | Yes |     |   |
| CA_38A-40A     | -                     | 38 |  |  |     | Yes |     | Yes | 40  | 0 |
|                |                       | 40 |  |  |     | Yes |     | Yes |     |   |
|                |                       | 38 |  |  | Yes | Yes | Yes |     |     |   |



|                |                                    |    |  |  |     |     |     |     |     |   |
|----------------|------------------------------------|----|--|--|-----|-----|-----|-----|-----|---|
|                |                                    | 40 |  |  |     | Yes | Yes | Yes |     |   |
| CA_38A-40A-40A | -                                  | 38 |  |  |     | Yes |     |     | Yes |   |
|                |                                    | 40 | See CA_40A-40A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     | 60  | 0 |
|                |                                    | 38 |  |  |     | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See CA_40A-40A Bandwidth Combination Set 1 in Table 5.6A.1-3     |  |     |     |     |     | 60  | 1 |
| CA_38A-40C     | -                                  | 38 |  |  |     | Yes |     |     | Yes |   |
|                |                                    | 40 | See CA_40C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 60  | 0 |
|                |                                    | 38 |  |  |     | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1         |  |     |     |     |     | 60  | 1 |
| CA_38A-40D     | -                                  | 38 |  |  |     | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See CA_40D Bandwidth Combination Set 1 in Table 5.6A.1-1         |  |     |     |     |     | 80  | 0 |
| CA_39A-40A     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_39A-40C     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See CA_40C Bandwidth Combination Set 0 in the Table 5.6A.1-1     |  |     |     |     |     | 60  | 0 |
| CA_39A-40D     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See CA_40D Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     | 80  | 0 |
| CA_39A-40E     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 40 | See the CA_40E Bandwidth combination set 0 in the Table 5.6A.1-1 |  |     |     |     |     | 100 | 0 |
| CA_39C-40A     | -                                  | 39 | See CA_39C Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     | 55  | 0 |
|                |                                    | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_39C-40C     | -                                  | 39 | See CA_39C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     | 75  | 0 |
|                |                                    | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39C-40D     | -                                  | 39 | See the CA_39C Bandwidth combination set 0 in the Table 5.6A.1-1 |  |     |     |     |     | 95  | 0 |
|                |                                    | 40 | See the CA_40D Bandwidth combination set 0 in the Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_39A-41A     | CA_39A-41A                         | 39 |  |  |     | Yes | Yes |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
| CA_39A-41C     | CA_41C<br>CA_39A-41A<br>CA_39A-41C | 39 |  |  |     | Yes | Yes |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
| CA_39A-41D     | CA_41C<br>CA_39A-41A               | 39 |  |  |     | Yes | Yes |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
| CA_39C-41A     | CA_39C<br>CA_39A-41A<br>CA_39C-41A | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 55  | 0 |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
| CA_39C-41C     | CA_39C<br>CA_41C<br>CA_39A-41A     | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 75  | 0 |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
|                |                                    | 41 |  |  |     |     |     |     | Yes |   |
| CA_39C-41D     | -                                  | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 95  | 0 |
|                |                                    | 41 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39A-42A     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_39A-42C     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |
|                |                                    | 42 | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1         |  |     |     |     |     | 60  | 0 |
| CA_39A-42D     | -                                  | 39 |  |  | Yes | Yes | Yes | Yes |     |   |

|            |            |    |  |  |     |     |     |     |     |   |
|------------|------------|----|--|--|-----|-----|-----|-----|-----|---|
|            |            | 42 | See CA_42D Bandwidth combination set 1 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39A-42E | -          | 39 |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|            |            | 42 | See the CA_42E Bandwidth combination set 0 in the Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_39C-42A | -          | 39 | See CA_39C Bandwidth Combination Set 0 in the Table 5.6A.1-1     |  |     |     |     |     | 55  | 0 |
|            |            | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_39C-42C | -          | 39 | See CA_39C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     | 75  | 0 |
|            |            | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39C-42D | -          | 39 | See the CA_39C Bandwidth combination set 0 in the Table 5.6A.1-1 |  |     |     |     |     | 95  | 0 |
|            |            | 42 | See the CA_42D Bandwidth combination set 1 in the Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_39A-46A | -          | 39 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|            |            | 46 |  |  |     |     |     | Yes |     |   |
| CA_39A-46C | -          | 39 |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|            |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39A-46D | -          | 39 |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|            |            | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_39A-46E | -          | 39 |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|            |            | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_39C-46A | -          | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 55  | 0 |
|            |            | 46 |  |  |     |     |     | Yes |     |   |
| CA_39C-46C | -          | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 75  | 0 |
|            |            | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_39C-46D | -          | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 95  | 0 |
|            |            | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_40A-41A | -          | 40 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|            |            | 41 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_40A-42A | CA_40A-42A | 40 |  |  |     | Yes | Yes | Yes | 40  | 0 |
|            |            | 42 |  |  |     | Yes | Yes | Yes |     |   |
| CA_40A-42C | -          | 40 |  |  |     | Yes | Yes | Yes | 60  | 0 |
|            |            | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_40C-42C | -          | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1         |  |     |     |     |     | 80  | 0 |
|            |            | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_40A-43A | -          | 40 |  |  | Yes | Yes | Yes | Yes | 40  | 0 |
|            |            | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_40A-46A | -          | 40 |  |  |     |     |     | Yes | 40  | 0 |
|            |            | 46 |  |  |     |     |     | Yes |     |   |
|            |            | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_40A-46C | -          | 46 |  |  |     |     |     | Yes | 60  | 0 |
|            |            | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
|            |            | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_40A-46C | -          | 40 |  |  | Yes | Yes | Yes | Yes | 60  | 1 |
|            |            | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_40A-46D | -          | 40 |  |  | Yes | Yes | Yes | Yes | 80  | 0 |

|                                       |  |    |  |     |     |     |     |   |
|---------------------------------------|--|----|--|-----|-----|-----|-----|---|
|                                       |  | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |   |
|                                       |  | 40 |  | Yes | Yes | Yes | Yes |   |
|                                       |  | 46 | See CA_46D Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     | 80  | 1 |
| CA_40A-46E                            | -                                      | 40 |  | Yes | Yes | Yes | Yes |   |
|                                       |  | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 100 | 0 |
|                                       |  | 40 |  | Yes | Yes | Yes | Yes |   |
|                                       |  | 46 | See CA_46E Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     | 100 | 1 |
| CA_40C-42A                            | -                                      | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     | 60  | 0 |
|                                       |  | 42 |  | Yes | Yes | Yes |     |   |
| CA_40C-46A                            | -                                      | 40 | See CA_40C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 60  | 0 |
|                                       |  | 46 |  |     |     |     | Yes |   |
| CA_40C-46C                            | -                                      | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |
|                                       |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_40C-46D                            | -                                      | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 100 | 0 |
|                                       |  | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_40D-46A                            | -                                      | 40 | See CA_40D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |
|                                       |  | 46 |  |     |     |     |     |   |
| CA_40D-46C                            | -                                      | 40 | See CA_40D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 100 | 0 |
|                                       |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_41A <sup>9</sup> -42A <sup>9</sup> | CA_41A-42A                             | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 |  |     | Yes | Yes | Yes |   |
| CA_41A-42C                            | CA_41A-42A, CA_42C, CA_41A-42C         | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     | 60  | 0 |
| CA_41A-42A-42A                        | -                                      | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 | See CA_42A-42A Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     | 60  | 0 |
| CA_41A-42D                            | -                                      | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 | See CA_42D Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     | 80  | 0 |
| CA_41A-42A-42C                        | CA_42C                                 | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 | See CA_42A-42C Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     | 80  | 0 |
| CA_41A-42C-42C                        | CA_42C                                 | 41 |  |     | Yes | Yes | Yes |   |
|                                       |  | 42 | See CA_42C-42C Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     | 100 | 0 |
| CA_41C-42A                            | CA_41A-42A, CA_41C, CA_41C-42A         | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 60  | 0 |
|                                       |  | 42 |  |     | Yes | Yes |     |   |
| CA_41C-42C                            | CA_41A-42A, CA_41C, CA_42C, CA_41C-42C | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |
|                                       |  | 42 | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_41C-42A-42A                        | -                                      | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |
|                                       |  | 42 | See CA_42A-42A Bandwidth combination set 1 in Table 5.6A.1-3 |     |     |     |     |   |
| CA_41C-42D                            | -                                      | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 100 | 0 |

|                |        |    |  |  |     |     |     |     |     |     |
|----------------|--------|----|--|--|-----|-----|-----|-----|-----|-----|
|                |        | 42 | See CA_42D Bandwidth Combination Set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41C-42A-42C | CA_42C | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     | 100 | 0   |     |
|                |        | 42 | See CA_42A-42C Bandwidth combination set 1 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
| CA_41C-42C-42C | CA_42C | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     | 120 | 0   |     |
|                |        | 42 | See CA_42C-42C Bandwidth combination set 1 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
| CA_41D-42A     | -      | 41 | See CA_41D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     | 80  | 0   |     |
|                |        | 42 |  |  | Yes | Yes | Yes |     |     |     |
| CA_41D-42C     | -      | 41 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     | 100 | 0   |     |
|                |        | 42 | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41A-46A     | -      | 41 |  |  | Yes | Yes | Yes | Yes | 40  | 0   |
|                |        | 46 |  |  |     |     |     | Yes |     |     |
| CA_41A-46C     | -      | 41 |  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                |        | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41A-46D     | -      | 41 |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                |        | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41A-46E     | -      | 41 |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                |        | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |     |
| CA_41C-46A     | -      | 41 | See CA_41C Bandwidth Combination Set 2 in Table 5.6A.1-1     |  |     |     |     | 60  | 0   |     |
|                |        | 46 |  |  |     |     | Yes |     |     |     |
| CA_41C-46C     | -      | 41 | See CA_41C Bandwidth combination set 2 in Table 5.6A.1-1     |  |     |     |     | 80  | 0   |     |
|                |        | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41C-46D     | -      | 41 | See the CA_41C Bandwidth combination set 2 in Table 5.6A.1-1 |  |     |     |     | 100 | 0   |     |
|                |        | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |     |
| CA_41D-46A     | -      | 41 | See CA_41D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     | 80  | 0   |     |
|                |        | 46 |  |  |     |     | Yes |     |     |     |
| CA_41D-46C     | -      | 41 | See the CA_41D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     | 100 | 0   |     |
|                |        | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |     |
| CA_41A-48A     | -      | 41 |  |  |     | Yes | Yes | Yes | 40  | 0   |
|                |        | 48 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_41A-48C     | -      | 41 |  |  |     | Yes | Yes | Yes | 60  | 0   |
|                |        | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41A-48D     | -      | 41 |  |  |     | Yes | Yes | Yes | 80  | 0   |
|                |        | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_41C-48A     | CA_41C | 41 | See the CA_41C Bandwidth combination set 2 in Table 5.6A.1-1 |  |     |     |     | 60  | 0   |     |
|                |        | 48 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_41C-48C     | CA_41C | 41 | See the CA_41C Bandwidth combination set 2 in Table 5.6A.1-1 |  |     |     |     | 80  | 0   |     |
|                |        | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |     |
| CA_41C-48D     | CA_41C | 41 | See the CA_41C Bandwidth combination set 2 in Table 5.6A.1-1 |  |     |     |     | 100 | 0   |     |
|                |        | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |     |

|                |        |    |   |     |     |     |     |     |     |
|----------------|--------|----|---|-----|-----|-----|-----|-----|-----|
| CA_41D-48A     | CA_41C | 41 | See the CA_41D Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     | 80  | 0   |     |
|                |        | 48 |   | Yes | Yes | Yes |     |     | Yes |
| CA_41D-48C     | CA_41C | 41 | See the CA_41D Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     | 100 | 0   |     |
|                |        | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     |     |
| CA_42A-43A     | -      | 42 |   | Yes | Yes | Yes | Yes | 40  | 0   |
|                |        | 43 |   | Yes | Yes | Yes | Yes |     |     |
| CA_42A-46A     | -      | 42 |   | Yes | Yes | Yes | Yes | 40  | 0   |
|                |        | 46 |   |     |     |     | Yes |     |     |
| CA_46A-48A     | -      | 46 |   |     |     |     | Yes | 40  | 0   |
|                |        | 48 |   | Yes | Yes | Yes | Yes |     |     |
| CA_46A-48A-48A | -      | 46 |   |     |     |     | Yes | 60  | 0   |
|                |        | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3    |     |     |     |     |     |     |
| CA_46A-48C     | CA_48C | 46 |   |     |     |     | Yes | 60  | 0   |
|                |        | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1        |     |     |     |     |     |     |
| CA_46C-48A     | -      | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1        |     |     |     | 60  | 0   |     |
|                |        | 48 |   | Yes | Yes | Yes |     |     | Yes |
| CA_46C-48A-48A | -      | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     | 80  | 0   |     |
|                |        | 48 | See CA_48A-48A Bandwidth Combination Set 0 in Table 5.6A.1-3    |     |     |     |     |     |     |
| CA_46A-48B     | CA_48B | 46 |   |     |     |     | Yes | 40  | 0   |
|                |        | 48 | See CA_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_46C-48C     | CA_48C | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     | 80  | 0   |     |
|                |        | 48 | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |     |
| CA_46C-48B     | CA_48B | 46 | See CA_46C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 |     |     |     | 60  | 0   |     |
|                |        | 48 | See CA_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_46A-48D     | CA_48C | 46 |   |     |     |     | Yes | 80  | 0   |
|                |        | 48 | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     |     |     |     |
| CA_46D-48A     | -      | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1        |     |     |     | 80  | 0   |     |
|                |        | 48 |   | Yes | Yes | Yes |     |     | Yes |
| CA_46D-48B     | CA_48B | 46 | See CA_46D Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 |     |     |     | 80  | 0   |     |
|                |        | 48 | See CA_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_46A-46A-66A | -      | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3    |     |     |     | 60  | 0   |     |
|                |        | 66 |   | Yes | Yes | Yes |     |     | Yes |
| CA_46A-46C-66A | -      | 46 | See CA_46A-46C Bandwidth Combination Set 0 in Table 5.6A.1-3    |     |     |     | 80  | 0   |     |
|                |        | 66 |   | Yes | Yes | Yes |     |     | Yes |
| CA_46A-46D-66A | -      | 46 | See CA_46A-46D Bandwidth Combination Set 0 in Table 5.6A.1-3    |     |     |     | 100 | 0   |     |
|                |        | 66 |   | Yes | Yes | Yes |     |     | Yes |
| CA_46A-48E     | CA_48C | 46 |   |     |     |     | Yes | 100 | 0   |
|                |        | 48 | See CA_48E Bandwidth combination set 0 in the Table 5.6A.1-1    |     |     |     |     |     |     |
| CA_46C-48D     | CA_48C | 46 | See CA_46C Bandwidth combination set 0 in the Table 5.6A.1-1    |     |     |     | 100 | 0   |     |
|                |        | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1    |     |     |     |     |     |     |
| CA_46D-48A-48A | -      | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1        |     |     |     | 100 | 0   |     |

|                |        |    |  |     |     |     |     |    |     |
|----------------|--------|----|--|-----|-----|-----|-----|----|-----|
|                |        | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_46D-48C     | -      | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 100 | 0  |     |
|                |        | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_46E-48A     | -      | 46 | See CA_46E Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     | 100 | 0  |     |
|                |        | 48 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46E-48B     | CA_48B | 46 | See CA_46E Bandwidth combination set 0 in 36.101 Table 5.6A.1-1      |     |     |     | 100 | 0  |     |
|                |        | 48 | See CA_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1      |     |     |     |     |    |     |
| CA_46C-66A     | -      | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     | 60  | 0  |     |
|                |        | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46A-66A     | -      | 46 |  |     |     | Yes | 40  | 0  |     |
|                |        | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46A-66A-66A | -      | 46 |  |     |     | Yes | 60  | 0  |     |
|                |        | 66 | See the CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |    |     |
| CA_46C-66A-66A | -      | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     | 80  | 0  |     |
|                |        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_46A-66C     | -      | 46 |  |     |     | Yes | 60  | 0  |     |
|                |        | 66 | See the CA_66C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |    |     |
| CA_46D-66A     | -      | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 80  | 0  |     |
|                |        | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46D-66A-66A | -      | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     | 100 | 0  |     |
|                |        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_46C-48E     | CA_48C | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     | 120 | 0  |     |
|                |        | 48 | See the CA_48E Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |    |     |
| CA_46E-48C     | -      | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     | 120 | 0  |     |
|                |        | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |    |     |
| CA_46E-66A     | -      | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 100 | 0  |     |
|                |        | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46E-66A-66A | -      | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     | 120 | 0  |     |
|                |        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_46A-70A     | -      | 46 |  |     |     | Yes | 35  | 0  |     |
|                |        | 70 |  | Yes | Yes | Yes |     |    |     |
| CA_46A-71A     | -      | 46 |  |     |     | Yes | 40  | 0  |     |
|                |        | 71 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46C-71A     | -      | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 60  | 0  |     |
|                |        | 71 |  | Yes | Yes | Yes |     |    | Yes |
| CA_46D-71A     | -      | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 80  | 0  |     |
|                |        | 71 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48A-66A     | -      | 48 |  | Yes | Yes | Yes | Yes | 40 | 0   |
|                |        | 66 |  | Yes | Yes | Yes | Yes |    |     |
| CA_48A-48A-66A | -      | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3         |     |     |     | 60  | 0  |     |
|                |        | 66 |  | Yes | Yes | Yes |     |    | Yes |

|                    |   |    |  |     |     |     |     |    |     |
|--------------------|---|----|--|-----|-----|-----|-----|----|-----|
| CA_48A-48C-66A     | - | 48 | See the CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     | 80  | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48A-48C-66B     | - | 48 | See CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 80  | 0  |     |
|                    |   | 66 | See CA_66B Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     |     |    |     |
| CA_48A-48C-66C     | - | 48 | See CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 100 | 0  |     |
|                    |   | 66 | See CA_66C Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     |     |    |     |
| CA_48A-48D-66A     | - | 48 | See CA_48A-48D Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 100 | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48C-48C-66A     | - | 48 | See CA_48C-48C Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 100 | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48A-66A-66A     | - | 48 |  | Yes | Yes | Yes | Yes | 60 | 0   |
|                    |   | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_48A-48A-66A-66A | - | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 80  | 0  |     |
|                    |   | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_48A-48A-66B     | - | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 60  | 0  |     |
|                    |   | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48A-48A-66C     | - | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3     |     |     |     | 80  | 0  |     |
|                    |   | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48C-66A-66A     | - | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     | 80  | 0  |     |
|                    |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3         |     |     |     |     |    |     |
| CA_48C-66B         | - | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     | 60  | 0  |     |
|                    |   | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48C-66C         | - | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     | 80  | 0  |     |
|                    |   | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48A-66B         | - | 48 |  | Yes | Yes | Yes | Yes | 40 | 0   |
|                    |   | 66 | See CA_66B Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48A-66C         | - | 48 |  | Yes | Yes | Yes | Yes | 60 | 0   |
|                    |   | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |    |     |
| CA_48C-66A         | - | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 60  | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48D-66A         | - | 48 | See the CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     | 80  | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48E-66A         | - | 48 | See CA_48E Bandwidth combination set 0 in the Table 5.6A.1-1         |     |     |     | 100 | 0  |     |
|                    |   | 66 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48A-71A         | - | 48 |  | Yes | Yes | Yes | Yes | 40 | 0   |
|                    |   | 71 |  | Yes | Yes | Yes | Yes |    |     |
| CA_48C-71A         | - | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     | 60  | 0  |     |
|                    |   | 71 |  | Yes | Yes | Yes |     |    | Yes |
| CA_48A-48A-71A     | - | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3         |     |     |     | 60  | 0  |     |

|                |   |    |  |  |     |     |     |     |    |   |
|----------------|---|----|--|--|-----|-----|-----|-----|----|---|
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66A-70A     | - | 66 |  |  | Yes | Yes | Yes | Yes | 35 | 0 |
|                |   | 70 |  |  | Yes | Yes | Yes |     |    |   |
| CA_66A-66A-70A | - | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |  |     |     |     |     | 55 | 0 |
|                |   | 70 |  |  | Yes | Yes | Yes |     |    |   |
| CA_66A-70C     | - | 66 |  |  | Yes | Yes | Yes | Yes | 45 | 0 |
|                |   | 70 | See CA_70C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_66A-66A-70C | - | 66 | See the CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     | 65 | 0 |
|                |   | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |    |   |
| CA_66C-70A     | - | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     | 55 | 0 |
|                |   | 70 |  |  | Yes | Yes | Yes |     |    |   |
| CA_66C-70C     | - | 66 | See the CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     | 65 | 0 |
|                |   | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |    |   |
| CA_66A-71A     | - | 66 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66C-71A     | - | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     | 60 | 0 |
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66A-66A-71A | - | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     | 60 | 0 |
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_70A-71A     | - | 70 |  |  | Yes | Yes | Yes |     | 35 | 0 |
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_70C-71A     | - | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     | 45 | 0 |
|                |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.

NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

NOTE 4: Uplink CA configurations are the configurations supported by the present release of specifications.

NOTE 5: For TDD inter-band Carrier Aggregation only non-simultaneous Rx/Tx uplink CA configurations can be supported by UE supporting corresponding DL CA configuration without simultaneous Rx/Tx.

NOTE 6: Void

NOTE 7: Power imbalance between downlink carriers on Band 20 and Band 28 is assumed to be within [6dB].

NOTE 8: For the corresponding CA configuration, UE may not support Pcell transmissions in this E-UTRA band.

NOTE 9: 8Rx Requirements are applicable for this band configuration if UE supports 8Rx.

**Table 5.6A.1-2a: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (three bands)**

| E-UTRA CA configuration / Bandwidth combination set |   |              |  |       |       |        |        |        |                                    |                           |
|---|---|--------------|--|-------|-------|--------|--------|--------|------------------------------------|---------------------------|
| E-UTRA CA Configuration                             | Uplink CA configurations (NOTE 5)             | E-UTRA Bands | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
| CA_1A-3A-5A   | CA_1A-3A<br>CA_1A-5A <sup>6</sup><br>CA_3A-5A | 1            |  |       | Yes   | Yes    | Yes    | Yes    | 50                                 | 0                         |
|   |   | 3            |  |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|   |   | 5            |  |       | Yes   | Yes    |        |        |                                    |                           |
|   |   | 1            |  |       | Yes   | Yes    |        |        | 40                                 | 1                         |
|   |   | 3            |  |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|   |   | 5            |  |       | Yes   | Yes    |        |        |                                    |                           |
| CA_1A-1A-3A-5A                                      | -   | 1            | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |       |       |        |        |        | 70                                 | 0                         |
|   |   | 3            |  |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|   |   | 5            |  |       | Yes   | Yes    |        |        |                                    |                           |



|                   |                                    |   |  |  |     |     |     |     |     |     |
|-------------------|------------------------------------|---|--|--|-----|-----|-----|-----|-----|-----|
| CA_1A-1A-3C-5A    | CA_1A-3A,<br>CA_1A-5A<br>CA_3A-5A  | 1 | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     | 90  | 0   |     |
|                   |                                    | 3 | See CA_3C Bandwidth combination set 0 in table 5.6A.1-1            |  |     |     |     |     |     |     |
|                   |                                    | 5 |  |  | Yes | Yes |     |     |     |     |
| CA_1A-3A-3A-5A    | -                                  | 1 |  |  | Yes | Yes | Yes |     | 65  | 0   |
|                   |                                    | 3 | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |     |     |
|                   |                                    | 5 |  |  | Yes | Yes |     |     |     |     |
| CA_1C-3A-5A       | -                                  | 1 | See CA_1C Bandwidth combination set 0 in Table 5.6A.1-1            |  |     |     |     | 70  | 0   |     |
|                   |                                    | 3 |  |  | Yes | Yes | Yes |     |     | Yes |
|                   |                                    | 5 |  |  | Yes | Yes |     |     |     |     |
| CA_1A-3A-3A-7A-7A | CA_1A-3A,<br>CA_1A-7A,<br>CA_3A-7A | 1 |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                   |                                    | 3 | See the CA_3A-3A Bandwidth combination set 0 in Table below        |  |     |     |     |     |     |     |
|                   |                                    | 7 | See the CA_7A-7A Bandwidth combination set 1 in Table below        |  |     |     |     |     |     |     |
| CA_1A-3C-5A       | -                                  | 1 |  |  | Yes | Yes | Yes | Yes | 70  | 0   |
|                   |                                    | 3 | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1            |  |     |     |     |     |     |     |
|                   |                                    | 5 |  |  | Yes | Yes |     |     |     |     |
| CA_1A-3A-7A       | CA_1A-3A<br>CA_1A-7A<br>CA_3A-7A   | 1 |  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                   |                                    | 3 |  |  | Yes | Yes | Yes | Yes |     |     |
|                   |                                    | 7 |  |  | Yes | Yes | Yes | Yes |     |     |
|                   |                                    | 1 |  |  | Yes | Yes | Yes | Yes | 60  | 1   |
|                   |                                    | 3 |  |  | Yes | Yes | Yes | Yes |     |     |
|                   |                                    | 7 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-1A-3A-7A    | -                                  | 1 | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     | 80  | 0   |     |
|                   |                                    | 3 |  |  | Yes | Yes | Yes |     |     | Yes |
|                   |                                    | 7 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-1A-3C-7A    | -                                  | 1 | See the CA_1A-1A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     | 100 | 0   |     |
|                   |                                    | 3 | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1            |  |     |     |     |     |     |     |
|                   |                                    | 7 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-1A-3A-3A-7A | CA_1A-3A<br>CA_1A-7A<br>CA_3A-7A   | 1 | See the CA_1A-1A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     | 100 | 0   |     |
|                   |                                    | 3 | See the CA_3A-3A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                   |                                    | 7 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-3A-3A-7A    | CA_1A-3A,<br>CA_1A-7A,<br>CA_3A-7A | 1 |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                   |                                    | 3 | See the CA_3A-3A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                   |                                    | 7 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-1A-3A-3A-7C | CA_7C                              | 1 | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     | 120 | 0   |     |
|                   |                                    | 3 | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |     |     |
|                   |                                    | 7 | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1 of 36.101  |  |     |     |     |     |     |     |
| CA_1A-3A-3A-7C    | 7C                                 | 1 |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                   |                                    | 3 | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3         |  |     |     |     |     |     |     |
|                   |                                    | 7 | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1            |  |     |     |     |     |     |     |
| CA_1A-3A-7A-7A    | CA_1A-3A<br>CA_1A-7A<br>CA_3A-7A   | 1 |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                   |                                    | 3 |  |  | Yes | Yes | Yes | Yes |     |     |
|                   |                                    | 7 | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3         |  |     |     |     |     |     |     |
|                   |                                    | 1 |  |  | Yes | Yes | Yes | Yes | 80  | 1   |
|                   |                                    | 3 |  |  | Yes | Yes | Yes | Yes |     |     |
|                   |                                    | 7 | See CA_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3         |  |     |     |     |     |     |     |
| CA_1A-3A-7C       |                                    | 1 |  |  | Yes | Yes | Yes | Yes | 80  | 0   |

|                 |  |    |   |     |     |     |     |     |     |   |
|-----------------|--|----|---|-----|-----|-----|-----|-----|-----|---|
|                 | CA_1A-3A,<br>CA_1A-7A,<br>CA_3A-7A,<br>CA_7C           | 3  |   |     | Yes | Yes | Yes |     | 80  | 1 |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                 |  | 1  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
| CA_1A-1A-3A-7C  | CA_7C  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 100 | 0 |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1 of 36.101 |     |     |     |     |     |     |   |
| CA_1A-1A-3C-7A  | CA_3C  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 100 | 0 |
|                 |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1 of 36.101 |     |     |     |     |     |     |   |
|                 |  | 7  |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-3C-7C  | CA_3C<br>CA_7C   | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 120 | 0 |
|                 |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1 of 36.101 |     |     |     |     |     |     |   |
|                 |  | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1 of 36.101 |     |     |     |     |     |     |   |
| CA_1A-3C-7A     | CA_1A-3A,<br>CA_1A-7A,<br>CA_3A-7A,<br>CA_3C           | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                 |  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                 |  | 7  |   |     | Yes | Yes | Yes |     |     |   |
|                 |  | 1  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
| 7               |  |    | Yes   | Yes | Yes | Yes |     |     |     |   |
| CA_1A-3C-7C     | CA_1A-3A,<br>CA_1A-7A,<br>CA_3A-7A,<br>CA_3C,<br>CA_7C | 1  |   |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                 |  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
| CA_1A-3A-8A     | CA_1A-3A<br>CA_1A-8A<br>CA_3A-8A                       | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 8  |   | Yes | Yes | Yes |     |     |     |   |
|                 |  | 1  |   |     | Yes | Yes |     |     | 40  | 1 |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 8  |   | Yes | Yes | Yes |     |     |     |   |
|                 |  | 1  |   |     | Yes | Yes | Yes |     | 40  | 2 |
|                 |  | 3  |   |     | Yes | Yes | Yes |     |     |   |
|                 |  | 8  |   | Yes | Yes | Yes |     |     |     |   |
|                 |  | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 3 |
| 3               |  |    | Yes   | Yes | Yes | Yes |     |     |     |   |
| 8               |  |    | Yes   | Yes |     |     |     |     |     |   |
| CA_1A-3A-3A-8A  | CA_1A-3A<br>CA_1A-8A<br>CA_3A-8A                       | 1  |   |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                 |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                 |  | 8  |   |     | Yes | Yes |     |     |     |   |
| CA_1A-3C-8A     | CA_1A-3A<br>CA_1A-8A<br>CA_3A-8A<br>CA_3C              | 1  |   |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                 |  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                 |  | 8  |   | Yes | Yes | Yes |     |     |     |   |
| CA_1A-3A-3A-42C | CA_1A-3A,<br>CA_1A-42A,<br>CA_3A-42A                   | 1  |   |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                 |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                 |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1          |     |     |     |     |     |     |   |
| CA_1A-3A-11A    | -  | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 11 |   |     | Yes | Yes |     |     |     |   |
| CA_1A-3A-18A    |  | 1  |   |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                 |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |

|                    |  |    |   |     |     |     |     |     |     |   |
|--------------------|--|----|---|-----|-----|-----|-----|-----|-----|---|
|                    | CA_1A-3A,<br>CA_1A-18A <sup>6</sup> ,<br>CA_3A-18A | 18 |   |     | Yes | Yes | Yes |     |     |   |
| CA_1A-3A-19A       | CA_1A-3A<br>CA_1A-19A <sup>6</sup><br>CA_3A-19A    | 1  |   |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 19 |   |     | Yes | Yes | Yes |     |     |   |
| CA_1A-3A-3A-19A    | CA_1A-3A<br>CA_1A-19A <sup>6</sup><br>CA_3A-19A    | 1  |   |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                    |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                    |  | 19 |   |     | Yes | Yes | Yes |     |     |   |
| CA_1A-3A-26A       | CA_1A-3A,<br>CA_1A-26A,<br>CA_3A-26A               | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 26 |   |     | Yes | Yes |     |     |     |   |
|                    |  | 1  |   |     | Yes | Yes | Yes | Yes | 55  | 1 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
| 26                 |  |    | Yes   | Yes | Yes |     |     |     |     |   |
| CA_1A-3A-20A       | CA_1A-3A,<br>CA_3A-20A,<br>CA_1A-20A               | 1  |   |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 20 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-3A-20A    | -  | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                    |  | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                    |  | 20 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3C-20A       | -  | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                    |  | 20 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-21A       | CA_1A-3A,<br>CA_1A-21A,<br>CA_3A-21A               | 1  |   |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 21 |   |     | Yes | Yes | Yes |     |     |   |
| CA_1A-3A-3A-21A    | CA_1A-3A,<br>CA_1A-21A,<br>CA_3A-21A               | 1  |   |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                    |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                    |  | 21 |   |     | Yes | Yes | Yes |     |     |   |
| CA_1A-3A-28A       | CA_1A-3A,<br>CA_1A-28A,<br>CA_3A-28A <sup>6</sup>  | 1  |   |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-3A-28A    | -  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 80  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-3A-3A-28A | -  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 100 | 0 |
|                    |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-3C-28A    | CA_3C  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 100 | 0 |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1 of 36.101 |     |     |     |     |     |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-3A-28A    | -  | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                    |  | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3        |     |     |     |     |     |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3C-28A       | CA_3C  | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-3C-28A    | CA_1A-3A,<br>CA_1A-28A<br>CA_3A-28A                | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3        |     |     |     |     |     | 100 | 0 |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1           |     |     |     |     |     |     |   |
|                    |  | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-32A       | -  | 1  |   |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                    |  | 3  |   |     | Yes | Yes | Yes | Yes |     |   |

|                           |  |    |  |  |  |     |     |     |     |   |
|---------------------------|--|----|--|--|--|-----|-----|-----|-----|---|
|                           |  | 32 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-38A              | CA_1A-3A   | 1  |  |  | Yes  | Yes | Yes | Yes | 60  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 38 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3C-38A              | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |   |
|                           |  | 38 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-40A              | CA_1A-3A   | 1  |  |  | Yes  | Yes | Yes | Yes | 60  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 40 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-40C              | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 40 |  |  | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_1A-3C-40A              | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |   |
|                           |  | 40 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3C-40C              | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 100 | 0 |
|                           |  | 3  |  |  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |   |
|                           |  | 40 |  |  | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_1A-3A-41A <sup>9</sup> | CA_1A-3A   | 1  |  |  | Yes  | Yes | Yes | Yes | 60  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 41 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-41C <sup>9</sup> | CA_1A-3A   | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 41 |  |  | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_1A-3A-41D <sup>9</sup> | CA_1A-3A   | 1  |  |  | Yes  | Yes | Yes | Yes | 100 | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 41 |  |  | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_1A-3A-42A              | CA_1A-3A,<br>CA_1A-42A,<br>CA_3A-42A                                       | 1  |  |  | Yes  | Yes | Yes | Yes | 60  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-3A-42A           | CA_1A-3A,<br>CA_1A-42A,<br>CA_3A-42A                                       | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |   |
|                           |  | 42 |  |  | Yes  | Yes | Yes | Yes |     |   |
| CA_1A-3A-42A-42A          | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | See CA_42A-42A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |   |
| CA_1A-3A-42A-42C          | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 100 | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | See CA_42A-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |   |
| CA_1A-3A-42C              | CA_1A-3A,<br>CA_1A-42A,<br>CA_1A-42C,<br>CA_3A-42A,<br>CA_3A-42C<br>CA_42C | 1  |  |  | Yes  | Yes | Yes | Yes | 80  | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_1A-3A-42C-42C          | -  | 1  |  |  | Yes  | Yes | Yes | Yes | 120 | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | See CA_42C-42C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |   |
| CA_1A-3A-42D              | CA_1A-3A,<br>CA_1A-42A,<br>CA_3A-42A,<br>CA_1A-42C,<br>CA_3A-42C           | 1  |  |  | Yes  | Yes | Yes | Yes | 100 | 0 |
|                           |  | 3  |  |  | Yes  | Yes | Yes | Yes |     |   |
|                           |  | 42 |  |  | See CA_42D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |   |
|                           |  | 1  |  |  | Yes  | Yes | Yes |     | 50  | 0 |

|                            |   |    |   |  |     |     |     |     |     |   |  |
|----------------------------|---|----|---|--|-----|-----|-----|-----|-----|---|--|
| CA_1A-3A-43A               |   | 3  |   |  | Yes | Yes | Yes |     |     |   |  |
|                            |   | 43 |   |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-46A               | -   | 1  |   |  | Yes | Yes | Yes | Yes | 60  | 0 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 |   |  |     |     | Yes | Yes |     |   |  |
|                            | -   | 1  |   |  | Yes | Yes | Yes | Yes | 60  | 1 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 |   |  |     |     |     | Yes |     |   |  |
| CA_1A-3A-46C               | -   | 1  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 | See CA_46C Bandwidth Combination Set 1 in Table 5.6A.1-1              |  |     |     |     |     |     |   |  |
|                            | -   | 1  |   |  | Yes | Yes | Yes | Yes | 80  | 1 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 | See CA_46C in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |  |
| CA_1A-3A-46D               | -   | 1  |   |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 | See CA_46D in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |  |
| CA_1A-3A-46E               | -   | 1  |   |  | Yes | Yes | Yes | Yes | 120 | 0 |  |
|                            |   | 3  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 46 | See CA_46E in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |  |
| CA_1A-5A-40A               | CA_1A-5A <sup>6</sup>                         | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 40 |   |  |     | Yes | Yes | Yes |     |   |  |
| CA_1A-5A-41A <sup>11</sup> | -   | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 41 |   |  |     |     |     | Yes |     |   |  |
| CA_1A-5A-46A               | CA_1A-5A <sup>6</sup>                         | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 46 |   |  |     |     |     | Yes |     |   |  |
| CA_1A-5A-7A                | CA_1A-5A <sup>6</sup><br>CA_1A-7A<br>CA_5A-7A | 1  |   |  | Yes | Yes |     |     | 40  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 7  |   |  |     | Yes | Yes | Yes |     |   |  |
|                            |   | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 1 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 7  |   |  |     | Yes | Yes | Yes |     |   |  |
| CA_1A-5A-7A-7A             | CA_1A-5A <sup>6</sup><br>CA_1A-7A<br>CA_5A-7A | 1  |   |  | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3            |  |     |     |     |     |     |   |  |
| CA_1A-5A-28A               | -   | 1  |   |  | Yes | Yes | Yes |     | 45  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 28 |   |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-5A-46C               | CA_1A-5A <sup>6</sup>                         | 1  |   |  | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1              |  |     |     |     |     |     |   |  |
| CA_1A-5A-46D               | -   | 1  |   |  | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                            |   | 5  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1              |  |     |     |     |     |     |   |  |
| CA_1A-7A-8A                | CA_1A-7A,<br>CA_1A-8A<br>CA_7A-8A             | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                            |   | 7  |   |  |     | Yes | Yes | Yes |     |   |  |
|                            |   | 8  |   |  | Yes | Yes |     |     |     |   |  |
|                            |   | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 1 |  |
|                            |   | 7  |   |  | Yes | Yes | Yes | Yes |     |   |  |
|                            |   | 8  |   |  | Yes | Yes |     |     |     |   |  |
| CA_1A-7A-7A-8A             | CA_1A-7A<br>CA_1A-8A<br>CA_7A-8A              | 1  |   |  | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                            |   | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3            |  |     |     |     |     |     |   |  |
|                            |   | 8  |   |  | Yes | Yes |     |     |     |   |  |
| CA_1A-7A-20A               | CA_1A-7A<br>CA_1A-20A                         | 1  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                            |   | 7  |   |  |     | Yes | Yes | Yes |     |   |  |

|                            |  |    |  |     |     |     |     |     |     |   |
|----------------------------|--|----|--|-----|-----|-----|-----|-----|-----|---|
|                            | CA_7A-20A                                      | 20 |  |     | Yes | Yes |     |     | 60  | 1 |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-7A-20A            | -  | 20 |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_1A-7C-20A               | -  | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                            |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                            |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-26A               | CA_1A-7A<br>CA_1A-26A,<br>CA_7A-26A            | 1  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                            |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 26 |  |     | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-7A-26A            | CA_1A-7A<br>CA_1A-26A,<br>CA_7A-26A            | 1  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                            |  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
|                            |  | 26 |  |     | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-28A               | CA_1A-7A,<br>CA_1A-28A,<br>CA_7A-28A           | 1  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 28 |  |     | Yes | Yes | Yes |     |     |   |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 1 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 28 |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 2 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
| 28                         |  |    | Yes  | Yes | Yes | Yes |     |     |     |   |
| CA_1A-1A-7A-28A            | -  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 80  | 0 |
|                            |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-1A-7C-28A            | CA_7C  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 100 | 0 |
|                            |  | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                            |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-7A-28A            | -  | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                            |  | 7  | See CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_1A-7C-28A               | CA_1A-7A,<br>CA_1A-28A,<br>CA_7A-28A,<br>CA_7C | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                            |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                            |  | 28 |  |     |     | Yes | Yes | Yes |     |   |
| CA_1A-7A-32A               | -  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-38A <sup>16</sup> | -  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                            |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-40A               | -  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-40C               | -  | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
| CA_1A-7A-42A               | -  | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1   |     |     |     |     |     |     |   |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
| 7                          |  |    |  | Yes | Yes | Yes |     |     |     |   |
| CA_1A-7A-46A               | CA_1A-7A                                       | 42 |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                            |  | 1  |  |     | Yes | Yes | Yes | Yes |     |   |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                            |  | 7  |  |     |     | Yes | Yes | Yes |     |   |

|               |          |    |   |     |     |     |     |     |     |   |
|---------------|----------|----|---|-----|-----|-----|-----|-----|-----|---|
|               |          | 46 |   |     |     |     |     | Yes |     |   |
| CA_1A-7A-46A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 60  | 1 |
|               |          | 7  |   |     | Yes | Yes | Yes | Yes |     |   |
|               |          | 46 |   |     |     |     |     | Yes |     |   |
| CA_1A-7A-46C  | CA_1A-7A | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 0 |
|               |          | 7  |   |     |     | Yes | Yes | Yes |     |   |
|               |          | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1              |     |     |     |     |     |     |   |
| CA_1A-7A-46C  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 80  | 1 |
|               |          | 7  |   |     | Yes | Yes | Yes | Yes |     |   |
|               |          | 46 | See CA_46C in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |     |   |
| CA_1A-7A-46D  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 100 | 0 |
|               |          | 7  |   |     |     | Yes | Yes | Yes |     |   |
|               |          | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |     |   |
| CA_1A-7A-46D  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 100 | 1 |
|               |          | 7  |   |     | Yes | Yes | Yes | Yes |     |   |
|               |          | 46 | See CA_46D in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |     |   |
| CA_1A-7A-46E  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 120 | 0 |
|               |          | 7  |   |     | Yes | Yes | Yes | Yes |     |   |
|               |          | 46 | See CA_46E in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |     |   |
| CA_1A-8A-11A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 40  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |
| CA_1A-8A-20A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 20 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-8A-28A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 8  |   | Yes | Yes | Yes |     |     |     |   |
|               |          | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-8A-38A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 38 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-8A-40A  | CA_1A-8A | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 8  |   | Yes | Yes | Yes |     |     |     |   |
|               |          | 40 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-8A-40C  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 70  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1              |     |     |     |     |     |     |   |
| CA_1A-8A-42A  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 42 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-8A-42C  | -        | 1  |   |     | Yes | Yes | Yes | Yes | 70  | 0 |
|               |          | 8  |   |     | Yes | Yes |     |     |     |   |
|               |          | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1              |     |     |     |     |     |     |   |
| CA_1A-11A-18A | -        | 1  |   |     | Yes | Yes | Yes | Yes | 45  | 0 |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |
|               |          | 18 |   |     | Yes | Yes | Yes |     |     |   |
|               |          | 1  |   |     | Yes | Yes | Yes | Yes | 40  | 1 |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |
| 18            |          |    | Yes   | Yes |     |     |     |     |     |   |
| CA_1A-11A-28A | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |
|               |          | 28 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-11A-42A | -        | 1  |   |     | Yes | Yes | Yes | Yes | 50  | 0 |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |
|               |          | 42 |   |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-11A-42C | -        | 1  |   |     | Yes | Yes | Yes | Yes | 70  | 0 |
|               |          | 11 |   |     | Yes | Yes |     |     |     |   |

|                             |   |    |  |     |     |     |     |     |    |   |
|-----------------------------|---|----|--|-----|-----|-----|-----|-----|----|---|
|                             |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |     |    |   |
| CA_1A-18A-28A               | CA_1A-18A <sup>6</sup><br>CA_1A-28A<br>CA_18A-28A                         | 1  |  |     | Yes | Yes | Yes | Yes | 45 | 0 |
|                             |   | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 28 |  |     | Yes | Yes |     |     |    |   |
|                             |   | 1  |  |     | Yes | Yes | Yes | Yes | 40 | 1 |
|                             |   | 18 |  |     | Yes | Yes |     |     |    |   |
| 28                          |   |    | Yes  | Yes |     |     |     |     |    |   |
| CA_1A-18A-41A               | CA_1A-18A<br>CA_1A-41A<br>CA_18A-41A                                      | 1  |  |     | Yes | Yes | Yes | Yes | 55 | 0 |
|                             |   | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 41 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-18A-41C               | CA_1A-18A<br>CA_1A-41A<br>CA_1A-41C<br>CA_18A-41A<br>CA_18A-41C<br>CA_41C | 1  |  |     | Yes | Yes | Yes | Yes | 75 | 0 |
|                             |   | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 41 | See CA_41C Bandwidth combination set 1 in Table 5.6A.1-1 in TS36.101 |     |     |     |     |     |    |   |
| CA_1A-18A-42A               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 55 | 0 |
|                             |   | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-18A-42C               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 75 | 0 |
|                             |   | 18 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1             |     |     |     |     |     |    |   |
| CA_1A-19A-21A               | CA_1A-19A <sup>6</sup><br>CA_1A-21A<br>CA_19A-21A                         | 1  |  |     | Yes | Yes | Yes | Yes | 50 | 0 |
|                             |   | 19 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 21 |  |     | Yes | Yes | Yes |     |    |   |
| CA_1A-19A-28A               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 45 | 0 |
|                             |   | 19 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 28 |  |     | Yes | Yes |     |     |    |   |
| CA_1A-19A-42A               | CA_1A-19A <sup>6</sup> ,<br>CA_1A-42A,<br>CA_19A-42A <sup>6</sup>         | 1  |  |     | Yes | Yes | Yes | Yes | 55 | 0 |
|                             |   | 19 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-19A-42C               | CA_1A-19A <sup>6</sup><br>CA_1A-42A<br>CA_19A-42A <sup>6</sup>            | 1  |  |     | Yes | Yes | Yes | Yes | 75 | 0 |
|                             |   | 19 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |     |    |   |
| CA_1A-20A-28A <sup>12</sup> | -   | 1  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                             |   | 20 |  |     |     | Yes | Yes | Yes |    |   |
|                             |   | 28 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-20A-32A               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 50 | 0 |
|                             |   | 20 |  |     | Yes | Yes |     |     |    |   |
|                             |   | 32 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-20A-38A               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                             |   | 20 |  |     | Yes | Yes | Yes | Yes |    |   |
|                             |   | 38 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-20A-42A               | -   | 1  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |
|                             |   | 20 |  |     | Yes | Yes | Yes | Yes |    |   |
|                             |   | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-20A-43A               | -   | 1  |  |     | Yes | Yes | Yes |     | 40 | 0 |
|                             |   | 20 |  |     | Yes |     |     |     |    |   |
|                             |   | 43 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-21A-28A               | CA_1A-21A,<br>CA_1A-28A,<br>CA_21A-28A                                    | 1  |  |     | Yes | Yes | Yes | Yes | 45 | 0 |
|                             |   | 21 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 28 |  |     | Yes | Yes |     |     |    |   |
| CA_1A-21A-42A               | CA_1A-21A,<br>CA_1A-42A,<br>CA_21A-42A                                    | 1  |  |     | Yes | Yes | Yes | Yes | 55 | 0 |
|                             |   | 21 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_1A-21A-42C               | CA_1A-21A<br>CA_1A-42A<br>CA_21A-42A                                      | 1  |  |     | Yes | Yes | Yes | Yes | 75 | 0 |
|                             |   | 21 |  |     | Yes | Yes | Yes |     |    |   |
|                             |   | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1             |     |     |     |     |     |    |   |
|                             |   | 1  |  |     | Yes | Yes | Yes | Yes | 95 | 0 |



|                             |  |    |  |  |     |     |     |     |     |   |
|-----------------------------|--|----|--|--|-----|-----|-----|-----|-----|---|
| CA_1A-21A-42D               |  | 21 |  |  | Yes | Yes | Yes |     |     |   |
|                             |  | 42 | See CA_42D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_1A-28A-40A               | -                                      | 1  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                             |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-28A-40C               | -                                      | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                             |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_1A-28A-42A               | CA_1A-28A,<br>CA_1A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes | 50  | 0 |
|                             |  | 28 |  |  | Yes | Yes |     |     |     |   |
|                             |  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-28A-42C               | CA_1A-28A,<br>CA_1A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes | 70  | 0 |
|                             |  | 28 |  |  | Yes | Yes |     |     |     |   |
|                             |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_1A-32A-42A               | -                                      | 1  |  |  | Yes | Yes | Yes |     | 55  | 0 |
|                             |  | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-32A-43A               | -                                      | 1  |  |  | Yes | Yes | Yes |     | 55  | 0 |
|                             |  | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-41A-42A <sup>10</sup> | CA_1A-42A                              | 1  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                             |  | 41 |  |  |     | Yes | Yes | Yes |     |   |
|                             |  | 42 |  |  |     |     | Yes | Yes |     |   |
| CA_1A-41A-42C <sup>10</sup> | CA_1A-42A,<br>CA_42C,<br>CA_1A-42C     | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                             |  | 41 |  |  |     | Yes | Yes | Yes |     |   |
|                             |  | 42 | See CA_42C Bandwidth combination Set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_1A-41C-42A <sup>10</sup> | CA_1A-42A                              | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                             |  | 41 | See CA_41C Bandwidth combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
|                             |  | 42 |  |  |     | Yes | Yes | Yes |     |   |
| CA_1A-41C-42C <sup>10</sup> | CA_1A-42A,<br>CA_42C,<br>CA_1A-42C     | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                             |  | 41 | See CA_41C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
|                             |  | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_1A-42A-43A               | -                                      | 1  |  |  | Yes | Yes | Yes |     | 55  | 0 |
|                             |  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_2A-4A-5A                 | CA_2A-4A                               | 2  |  |  | Yes | Yes | Yes | Yes | 50  | 0 |
|                             |  | 4  |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 5  |  |  | Yes | Yes |     |     |     |   |
| CA_2A-2A-4A-5A              | CA_2A-5A<br>CA_4A-5A                   | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     |     |   |
|                             |  | 4  |  |  | Yes | Yes | Yes | Yes | 70  | 0 |
|                             |  | 5  |  |  | Yes | Yes |     |     |     |   |
| CA_2A-2A-12A-66A-66A        | -                                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     |     |   |
|                             |  | 12 |  |  | Yes | Yes |     |     | 90  | 0 |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_2A-2A-14A-66A-66A        | CA_2A-14A<br>CA_14A-66A                | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     |     |   |
|                             |  | 14 |  |  | Yes | Yes |     |     | 90  | 0 |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_2A-4A-5B                 | -                                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 4  |  |  | Yes | Yes | Yes | Yes |     |   |
|                             |  | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |  |     |     |     |     |     |   |

|                  |                        |    |  |  |     |     |     |     |    |   |  |
|------------------|------------------------|----|--|--|-----|-----|-----|-----|----|---|--|
| CA_2A-4A-7A      | CA_2A-4A               | 2  |  |  | Yes | Yes | Yes | Yes | 60 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 7  |  |  | Yes | Yes | Yes | Yes |    |   |  |
| CA_2A-4A-7A-7A   | CA_2A-4A               | 2  |  |  | Yes | Yes | Yes | Yes | 80 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 7  | See the CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 |  |     |     |     |     |    |   |  |
| CA_2A-4A-7C      | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 80 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1        |  |     |     |     |     |    |   |  |
| CA_2A-4A-4A-5A   | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |  |
|                  |                        | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |  |
|                  |                        | 5  |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-12A     | CA_2A-4A<br>CA_4A-12A  | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 12 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-12A-12A | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     |    |   |  |
| CA_2A-4A-12B     | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 55 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1       |  |     |     |     |     |    |   |  |
| CA_2A-2A-4A-12A  | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     | 70 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 12 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-4A-12A  | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |  |
|                  |                        | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |  |
|                  |                        | 12 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-13A     | CA_2A-13A<br>CA_4A-13A | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 13 |  |  |     | Yes |     |     |    |   |  |
| CA_2A-4A-28A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 60 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 28 |  |  | Yes | Yes | Yes | Yes |    |   |  |
| CA_2A-4A-29A     | CA_2A-4A               | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 29 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-30A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 30 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-4A-71A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 60 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 71 |  |  | Yes | Yes | Yes | Yes |    |   |  |
| CA_2A-2A-4A-71A  | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     | 80 | 0 |  |
|                  |                        | 4  |  |  | Yes | Yes | Yes | Yes |    |   |  |
|                  |                        | 71 |  |  | Yes | Yes | Yes | Yes |    |   |  |
| CA_2A-5A-7A      | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |  |
|                  |                        | 5  |  |  | Yes | Yes |     |     |    |   |  |
|                  |                        | 7  |  |  |     | Yes | Yes | Yes |    |   |  |
| CA_2A-5A-12A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 40 | 0 |  |
|                  |                        | 5  |  |  | Yes | Yes |     |     |    |   |  |
|                  |                        | 12 |  |  | Yes | Yes |     |     |    |   |  |
| CA_2A-2A-5A-12A  | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     | 60 | 0 |  |
|                  |                        | 5  |  |  | Yes | Yes |     |     |    |   |  |

|                     |                        |    |  |  |     |     |     |     |     |     |
|---------------------|------------------------|----|--|--|-----|-----|-----|-----|-----|-----|
|                     |                        | 12 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-5A-12A-12A    | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 40  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
| CA_2A-5A-46C        | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 70  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-2A-5A-66A     | CA_2A-5A-CA_5A-66A     | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 70  | 0   |     |     |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 66 |  |  | Yes | Yes |     |     | Yes | Yes |
| CA_2A-2A-5A-66A-66A | CA_2A-5A-CA_5A-66A     | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 90  | 0   |     |     |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
| CA_2A-2A-5A-66B     | CA_2A-5A-CA_5A-66A     | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 70  | 0   |     |     |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-2A-5A-66C     | CA_2A-5A-CA_5A-66A     | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 90  | 0   |     |     |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-2A-7A-12A     | -                      | 2  | See CA_2A-2A Bandwidth combination set 0 in Table 5.6A.1-3   |  |     |     | 70  | 0   |     |     |
|                     |                        | 7  |  |  | Yes | Yes |     |     | Yes | Yes |
|                     |                        | 12 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-2A-7A-66A     | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 80  | 0   |     |     |
|                     |                        | 7  |  |  | Yes | Yes |     |     | Yes | Yes |
|                     |                        | 66 |  |  | Yes | Yes |     |     | Yes | Yes |
| CA_2A-2A-12B-66A    | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 75  | 0   |     |     |
|                     |                        | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
|                     |                        | 66 |  |  | Yes | Yes |     |     | Yes | Yes |
| CA_2A-2A-13A-66A    | CA_2A-13A-CA_13A-66A   | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 70  | 0   |     |     |
|                     |                        | 13 |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 66 |  |  | Yes | Yes |     |     | Yes | Yes |
| CA_2A-5A-12B        | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 45  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-5A-13A        | CA_2A-13A <sup>6</sup> | 2  |  |  | Yes | Yes | Yes | Yes | 40  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 13 |  |  |     | Yes |     |     |     |     |
| CA_2A-5A-28A        | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 50  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 28 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_2A-5A-29A        | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 40  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 29 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-5A-30A        | -                      | 2  |  |  | Yes | Yes | Yes | Yes | 40  | 0   |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |
|                     |                        | 30 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-2A-5A-30A     | -                      | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     | 60  | 0   |     |     |
|                     |                        | 5  |  |  | Yes | Yes |     |     |     |     |

|                  |                                    |    |  |            |            |            |            |            |     |   |
|------------------|------------------------------------|----|--|------------|------------|------------|------------|------------|-----|---|
|                  |                                    | 30 |  |            | Yes        | Yes        |            |            |     |   |
| CA_2C-5A-30A     | -                                  | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1      |            |            |            |            |            | 60  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 30 |  |            | Yes        | Yes        |            |            |     |   |
| CA_2A-5B-30A     | -                                  | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 50  | 0 |
|                  |                                    | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |            |            |            |            |            |     |   |
|                  |                                    | 30 |  |            | Yes        | Yes        |            |            |     |   |
| CA_2C-5B-30A     | -                                  | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1      |            |            |            |            |            | 70  | 0 |
|                  |                                    | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1      |            |            |            |            |            |     |   |
|                  |                                    | 30 |  |            | Yes        | Yes        |            |            |     |   |
| CA_2A-5A-46A     | -                                  | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 50  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 46 |  |            |            |            |            | Yes        |     |   |
| CA_2A-5A-46D     | CA_2A-5A                           | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 90  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-46E     | -                                  | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 110 | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-48A     | CA_2A-48A<br>CA_5A-48A             | 2  | Yes  | Yes        | Yes        | Yes        | Yes        | Yes        | 50  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 48 |  |            | Yes        | Yes        | Yes        | Yes        |     |   |
| CA_2A-5A-48C     | CA_2A-48A<br>CA_5A-48A<br>CA_2A-5A | 2  | <b>Yes</b>   | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | 70  | 0 |
|                  |                                    | 5  |  |            | <b>Yes</b> | <b>Yes</b> |            |            |     |   |
|                  |                                    | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-48D     | CA_2A-5A<br>CA_5A-48A<br>CA_2A-48A | 2  | Yes  | Yes        | Yes        | Yes        | Yes        | Yes        | 90  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-66A     | CA_2A-5A<br>CA_5A-66A<br>CA_2A-66A | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 50  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 66 |  |            | Yes        | Yes        | Yes        | Yes        |     |   |
| CA_2A-5A-66A-66A | CA_2A-5A<br>CA_5A-66A<br>CA_2A-66A | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 70  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |            |            |            |            |            |     |   |
| CA_2A-5B-66A-66A | CA_2A-5A<br>CA_5A-66A              | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 80  | 0 |
|                  |                                    | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |            |            |            |            |            |     |   |
|                  |                                    | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |            |            |            |            |            |     |   |
| CA_2A-5A-66B     | CA_2A-5A<br>CA_5A-66A              | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 50  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-66C     | CA_2A-5A<br>CA_5A-66A              | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 70  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5A-66D     | -                                  | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 90  | 0 |
|                  |                                    | 5  |  |            | Yes        | Yes        |            |            |     |   |
|                  |                                    | 66 | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1     |            |            |            |            |            |     |   |
| CA_2A-5B-66A     | CA_2A-5A<br>CA_5A-66A              | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 60  | 0 |
|                  |                                    | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |            |            |            |            |            |     |   |
|                  |                                    | 66 |  |            | Yes        | Yes        | Yes        | Yes        |     |   |
|                  | CA_2A-5A                           | 2  |  |            | Yes        | Yes        | Yes        | Yes        | 60  | 0 |

|                  |                       |    |  |     |     |     |     |    |     |
|------------------|-----------------------|----|--|-----|-----|-----|-----|----|-----|
| CA_2A-5B-66B     | CA_5A-66A             | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     | 80  | 0  |     |
|                  |                       | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |    |     |
| CA_2A-5B-66C     | CA_2A-5A<br>CA_5A-66A | 2  |  | Yes | Yes | Yes | Yes | 80 | 0   |
|                  |                       | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |    |     |
| CA_2A-5B-66A-66A | -                     | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0  |     |
|                  |                       | 2  |  | Yes | Yes | Yes |     |    | Yes |
| CA_2A-2A-5B-66A  | -                     | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     | 80  | 0  |     |
|                  |                       | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |    |     |
| CA_2A-2A-5B-66A  | -                     | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     | 80  | 0  |     |
|                  |                       | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |    |     |
| CA_2A-7A-12A     | -                     | 66 |  | Yes | Yes | Yes | Yes | 50 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7A-12B     | -                     | 7  |  | Yes | Yes | Yes | Yes | 55 | 0   |
|                  |                       | 12 | See CA_12B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |    |     |
| CA_2A-7A-13A     | -                     | 2  |  | Yes | Yes | Yes | Yes | 50 | 0   |
|                  |                       | 7  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7C-13A     | -                     | 13 |  | Yes | Yes |     |     | 70 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7A-7A-13A  | -                     | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1      |     |     |     | 70  | 0  |     |
|                  |                       | 13 |  | Yes | Yes |     |     |    |     |
| CA_2A-7A-7A-13A  | -                     | 2  |  | Yes | Yes | Yes | Yes | 70 | 0   |
|                  |                       | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3   |     |     |     |     |    |     |
| CA_2A-7A-26A     | -                     | 13 |  | Yes | Yes |     |     | 55 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7A-28A     | -                     | 7  |  | Yes | Yes | Yes | Yes | 60 | 0   |
|                  |                       | 26 |  | Yes | Yes | Yes |     |    |     |
| CA_2A-7C-28A     | -                     | 2  |  | Yes | Yes | Yes | Yes | 80 | 0   |
|                  |                       | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |    |     |
| CA_2A-7A-29A     | -                     | 28 |  | Yes | Yes | Yes | Yes | 50 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7C-29A     | -                     | 7  |  | Yes | Yes |     |     | 70 | 0   |
|                  |                       | 29 |  | Yes | Yes |     |     |    |     |
| CA_2A-7A-7A-29A  | -                     | 2  |  | Yes | Yes | Yes | Yes | 70 | 0   |
|                  |                       | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3   |     |     |     |     |    |     |
| CA_2A-7A-30A     | -                     | 29 |  | Yes | Yes |     |     | 50 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |
| CA_2A-7A-46A     | -                     | 7  |  | Yes | Yes |     |     | 60 | 0   |
|                  |                       | 2  |  | Yes | Yes | Yes | Yes |    |     |

|                     |                        |    |  |  |     |     |     |     |     |   |
|---------------------|------------------------|----|--|--|-----|-----|-----|-----|-----|---|
|                     |                        | 46 |  |  | Yes |     | Yes |     |     |   |
| CA_2A-7A-7A-46A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3   |  |     |     |     |     | 80  | 0 |
|                     |                        | 46 |  |  |     |     |     | Yes |     |   |
| CA_2A-7A-46C        | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     | 80  | 0 |
| CA_2A-7A-7A-46C     | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3   |  |     |     |     |     | 100 | 0 |
|                     |                        | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_2A-7A-46D        | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 46 | See CA_46D Bandwidth Combination Set 0 in the Table 5.6A.1-1 |  |     |     |     |     | 100 | 0 |
| CA_2A-7A-7A-46D     | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3   |  |     |     |     |     | 120 | 0 |
|                     |                        | 46 | See CA_46D Bandwidth Combination Set 0 in the Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_2A-7A-46E        | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     | 120 | 0 |
| CA_2A-7A-7A-46E     | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3   |  |     |     |     |     | 140 | 0 |
|                     |                        | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_2A-7A-66A        | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_2A-7A-7A-66A     | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3   |  |     |     |     |     | 80  | 0 |
|                     |                        | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_2A-7A-7A-66A-66A | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3   |  |     |     |     |     | 100 | 0 |
|                     |                        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_2A-7C-66A        | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1      |  |     |     |     |     | 80  | 0 |
|                     |                        | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_2A-7C-66A-66A    | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  | See CA_7C Bandwidth combination set 2 in table 5.6A.1-1      |  |     |     |     |     | 100 | 0 |
|                     |                        | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
| CA_2A-7A-66A-66A    | -                      | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     | 80  | 0 |
| CA_2A-12A-30A       | CA_2A-12A <sup>6</sup> | 2  |  |  | Yes | Yes | Yes | Yes |     |   |
|                     |                        | 12 |  |  | Yes | Yes |     |     |     |   |
|                     |                        | 30 |  |  | Yes | Yes |     |     |     |   |
| CA_2A-2A-12A-30A    | -                      | 2  | See CA_2A-2A Bandwidth combination set 0 in Table 5.6A.1-3   |  |     |     |     |     | 60  | 0 |
|                     |                        | 12 |  |  | Yes | Yes |     |     |     |   |
|                     |                        | 30 |  |  | Yes | Yes |     |     |     |   |

|                   |                                       |    |  |     |     |     |     |     |     |   |
|-------------------|---------------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_2C-12A-30A     | -                                     | 2  | See CA_2C Bandwidth combination set 0 in Table 5.6A.1-1          |     |     |     |     |     | 60  | 0 |
|                   |                                       | 12 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 30 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-12A-66A     | CA_2A-12A,<br>CA_2A-66A<br>CA_12A-66A | 2  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                   |                                       | 12 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 66 |  |     | Yes | Yes | Yes | Yes | 40  | 1 |
|                   |                                       | 2  |  |     | Yes | Yes |     |     |     |   |
| CA_2A-2A-12A-66A  | -                                     | 12 |  |     | Yes | Yes |     |     | 70  | 0 |
|                   |                                       | 2  |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                       | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-12A-66A-66A | -                                     | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                   |                                       | 12 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-12A-66C     | -                                     | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     | 70  | 0 |
|                   |                                       | 2  |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                       | 12 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-12B-66A     | -                                     | 2  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                   |                                       | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
|                   |                                       | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-12B-66A-66A | -                                     | 2  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                   |                                       | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-13A-46A     | CA_2A-13A                             | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 50  | 0 |
|                   |                                       | 2  |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-13A-46C     | CA_2A-13A                             | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     | 70  | 0 |
|                   |                                       | 2  |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-13A-46D     | CA_2A-13A                             | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     | 90  | 0 |
|                   |                                       | 2  |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
| CA_2A-13A-46E     | CA_2A-13A                             | 2  |  |     | Yes | Yes | Yes | Yes | 110 | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
| CA_2A-13A-46A-46D | CA_2A-13A                             | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 110 | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 46 | See CA_46A-46D Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-13A-46A-46C | CA_2A-13A                             | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 90  | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 46 | See CA_46A-46C Bandwidth Combination Set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-13A-46A-46A | CA_2A-13A                             | 2  | Yes  | Yes | Yes | 70  | 0   | Yes | 70  | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
| CA_2A-13A-48A     | CA_2A-48A<br>CA_13A-48A               | 2  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-13A-48A-48A | -                                     | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                   |                                       | 13 |  |     | Yes | Yes |     |     |     |   |
|                   |                                       | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
|                   | CA_2A-48A                             | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |

|                      |                                      |    |  |  |     |     |     |     |    |   |
|----------------------|--------------------------------------|----|--|--|-----|-----|-----|-----|----|---|
| CA_2A-13A-48C        | CA_13A-48A<br>CA_2A-13A              | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 48 | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_2A-13A-48D        | CA_2A-48A<br>CA_13A-48A              | 2  |  |  | Yes | Yes | Yes | Yes | 90 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     |    |   |
|                      |                                      | 2  |  |  | Yes | Yes | Yes | Yes | 90 | 0 |
| CA_2A-13A-48A-48C    | CA_2A-13A                            | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 48 | See CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |    |   |
| CA_2A-13A-66A        | CA_2A-13A<br>CA_13A-66A<br>CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_2A-13A-66D        | -                                    | 2  |  |  | Yes | Yes | Yes | Yes | 90 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66D Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_2A-13A-66A-66A    | CA_2A-13A<br>CA_13A-66A<br>CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |
| CA_2A-13A-66A-66B    | CA_2A-13A<br>CA_13A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66A-66B Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |
| CA_2A-13A-66A-66C    | CA_2A-13A<br>CA_13A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 90 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66A-66C Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |
| CA_2A-13A-66B        | CA_2A-13A<br>CA_13A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_2A-13A-66C        | CA_2A-13A<br>CA_13A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_2A-2A-13A-66B     | -                                    | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |  |     |     |     |     | 70 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |    |   |
| CA_2A-2A-13A-66A-66A | -                                    | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |  |     |     |     |     | 90 | 0 |
|                      |                                      | 13 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |  |     |     |     |     |    |   |
| CA_2A-14A-30A        | CA_2A-14A<br>CA_14A-30A              | 2  |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
|                      |                                      | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 30 |  |  | Yes | Yes |     |     |    |   |
| CA_2A-2A-14A-30A     | CA_2A-14A<br>CA_14A-30A              | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |  |     |     |     |     | 60 | 0 |
|                      |                                      | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 30 |  |  | Yes | Yes |     |     |    |   |
| CA_2A-14A-66A        | CA_2A-14A<br>CA_14A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 50 | 0 |
|                      |                                      | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_2A-2A-14A-66A     | CA_2A-14A<br>CA_14A-66A              | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |  |     |     |     |     | 70 | 0 |
|                      |                                      | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_2A-14A-66A-66A    | CA_2A-14A<br>CA_14A-66A              | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |
|                      |                                      | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 |  |  | Yes | Yes | Yes | Yes |    |   |
|                      |                                      | 2  |  |  | Yes | Yes | Yes | Yes | 70 | 0 |
| CA_2A-14A-66A-66A    | CA_2A-14A<br>CA_14A-66A              | 14 |  |  | Yes | Yes |     |     |    |   |
|                      |                                      | 66 |  |  | Yes | Yes |     |     |    |   |



|                       |                      |    |  |     |     |     |     |   |     |
|-----------------------|----------------------|----|--|-----|-----|-----|-----|---|-----|
|                       |                      | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |   |     |
| CA_2A-14A-66A-66A-66A | CA_2A-14A-CA_14A-66A | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 14 |  | Yes | Yes |     |     |   |     |
|                       |                      | 66 | See CA_66A-66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-4 |     |     |     | 90  | 0 |     |
| CA_2A-26A-66A         | -                    | 2  | Yes  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 26 | Yes  | Yes | Yes | Yes |     |   |     |
|                       |                      | 66 | Yes  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-28A-66A         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 28 |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 66 |  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-29A-30A         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 29 |  | Yes | Yes |     |     |   |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
| CA_2A-2A-29A-30A      | -                    | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     | 60  | 0 |     |
|                       |                      | 29 |  | Yes | Yes |     |     |   |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
| CA_2C-29A-30A         | -                    | 2  | See CA_2C Bandwidth Combination set 0 in Table 5.6A.1-1          |     |     |     | 60  | 0 |     |
|                       |                      | 29 |  | Yes | Yes |     |     |   |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
| CA_2A-29A-66A         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 29 |  | Yes | Yes |     |     |   |     |
|                       |                      | 66 |  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-2A-30A-66A      | -                    | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     | 70  | 0 |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
|                       |                      | 66 |  | Yes | Yes | Yes |     |   | Yes |
| CA_2A-30A-66A-66A     | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
|                       |                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     | 70  | 0 |     |
| CA_2A-30A-66A         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 30 |  | Yes | Yes |     |     |   |     |
|                       |                      | 66 |  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-46A-48A         | CA_2A-48A            | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 |  |     |     |     | Yes |   |     |
|                       |                      | 48 |  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-46A-48C         | CA_2A-48A            | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 |  |     |     |     | Yes |   |     |
|                       |                      | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |     |
| CA_2A-46A-48D         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 |  |     |     |     | Yes |   |     |
|                       |                      | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     | 100 | 0 |     |
| CA_2A-46A-48E         | -                    | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 |  |     |     |     | Yes |   |     |
|                       |                      | 48 | See the CA_48E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 120 | 0 |     |
| CA_2A-46C-48A         | CA_2A-48A            | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 80  | 0 |     |
|                       |                      | 48 |  | Yes | Yes | Yes | Yes |   |     |
| CA_2A-46C-48C         | CA_2A-48A            | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     | 100 | 0 |     |
|                       |                      | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |   |     |
| CA_2A-46D-48A         | CA_2A-48A            | 2  |  | Yes | Yes | Yes | Yes |   |     |
|                       |                      | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     | 100 | 0 |     |
|                       |                      | 48 |  | Yes | Yes | Yes | Yes |   |     |

|                   |           |    |  |  |     |     |     |     |     |   |     |
|-------------------|-----------|----|--|--|-----|-----|-----|-----|-----|---|-----|
| CA_2A-46A-66A     | CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |     |
|                   |           | 46 |  |  |     |     |     |     |     |   | Yes |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46A-46A-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                   |           | 46 | See CA_46A-46A Bandwidth combination set 0 in Table 5.6A.1-3         |  |     |     |     |     |     |   |     |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46C-48D     | -         | 2  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |     |
|                   |           | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
| CA_2A-46C-48E     | -         | 2  |  |  | Yes | Yes | Yes | Yes | 140 | 0 |     |
|                   |           | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 48 | See the CA_48E Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
| CA_2A-46C-66A     | CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                   |           | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1             |  |     |     |     |     |     |   |     |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46A-66A-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                   |           | 46 |  |  |     |     |     |     |     |   | Yes |
|                   |           | 66 | See the CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |   |     |
| CA_2A-46C-66A-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |     |
|                   |           | 46 | See the CA_46C Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     |     |   |     |
|                   |           | 66 | See the CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |   |     |
| CA_2A-46D-66A-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |     |
|                   |           | 46 | See the CA_46D Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     |     |   |     |
|                   |           | 66 | See the CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |   |     |
| CA_2A-46E-66A-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 140 | 0 |     |
|                   |           | 46 | See the CA_46E Bandwidth combination set 0 in the Table 5.6A.1-1     |  |     |     |     |     |     |   |     |
|                   |           | 66 | See the CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |  |     |     |     |     |     |   |     |
| CA_2A-46A-46C-66A | -         | 2  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |     |
|                   |           | 46 | See CA_46A-46C Bandwidth Combination Set 0 in the Table 5.6A.1-3     |  |     |     |     |     |     |   |     |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46D-66A     | CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |     |
|                   |           | 46 | See CA_46D Bandwidth Combination Set 0 in the Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46D-48C     | CA_2A-48A | 2  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |     |
|                   |           | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
| CA_2A-46E-48A     | CA_2A-48A | 2  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |     |
|                   |           | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 48 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46E-66A     | CA_2A-66A | 2  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |     |
|                   |           | 46 | See CA_46E Bandwidth Combination Set 0 in the Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 66 |  |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_2A-46E-48C     |           | 2  |  |  | Yes | Yes | Yes | Yes | 140 | 0 |     |
|                   |           | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |
|                   |           | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |     |

|                   |                                      |    |  |     |     |     |     |     |     |   |
|-------------------|--------------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_2A-48A-66A     | CA_2A-48A<br>CA_48A-66A<br>CA_2A-66A | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |                                      | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48C-66A     | CA_2A-48A<br>CA_48A-66A              | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |                                      | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48C-66A-66A | CA_48A-66A<br>CA_2A-66A<br>CA_2A-48A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |                                      | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                   |                                      | 66 | See CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-48D-66A     | CA_48A-66A<br>CA_2A-48A<br>CA_2A-66A | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |                                      | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48D-66A-66A | CA_48A-66A<br>CA_2A-66A<br>CA_2A-48A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 120 | 0 |
|                   |                                      | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                   |                                      | 66 | See CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-48E-66A     | CA_48A-66A<br>CA_2A-66A<br>CA_2A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 120 | 0 |
|                   |                                      | 48 | See CA_48E Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48E-66A-66A | CA_48A-66A<br>CA_2A-66A<br>CA_2A-48A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 140 | 0 |
|                   |                                      | 48 | See CA_48E Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                   |                                      | 66 | See CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-48A-48A-66A | -                                    | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |                                      | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48A-48C-66A | -                                    | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |                                      | 48 | See CA_48A-48C Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-48A-66A-66A | CA_48A-66A<br>CA_2A-48A<br>CA_2A-66A | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |                                      | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                      | 66 | See CA_66A-66A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_2A-66A-71A     | -                                    | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                      | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-2A-66A-71A  | -                                    | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 80  | 0 |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                      | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-66A-66A-71A | -                                    | 2  | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     | 80  | 0 |
|                   |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
|                   |                                      | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_2A-66C-71A     | -                                    | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |                                      | 66 | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |     |   |
|                   |                                      | 71 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-5A-7A       | CA_3A-5A,<br>CA_3A-7A,<br>CA_5A-7A   | 3  |  |     |     | Yes | Yes | Yes | 50  | 0 |
|                   |                                      | 5  |  |     | Yes | Yes |     |     |     |   |
|                   |                                      | 7  |  |     |     | Yes | Yes | Yes |     |   |
| CA_3A-5A-7A       | -                                    | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 1 |
|                   |                                      | 5  |  |     | Yes | Yes |     |     |     |   |
|                   |                                      | 7  |  |     |     | Yes | Yes | Yes |     |   |
| CA_3A-3A-5A-7A    | -                                    | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3       |     |     |     |     |     | 70  | 0 |
|                   |                                      | 5  |  |     | Yes | Yes |     |     |     |   |

|                   |                                    |    |  |     |     |     |     |     |    |   |
|-------------------|------------------------------------|----|--|-----|-----|-----|-----|-----|----|---|
|                   |                                    | 7  |  |     |     | Yes | Yes | Yes |    |   |
| CA_3A-5A-7A-7A    | CA_3A-5A,<br>CA_3A-7A,<br>CA_5A-7A | 3  |  |     |     | Yes | Yes | Yes | 70 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3   |     |     |     |     |     |    |   |
| CA_3A-5A-7C       | -                                  | 3  |  |     | Yes | Yes | Yes | Yes | 70 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     |    |   |
| CA_3A-5A-28A      | -                                  | 3  |  |     | Yes | Yes | Yes | Yes | 50 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 28 |  |     | Yes | Yes | Yes |     |    |   |
| CA_3A-3A-5A-28A   | -                                  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 70 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 28 |  |     | Yes | Yes | Yes | Yes |    |   |
| CA_3A-5A-40A      | CA_3A-5A                           | 3  |  |     | Yes | Yes | Yes | Yes | 50 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 40 |  |     | Yes | Yes | Yes |     |    |   |
|                   |                                    | 3  |  | Yes | Yes | Yes |     |     | 40 | 1 |
|                   |                                    | 5  |  | Yes | Yes | Yes |     |     |    |   |
| 40                |                                    |    |  |     |     | Yes |     |     |    |   |
| CA_3A-5A-40A-40A  | -                                  | 3  |  |     | Yes | Yes |     |     | 60 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 40 | See CA_40A-40A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |
| CA_3A-5A-41A      | -                                  | 3  |  |     | Yes | Yes | Yes | Yes | 50 | 0 |
|                   |                                    | 5  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 41 |  |     |     |     |     | Yes |    |   |
| CA_3C-7A-8A       | -                                  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     |     |     | 70 | 0 |
|                   |                                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
|                   |                                    | 8  |  |     | Yes | Yes |     |     |    |   |
| CA_3A-3A-7A-8A    | CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 70 | 0 |
|                   |                                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
|                   |                                    | 8  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 3  | See CA_3A-3A Bandwidth Combination Set 1 in Table 5.6A.1-3   |     |     |     |     |     | 60 | 1 |
|                   |                                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
| 8                 |                                    |    | Yes  | Yes |     |     |     |     |    |   |
| CA_3A-3A-7A-7A-8A | CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A | 3  | See CA_3A-3A Bandwidth Combination Set 0 in table 5.6A.1-3   |     |     |     |     |     | 90 | 0 |
|                   |                                    | 7  | See CA_7A-7A Bandwidth Combination Set 1 in table 5.6A.1-3   |     |     |     |     |     |    |   |
|                   |                                    | 8  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 3  | See CA_3A-3A Bandwidth Combination Set 1 in table 5.6A.1-3   |     |     |     |     |     | 70 | 1 |
|                   |                                    | 7  | See CA_7A-7A Bandwidth Combination Set 2 in table 5.6A.1-3   |     |     |     |     |     |    |   |
| 8                 |                                    |    | Yes  | Yes |     |     |     |     |    |   |
| CA_3A-7A-7A-8A    | CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A | 3  |  |     | Yes | Yes | Yes | Yes | 70 | 0 |
|                   |                                    | 7  | See CA_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3   |     |     |     |     |     |    |   |
|                   |                                    | 8  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 3  |  |     | Yes | Yes | Yes | Yes | 60 | 1 |
|                   |                                    | 7  | See CA_7A-7A Bandwidth Combination Set 2 in Table 5.6A.1-3   |     |     |     |     |     |    |   |
| 8                 |                                    |    | Yes  | Yes |     |     |     |     |    |   |
| CA_3A-7A-8A       | CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A | 3  |  |     | Yes | Yes | Yes |     | 40 | 0 |
|                   |                                    | 7  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 8  |  |     | Yes | Yes |     |     |    |   |
|                   |                                    | 3  |  |     | Yes | Yes | Yes | Yes | 50 | 1 |
|                   |                                    | 7  |  |     | Yes | Yes | Yes | Yes |    |   |
| 8                 |                                    |    | Yes  | Yes |     |     |     |     |    |   |

|                 |  |    |  |     |     |     |     |     |     |   |
|-----------------|--|----|--|-----|-----|-----|-----|-----|-----|---|
|                 |  | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 2 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 8  |  |     | Yes | Yes |     |     |     |   |
| CA_3A-7A-20A    | CA_3A-7A<br>CA_3A-20A<br>CA_7A-20A                 | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                 |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 1 |
| 7               |  |    | Yes  | Yes | Yes | Yes |     |     |     |   |
| 20              |  |    | Yes  | Yes | Yes | Yes |     |     |     |   |
| CA_3A-7A-7A-20A | -  | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                 |  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-7A-20A | -  | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     | 80  | 0 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-7A-20A    | -  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     | 80  | 0 |
|                 |  | 7  |  |     |     | Yes | Yes | Yes |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     | 80  | 1 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-7C-20A    | -  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     | 100 | 0 |
|                 |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7C-20A    | -  | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                 |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                 |  | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-26A    | CA_3A-7A,<br>CA_3A-26A,<br>CA_7A-26A               | 3  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 26 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-7A-7A-26A | CA_3A-7A,<br>CA_3A-26A,<br>CA_7A-26A               | 3  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                 |  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
|                 |  | 26 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-7A-28A    | CA_3A-7A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_7A-28A | 3  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-7A-28A | -  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 80  | 0 |
|                 |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-7C-28A | CA_7C  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 100 | 0 |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                 |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-7A-28A | -  | 3  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                 |  | 7  | See CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
|                 |  | 28 |  |     |     | Yes | Yes | Yes |     |   |
| CA_3A-7C-28A    | CA_3A-7A,<br>CA_7C,<br>CA_7A-28A                   | 3  |  |     |     | Yes | Yes | Yes | 80  | 0 |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |     |     |     |     |     |     |   |
|                 |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
|                 |  | 3  |  |     |     | Yes | Yes | Yes | 80  | 1 |
|                 |  | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1    |     |     |     |     |     |     |   |

|                           |                |    |  |     |     |     |     |     |     |
|---------------------------|----------------|----|--|-----|-----|-----|-----|-----|-----|
|                           |                | 28 |  |     | Yes | Yes | Yes |     |     |
| CA_3C-7A-28A              | CA_3C          | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1  |     |     |     | 80  | 0   |     |
|                           |                | 7  |  |     | Yes | Yes |     |     | Yes |
|                           |                | 28 |  |     | Yes | Yes |     |     | Yes |
| CA_3C-7C-28A              | CA_3C<br>CA_7C | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1  |     |     |     | 100 | 0   |     |
|                           |                | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1  |     |     |     |     |     |     |
|                           |                | 28 |  |     | Yes | Yes |     |     | Yes |
| CA_3A-7A-32A              | CA_3A-7A       | 3  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes |     |     |     |
|                           |                | 32 |  | Yes | Yes | Yes | Yes |     |     |
| CA_3C-7A-32A              | -              | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1  |     |     |     | 80  | 0   |     |
|                           |                | 7  |  |     | Yes | Yes |     |     | Yes |
|                           |                | 32 |  | Yes | Yes | Yes |     |     | Yes |
| CA_3A-7A-38A <sup>7</sup> | -              | 3  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes |     |     |     |
|                           |                | 38 |  | Yes | Yes | Yes | Yes |     |     |
| CA_3C-7A-38A <sup>7</sup> | -              | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1  |     |     |     | 80  | 0   |     |
|                           |                | 7  |  |     | Yes | Yes |     |     | Yes |
|                           |                | 38 |  | Yes | Yes | Yes |     |     | Yes |
| CA_3A-7A-40A              | -              | 3  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes | Yes |     |     |
|                           |                | 40 |  | Yes | Yes | Yes | Yes |     |     |
| CA_3A-7A-40C              | -              | 3  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes | Yes |     |     |
|                           |                | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_3A-7A-42A              | -              | 3  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes |     |     |     |
|                           |                | 42 |  | Yes | Yes | Yes | Yes |     |     |
| CA_3A-7A-46A              | -              | 3  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes | Yes |     |     |
|                           |                | 46 |  |     |     |     | Yes |     |     |
| CA_3A-7C-46A              | -              | 3  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                           |                | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1  |     |     |     |     |     |     |
|                           |                | 46 |  |     |     | Yes |     |     |     |
| CA_3A-7C-46C              | -              | 3  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                           |                | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1  |     |     |     |     |     |     |
|                           |                | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_3A-7C-46D              | -              | 3  |  | Yes | Yes | Yes | Yes | 120 | 0   |
|                           |                | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1  |     |     |     |     |     |     |
|                           |                | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_3A-7C-46E              | -              | 3  |  | Yes | Yes | Yes | Yes | 140 | 0   |
|                           |                | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1  |     |     |     |     |     |     |
|                           |                | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_3A-7A-46C              | -              | 3  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                           |                | 7  |  | Yes | Yes | Yes | Yes |     |     |
|                           |                | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |
| CA_3A-7A-46D              | -              | 3  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                           |                | 7  |  | Yes | Yes | Yes | Yes |     |     |
|                           |                | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |

|                  |  |    |  |     |     |     |     |     |     |   |
|------------------|--|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_3A-7A-46E     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 120 | 0 |
|                  |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |  | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |   |
| CA_3A-8A-11A     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 11 |  |     | Yes | Yes |     |     |     |   |
| CA_3A-8A-20A     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 40  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 20 |  |     | Yes | Yes |     |     |     |   |
| CA_3A-8A-28A     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 8  |  | Yes | Yes | Yes |     |     |     |   |
|                  |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-32A     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 8  |  | Yes | Yes | Yes |     |     |     |   |
|                  |  | 32 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-38A     | CA_3A-8A                               | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3C-8A-38A     | -                                      | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     | 70  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-40A     | CA_3A-8A                               | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 8  |  | Yes | Yes | Yes |     |     |     |   |
|                  |  | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-40C     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1   |     |     |     |     |     |     |   |
| CA_3A-8A-42A     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-42C     | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |  | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |   |
| CA_3A-11A-18A    | CA_3A-11A,<br>CA_3A-18A,<br>CA_11A-18A | 3  |  |     | Yes | Yes | Yes | Yes | 45  | 0 |
|                  |  | 11 |  |     | Yes | Yes |     |     |     |   |
|                  |  | 18 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-11A-26A    | CA_3A-11A,<br>CA_3A-26A,<br>CA_11A-26A | 3  |  |     | Yes | Yes | Yes | Yes | 45  | 0 |
|                  |  | 11 |  |     | Yes | Yes |     |     |     |   |
|                  |  | 26 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-11A-28A    | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 11 |  |     | Yes | Yes |     |     |     |   |
|                  |  | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-18A-42A    | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                  |  | 18 |  |     | Yes | Yes | Yes |     |     |   |
|                  |  | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_3A-18A-42C    | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                  |  | 18 |  |     | Yes | Yes | Yes |     |     |   |
|                  |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1   |     |     |     |     |     |     |   |
| CA_3A-19A-21A    | CA_3A-19A,<br>CA_3A-21A,<br>CA_19A-21A | 3  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                  |  | 19 |  |     | Yes | Yes | Yes |     |     |   |
|                  |  | 21 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-3A-19A-21A | CA_3A-19A,<br>CA_3A-21A,<br>CA_19A-21A | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 70  | 0 |
|                  |  | 19 |  |     | Yes | Yes | Yes |     |     |   |
|                  |  | 21 |  |     | Yes | Yes | Yes |     |     |   |
| CA_3A-19A-42A    | -                                      | 3  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                  |  | 19 |  |     | Yes | Yes | Yes |     |     |   |

|                                |  |    |  |  |     |     |     |     |     |   |
|--------------------------------|--|----|--|--|-----|-----|-----|-----|-----|---|
|                                | CA_3A-19A,<br>CA_3A-42A,<br>CA_19A-42A <sup>6</sup>  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-19A-42C                  | CA_3A-19A<br>CA_3A-42A<br>CA_19A-42A <sup>6</sup>    | 3  |  |  | Yes | Yes | Yes | Yes | 75  | 0 |
|                                |  | 19 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |     |   |
| CA_3A-19A-42D                  | -  | 3  |  |  | Yes | Yes | Yes | Yes | 95  | 0 |
|                                |  | 19 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 42 | See CA_42D Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |     |   |
| CA_3A-20A-28A <sup>12</sup>    | -  | 3  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                                |  | 20 |  |  |     | Yes | Yes | Yes |     |   |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-3A-20A-28A <sup>12</sup> | -  | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     | 80  | 0 |
|                                |  | 20 |  |  |     | Yes | Yes | Yes |     |   |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3C-20A-28A <sup>12</sup>    | -  | 3  | See CA_3C Bandwidth Combination Set 0 in Table 5.6A.1-1    |  |     |     |     |     | 80  | 0 |
|                                |  | 20 |  |  |     | Yes | Yes | Yes |     |   |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-20A-32A                  | CA_3A-20A  | 3  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                                |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-20A-42A                  | -  | 3  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                                |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-20A-43A                  | -  | 3  |  |  | Yes | Yes | Yes |     | 40  | 0 |
|                                |  | 20 |  |  | Yes |     |     |     |     |   |
|                                |  | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-21A-28A                  | CA_3A-21A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_21A-28A | 3  |  |  | Yes | Yes | Yes | Yes | 45  | 0 |
|                                |  | 21 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 28 |  |  | Yes | Yes |     |     |     |   |
| CA_3A-21A-42A                  | CA_3A-21A,<br>CA_3A-42A,<br>CA_21A-42A               | 3  |  |  | Yes | Yes | Yes | Yes | 55  | 0 |
|                                |  | 21 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-21A-42C                  | CA_3A-21A,<br>CA_3A-42A,<br>CA_21A-42A               | 3  |  |  | Yes | Yes | Yes | Yes | 75  | 0 |
|                                |  | 21 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |     |   |
| CA_3A-21A-42D                  | -  | 3  |  |  | Yes | Yes | Yes | Yes | 95  | 0 |
|                                |  | 21 |  |  | Yes | Yes | Yes |     |     |   |
|                                |  | 42 | See CA_42D Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |     |   |
| CA_3A-28A-38A                  | -  | 3  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 38 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3C-28A-38A                  | -  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     | 80  | 0 |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 38 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-28A-40A                  | CA_3A-28A <sup>6</sup>                               | 3  |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-28A-40C                  | CA_3A-28A <sup>6</sup>                               | 3  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1   |  |     |     |     |     |     |   |
| CA_3A-28A-40D                  | -  | 3  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                                |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                                |  | 40 | See CA_40D Bandwidth Combination Set 0 in Table 5.6A.1-1   |  |     |     |     |     |     |   |



|                   |   |    |   |  |     |     |     |     |     |   |
|-------------------|---|----|---|--|-----|-----|-----|-----|-----|---|
| CA_3A-28A-41A     | CA_3A-41A   | 3  |   |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |   | 28 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 |   |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-28A-41C     | CA_3A-41A   | 3  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |   | 28 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 | See CA_41C Bandwidth combination set 0 in Table 5.6A.1-1              |  |     |     |     |     |     |   |
| CA_3A-28A-42A     | CA_3A-28A <sup>6</sup> ,<br>CA_3A-42A,<br>CA_28A-42A            | 3  |   |  | Yes | Yes | Yes | Yes | 50  | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 |   |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-28A-42A-42A | -   | 3  |   |  | Yes | Yes |     |     | 70  | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42A-42A Bandwidth combination set 0 in Table 5.6A.1-3          |  |     |     |     |     |     |   |
| CA_3A-28A-42C     | CA_3A-28A <sup>6</sup> ,<br>CA_3A-42A,<br>CA_28A-42A,<br>CA_42C | 3  |   |  | Yes | Yes | Yes | Yes | 70  | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1              |  |     |     |     |     |     |   |
| CA_3A-28A-42A-42C | CA_42C  | 3  |   |  | Yes | Yes | Yes | Yes | 90  | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42A-42C Bandwidth combination set 0 in Table 5.6A.1-3          |  |     |     |     |     |     |   |
| CA_3A-28A-42C-42C | CA_42C  | 3  |   |  | Yes | Yes | Yes | Yes | 110 | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42C-42C Bandwidth combination set 0 in Table 5.6A.1-3          |  |     |     |     |     |     |   |
| CA_3A-28A-42D     | -   | 3  |   |  | Yes | Yes | Yes | Yes | 90  | 0 |
|                   |   | 28 |   |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1              |  |     |     |     |     |     |   |
| CA_3A-32A-42A     | -   | 3  |   |  | Yes | Yes | Yes |     | 55  | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 42 |   |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-32A-43A     | -   | 3  |   |  | Yes | Yes | Yes |     | 55  | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 43 |   |  | Yes | Yes | Yes | Yes |     |   |
| CA_3A-32A-46A     | -   | 3  |   |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 46 |   |  |     |     |     | Yes |     |   |
| CA_3A-32A-46C     | -   | 3  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 46 | See CA_46C in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |
| CA_3A-32A-46D     | -   | 3  |   |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 46 | See CA_46D in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |
| CA_3A-32A-46E     | -   | 3  |   |  | Yes | Yes | Yes | Yes | 120 | 0 |
|                   |   | 32 |   |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 46 | See CA_46E in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |  |     |     |     |     |     |   |
| CA_3A-41A-42A     | CA_3A-41A,<br>CA_41A-42A,<br>CA_3A-42A                          | 3  |   |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                   |   | 41 |   |  |     | Yes | Yes | Yes |     |   |
|                   |   | 42 |   |  |     | Yes | Yes | Yes |     |   |
| CA_3A-41A-42A-42A | -   | 3  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |   | 41 |   |  |     | Yes | Yes | Yes |     |   |
|                   |   | 42 | See CA_42A-42A Bandwidth combination set 1 in Table 5.6A.1-3          |  |     |     |     |     |     |   |
| CA_3A-41A-42C     | CA_3A-41A,<br>CA_3A-42C,<br>CA_3A-42A,<br>CA_41A-42A,           | 3  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |   | 41 |   |  |     | Yes | Yes | Yes |     |   |
|                   |   | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1              |  |     |     |     |     |     |   |

|                   |   |    |  |  |     |     |     |     |     |   |  |
|-------------------|---|----|--|--|-----|-----|-----|-----|-----|---|--|
|                   | CA_41A-42C,<br>CA_42C   |    |  |  |     |     |     |     |     |   |  |
| CA_3A-41A-42A-42C | CA_42C  | 3  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                   |   | 41 |  |  |     | Yes | Yes | Yes |     |   |  |
|                   |   | 42 | See CA_42A-42C Bandwidth combination set 1 in Table 5.6A.1-3 |  |     |     |     |     |     |   |  |
| CA_3A-41A-42C-42C | CA_42C  | 3  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |  |
|                   |   | 41 |  |  |     | Yes | Yes | Yes |     |   |  |
|                   |   | 42 | See CA_42C-42C Bandwidth combination set 1 in Table 5.6A.1-3 |  |     |     |     |     |     |   |  |
| CA_3A-41C-42A     | CA_3A-41A,<br>CA_3A-41C,<br>CA_3A-42A,<br>CA_41A-42A,<br>CA_41C<br>CA_41C-42A   | 3  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |  |
|                   |   | 41 | See CA_41C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
|                   |   | 42 |  |  |     | Yes | Yes | Yes |     |   |  |
| CA_3A-41C-42C     | CA_3A-41A,<br>CA_3A-41C,<br>CA_3A-42A,<br>CA_3A-42C,<br>CA_41A-42A,<br>CA_41A-42C<br>CA_41C,<br>CA_41C-42A,<br>CA_42C | 3  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                   |   | 41 | See CA_41C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
|                   |   | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
| CA_3A-42A-43A     | -   | 3  |  |  | Yes | Yes | Yes |     | 55  | 0 |  |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                   |   | 43 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_4A-5A-12A      | -   | 4  |  |  | Yes | Yes | Yes | Yes | 40  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 12 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-5A-12A-12A  | -   | 4  |  |  | Yes | Yes | Yes | Yes | 40  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 12 | See CA_12A-12A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |  |
| CA_4A-5A-12B      | -   | 4  |  |  | Yes | Yes | Yes | Yes | 45  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
| CA_4A-4A-5A-12A   | -   | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     | 60  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 12 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-5A-13A      | CA_4A-13A <sup>6</sup>  | 4  |  |  | Yes | Yes | Yes | Yes | 40  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 13 |  |  |     | Yes |     |     |     |   |  |
| CA_4A-5A-29A      | -   | 4  |  |  | Yes | Yes | Yes | Yes | 40  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 29 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-5A-30A      | -   | 4  |  |  | Yes | Yes | Yes | Yes | 40  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 30 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-4A-5A-30A   | -   | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     | 60  | 0 |  |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |  |
|                   |   | 30 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-4A-5B-30A   | -   | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |  |     |     |     |     | 70  | 0 |  |
|                   |   | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |  |     |     |     |     |     |   |  |
|                   |   | 30 |  |  | Yes | Yes |     |     |     |   |  |
| CA_4A-5B-30A      | -   | 4  |  |  | Yes | Yes | Yes | Yes | 50  | 0 |  |
|                   |   | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |  |     |     |     |     |     |   |  |

|                  |           |    |  |     |     |     |     |     |    |   |     |
|------------------|-----------|----|--|-----|-----|-----|-----|-----|----|---|-----|
|                  |           | 30 |  |     | Yes | Yes |     |     |    |   |     |
| CA_4A-7A-12A     | -         | 4  |  |     | Yes | Yes |     |     | 40 | 0 |     |
|                  |           | 7  |  |     | Yes | Yes | Yes | Yes |    |   |     |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 4  |  |     | Yes | Yes | Yes | Yes | 50 | 1 |     |
|                  |           | 7  |  |     | Yes | Yes | Yes | Yes |    |   |     |
| 12               |           |    | Yes  | Yes |     |     |     |     |    |   |     |
| CA_4A-7A-28A     | -         | 4  |  |     | Yes | Yes | Yes | Yes | 60 | 0 |     |
|                  |           | 7  |  |     | Yes | Yes | Yes | Yes |    |   |     |
|                  |           | 28 |  |     | Yes | Yes | Yes | Yes |    |   |     |
| CA_4A-12A-30A    | CA_4A-12A | 4  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |     |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 30 |  |     | Yes | Yes |     |     |    |   |     |
| CA_4A-4A-12A-30A | -         | 4  | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60 | 0 |     |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 30 |  |     | Yes | Yes |     |     |    |   |     |
| CA_4A-29A-30A    | -         | 4  |  |     | Yes | Yes | Yes | Yes | 40 | 0 |     |
|                  |           | 29 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 30 |  |     | Yes | Yes |     |     |    |   |     |
| CA_4A-4A-29A-30A | -         | 4  | See CA_4A-4A Bandwidth combination set 0 in Table 5.6A.1-3   |     |     |     |     |     | 60 | 0 |     |
|                  |           | 29 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 30 |  |     | Yes | Yes |     |     |    |   |     |
| CA_5A-7A-28A     | -         | 5  |  |     | Yes | Yes |     |     | 50 | 0 |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
|                  |           | 28 |  |     | Yes | Yes | Yes | Yes |    |   |     |
| CA_5A-7C-28A     | -         | 5  |  |     | Yes | Yes |     |     | 70 | 0 |     |
|                  |           | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     |    |   |     |
| CA_5A-7A-46A     | CA_5A-7A  | 5  |  |     | Yes | Yes |     |     | 50 | 0 |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
|                  |           | 46 |  |     |     |     |     | Yes |    |   |     |
| CA_5A-7A-46C     | CA_5A-7A  | 5  |  |     | Yes | Yes |     |     | 70 | 0 |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
| CA_5A-7A-46D     | -         | 46 | See CA_46C Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     | 90 | 0 |     |
|                  |           | 5  |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
| CA_5A-7A-66A     | -         | 5  |  |     | Yes | Yes |     |     | 50 | 0 |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
|                  |           | 66 |  |     | Yes | Yes | Yes | Yes |    |   |     |
| CA_5A-7A-66A-66A | -         | 5  |  |     | Yes | Yes |     |     | 70 | 0 |     |
|                  |           | 7  |  |     |     | Yes | Yes | Yes |    |   | Yes |
|                  |           | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |    |   |     |
| CA_5A-7C-66A     | -         | 5  |  |     | Yes | Yes |     |     | 70 | 0 |     |
|                  |           | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     |    |   |     |
|                  |           | 66 |  |     | Yes | Yes | Yes | Yes |    |   |     |
| CA_5A-7C-66A-66A | -         | 5  |  |     | Yes | Yes |     |     | 90 | 0 |     |
|                  |           | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     |     |     |    |   |     |
| CA_5A-7C-66A-66A | -         | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     | 90 | 0 |     |
|                  |           | 5  |  |     | Yes | Yes |     |     |    |   |     |
| CA_5A-12A-46A    | -         | 5  |  |     | Yes | Yes |     |     | 40 | 0 |     |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |     |
|                  |           | 46 |  |     |     |     |     | Yes |    |   |     |
| CA_5A-12A-46C    | -         | 5  |  |     | Yes | Yes |     |     | 60 | 0 |     |
|                  |           | 12 |  |     | Yes | Yes |     |     |    |   |     |

|                            |   |    |  |     |     |     |     |     |   |     |
|----------------------------|---|----|--|-----|-----|-----|-----|-----|---|-----|
|                            |   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     |     |   |     |
| CA_5A-12A-46D              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 12 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1         |     |     |     |     | 80  | 0 |     |
| CA_5A-12A-48A              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 12 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 48 |  |     | Yes | Yes | Yes | Yes |   |     |
| CA_5A-12A-48C              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 12 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     | 60  | 0 |     |
| CA_5A-12A-48D              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 12 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 48 | See the CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     | 80  | 0 |     |
| CA_5A-30A-66A              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 30 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 66 |  |     | Yes | Yes | Yes | Yes |   |     |
| CA_5A-30A-66A-66A          | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 30 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     | 60  | 0 |     |
| CA_5B-30A-66A              | - | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1          |     |     |     |     | 50  | 0 |     |
|                            |   | 30 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 66 |  |     | Yes | Yes | Yes |     |   | Yes |
| CA_5B-30A-66A-66A          | - | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1          |     |     |     |     | 70  | 0 |     |
|                            |   | 30 |  |     | Yes | Yes |     |     |   |     |
|                            |   | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |   |     |
| CA_5A-46A-66A              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 |  |     |     |     |     | Yes |   |     |
|                            |   | 66 |  |     | Yes | Yes | Yes | Yes |   |     |
| CA_5A-46E-66A              | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     | 110 | 0 |     |
|                            |   | 66 |  |     | Yes | Yes | Yes |     |   | Yes |
| CA_5A-46A-66A-66A          | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 |  |     |     |     |     | Yes |   |     |
|                            |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     | 70  | 0 |     |
| CA_5A-46C-66A-66A          | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     | 90  | 0 |     |
|                            |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |   |     |
| CA_5A-46D-66A-66A          | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     | 110 | 0 |     |
|                            |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |   |     |
| CA_5A-46E-66A-66A          | - | 5  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1         |     |     |     |     | 130 | 0 |     |
|                            |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |     |     |     |     |     |   |     |
| CA_7A-8A-20A               | - | 7  |  |     |     | Yes | Yes |     |   | Yes |
|                            |   | 8  |  | Yes | Yes | Yes |     |     |   |     |
|                            |   | 20 |  |     | Yes | Yes |     |     |   |     |
| CA_7A-8A-38A <sup>13</sup> | - | 7  |  |     |     | Yes | Yes | Yes |   |     |
|                            |   | 8  |  |     | Yes | Yes |     |     |   |     |
|                            |   | 38 |  |     | Yes | Yes | Yes | Yes |   |     |

|                             |                                      |    |  |     |     |     |     |     |     |   |
|-----------------------------|--------------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
| CA_7A-8A-40A                | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                             |                                      | 8  |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-12A-66A               | -                                    | 5  |  |     | Yes | Yes |     |     | 40  | 0 |
|                             |                                      | 12 |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-40A-41A               | -                                    | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|                             |                                      | 40 |  |     |     | Yes |     | Yes |     |   |
|                             |                                      | 41 |  |     |     |     |     | Yes |     |   |
| CA_5A-46C-66A               | -                                    | 5  |  |     | Yes | Yes |     |     | 70  | 0 |
|                             |                                      | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-46D-66A               | CA_5A-46A<br>CA_5A-66A               | 5  |  |     | Yes | Yes |     |     | 90  | 0 |
|                             |                                      | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-48A-66A               | CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A | 5  |  |     | Yes | Yes |     |     | 50  | 0 |
|                             |                                      | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_5A-48A-66A-66A           | CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A | 5  |  |     | Yes | Yes |     |     | 70  | 0 |
|                             |                                      | 48 |  |     | Yes | Yes | Yes | Yes |     |   |
|                             |                                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-48C-66A               | CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A | 5  |  |     | Yes | Yes |     |     | 70  | 0 |
|                             |                                      | 48 | See CA_48C Bandwidth combination set 0 in Table 1.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |     |   |
| CA_5A-48C-66A-66A           | CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A | 5  |  |     | Yes | Yes |     |     | 90  | 0 |
|                             |                                      | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_5A-48D-66A               | CA_48A-66A<br>CA_5A-48A              | 5  |  |     | Yes | Yes |     |     | 90  | 0 |
|                             |                                      | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |     |   |
| CA_5A-48D-66A-66A           | CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A | 5  |  |     | Yes | Yes |     |     | 110 | 0 |
|                             |                                      | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_7A-8A-40C                | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                             |                                      | 8  |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_7A-12A-66A               | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                             |                                      | 12 |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_7A-12B-66A               | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 55  | 0 |
|                             |                                      | 12 | See CA_12B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_7A-13A-66A               | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 50  | 0 |
|                             |                                      | 13 |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_7C-13A-66A               | -                                    | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1      |     |     |     |     |     | 70  | 0 |
|                             |                                      | 13 |  |     | Yes | Yes |     |     |     |   |
|                             |                                      | 66 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_7A-20A-28A <sup>12</sup> | -                                    | 7  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                             |                                      | 20 |  |     |     | Yes | Yes | Yes |     |   |
|                             |                                      | 28 |  |     | Yes | Yes | Yes | Yes |     |   |

|                             |           |    |   |     |     |     |     |     |   |
|-----------------------------|-----------|----|---|-----|-----|-----|-----|-----|---|
| CA_7A-20A-32A               | CA_7A-20A | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 20 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 32 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-20A-38A <sup>8</sup>  | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 20 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 38 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-26A-66A               | -         | 7  |   |     | Yes | Yes | Yes | 55  | 0 |
|                             |           | 26 |   | Yes | Yes | Yes | Yes |     |   |
|                             |           | 66 |   | Yes | Yes | Yes | Yes |     |   |
| CA_7A-28A-40A               | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 28 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 40 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-28A-40C               | -         | 7  |   |     | Yes | Yes | Yes | 80  | 0 |
|                             |           | 28 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1              |     |     |     |     |     |   |
| CA_7A-20A-42A               | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 20 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 42 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-28A-38A <sup>14</sup> | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 28 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 38 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-29A-66A               | -         | 7  |   |     | Yes | Yes | Yes | 50  | 0 |
|                             |           | 29 |   |     | Yes | Yes |     |     |   |
|                             |           | 66 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-7A-29A-66A            | -         | 7  | See CA_7A-7A Bandwidth combination set 1 in table 5.6A.1-3            |     |     |     |     | 70  | 0 |
|                             |           | 29 |   |     | Yes | Yes |     |     |   |
|                             |           | 66 |   |     | Yes | Yes | Yes |     |   |
| CA_7C-29A-66A               | -         | 7  | See CA_7C Bandwidth combination set 2 in table 5.6A.1-1               |     |     |     |     | 70  | 0 |
|                             |           | 29 |   |     | Yes | Yes |     |     |   |
|                             |           | 66 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-30A-66A               | -         | 7  |   |     | Yes | Yes | Yes | 50  | 0 |
|                             |           | 30 |   |     | Yes | Yes |     |     |   |
|                             |           | 66 |   |     | Yes | Yes | Yes |     |   |
| CA_7A-32A-46A               | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 32 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 46 |   |     |     |     | Yes |     |   |
| CA_7A-32A-46C               | -         | 7  |   |     | Yes | Yes | Yes | 80  | 0 |
|                             |           | 32 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 46 | See CA_46C in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |   |
| CA_7A-32A-46D               | -         | 7  |   |     | Yes | Yes | Yes | 100 | 0 |
|                             |           | 32 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 46 | See CA_46D in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |   |
| CA_7A-32A-46E               | -         | 7  |   |     | Yes | Yes | Yes | 120 | 0 |
|                             |           | 32 |   |     | Yes | Yes | Yes |     |   |
|                             |           | 46 | See CA_46E in Table 5.6A.1-1 of TS 36.101 Bandwidth Combination Set 0 |     |     |     |     |     |   |
| CA_7A-46A-66A               | -         | 7  |   |     | Yes | Yes | Yes | 60  | 0 |
|                             |           | 46 |   |     | Yes |     | Yes |     |   |
|                             |           | 66 |   |     | Yes | Yes | Yes |     |   |
| CA_8A-11A-28A               | -         | 8  |   |     | Yes | Yes |     | 40  | 0 |
|                             |           | 11 |   |     | Yes | Yes |     |     |   |
|                             |           | 28 |   |     | Yes | Yes | Yes |     |   |
| CA_8A-11A-42A               | -         | 8  |   |     | Yes | Yes |     | 40  | 0 |
|                             |           | 11 |   |     | Yes | Yes |     |     |   |
|                             |           | 42 |   |     | Yes | Yes | Yes |     |   |
| CA_8A-11A-42C               | -         | 8  |   |     | Yes | Yes |     | 60  | 0 |
|                             |           | 11 |   |     | Yes | Yes |     |     |   |

|                             |  |    |  |  |            |            |     |     |   |     |
|-----------------------------|--|----|--|--|------------|------------|-----|-----|---|-----|
|                             |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
| CA_8A-20A-28A <sup>15</sup> | -                                      | 8  |  |  | Yes        | Yes        |     | 50  | 0 |     |
|                             |  | 20 |  |  |            | Yes        | Yes |     |   | Yes |
|                             |  | 28 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_8A-28A-41A               | -                                      | 8  |  |  | Yes        | Yes        |     | 50  | 0 |     |
|                             |  | 28 |  |  | Yes        | Yes        | Yes |     |   | Yes |
|                             |  | 41 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_8A-39A-41A               | -                                      | 8  |  |  | Yes        | Yes        |     | 50  | 0 |     |
|                             |  | 39 |  |  |            | Yes        | Yes |     |   | Yes |
|                             |  | 41 |  |  |            |            |     |     |   | Yes |
| CA_12A-30A-66A              | -                                      | 12 |  |  | Yes        | Yes        |     | 40  | 0 |     |
|                             |  | 30 |  |  | Yes        | Yes        |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_12A-30A-66A-66A          | -                                      | 12 |  |  | Yes        | Yes        |     | 60  | 0 |     |
|                             |  | 30 |  |  | Yes        | Yes        |     |     |   |     |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
| CA_13A-46A-66A              | -                                      | 13 |  |  | Yes        | Yes        |     | 50  | 0 |     |
|                             |  | 46 |  |  |            |            | Yes |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-46A-66A-66A          | -                                      | 13 |  |  | Yes        | Yes        |     | 70  | 0 |     |
|                             |  | 46 |  |  |            |            | Yes |     |   |     |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
| CA_13A-46C-66A              | -                                      | 13 |  |  | Yes        | Yes        |     | 70  | 0 |     |
|                             |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-46C-66A-66A          | -                                      | 13 |  |  | Yes        | Yes        |     | 90  | 0 |     |
|                             |  | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
| CA_13A-46D-66A              | CA_13A-66A                             | 13 |  |  | Yes        | Yes        |     | 90  | 0 |     |
|                             |  | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-46D-66A-66A          | -                                      | 13 |  |  | Yes        | Yes        |     | 110 | 0 |     |
|                             |  | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
| CA_13A-46E-66A              | -                                      | 13 |  |  | Yes        | Yes        |     | 110 | 0 |     |
|                             |  | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-48A-66A              | CA_13A-48A<br>CA_13A-66A<br>CA_48A-66A | 13 |  |  | Yes        | Yes        |     | 50  | 0 |     |
|                             |  | 48 |  |  | Yes        | Yes        | Yes |     |   | Yes |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-48A-48A-66A          | CA_13A-48A<br>CA_13A-66A<br>CA_48A-66A | 13 |  |  | Yes        | Yes        |     | 70  | 0 |     |
|                             |  | 48 | See CA_48A-48A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-48C-66A              | CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 13 |  |  | Yes        | Yes        |     | 70  | 0 |     |
|                             |  | 48 | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 |  |  | Yes        | Yes        | Yes |     |   | Yes |
| CA_13A-48C-66A-66A          | CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 13 |  |  | <b>Yes</b> | <b>Yes</b> |     | 90  | 0 |     |
|                             |  | 48 | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |            |            |     |     |   |     |
|                             |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |            |            |     |     |   |     |
|                             | CA_48A-66A                             | 13 |  |  | Yes        | Yes        |     | 90  | 0 |     |

|                    |  |    |  |     |     |     |     |   |
|--------------------|--|----|--|-----|-----|-----|-----|---|
| CA_13A-48D-66A     | CA_13A-48A   | 48 | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     | 110 | 0 |
|                    |  | 66 |  | Yes | Yes | Yes |     |   |
| CA_13A-48D-66A-66A | CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A                 | 13 |  | Yes | Yes |     |     |   |
|                    |  | 48 | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |   |
| CA_13A-48D-66A     | -  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 90  | 0 |
|                    |  | 13 |  | Yes | Yes |     |     |   |
| CA_13A-48E-66A     | -  | 48 | See CA_48E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 110 | 0 |
|                    |  | 66 |  | Yes | Yes | Yes |     |   |
| CA_13A-48A-48C-66A | -  | 13 |  | Yes | Yes |     |     |   |
|                    |  | 48 | See CA_48A-48C Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     | 90  | 0 |
| CA_13A-48A-66A-66A | CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A                 | 66 |  | Yes | Yes | Yes |     |   |
|                    |  | 13 |  | Yes | Yes |     |     |   |
| CA_13A-48A-66B     | -  | 48 |  | Yes | Yes | Yes | Yes |   |
|                    |  | 66 | See CA_66B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 50  | 0 |
| CA_13A-48A-66C     | -  | 13 |  | Yes | Yes |     |     |   |
|                    |  | 48 |  | Yes | Yes | Yes | Yes |   |
| CA_14A-30A-66A     | CA_14A-30A<br>CA_14A-66A                               | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 70  | 0 |
|                    |  | 14 |  | Yes | Yes |     |     |   |
| CA_14A-30A-66A-66A | CA_14A-30A<br>CA_14A-66A                               | 30 |  | Yes | Yes |     |     |   |
|                    |  | 66 |  | Yes | Yes | Yes | Yes |   |
| CA_19A-21A-42A     | CA_19A-21A,<br>CA_19A-42A <sup>6</sup> ,<br>CA_21A-42A | 14 |  | Yes | Yes |     |     |   |
|                    |  | 30 |  | Yes | Yes |     |     |   |
| CA_19A-21A-42C     | CA_19A-21A,<br>CA_19A-42A <sup>6</sup> ,<br>CA_21A-42A | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     | 60  | 0 |
|                    |  | 19 |  | Yes | Yes | Yes |     |   |
| CA_20A-32A-42A     | -  | 21 |  | Yes | Yes | Yes | Yes |   |
|                    |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 70  | 0 |
| CA_20A-32A-43A     | -  | 19 |  | Yes | Yes | Yes |     |   |
|                    |  | 21 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40A     | -  | 42 |  | Yes | Yes | Yes |     |   |
|                    |  | 20 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40A-40A | -  | 32 |  | Yes | Yes | Yes | Yes |   |
|                    |  | 42 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40C     | -  | 20 |  | Yes | Yes | Yes |     |   |
|                    |  | 32 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40D     | -  | 43 |  | Yes | Yes | Yes | Yes |   |
|                    |  | 40 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40D     | -  | 20 |  | Yes | Yes | Yes |     |   |
|                    |  | 38 |  | Yes | Yes | Yes | Yes |   |
| CA_20A-38A-40D     | -  | 40 | See CA_40A-40A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     | 75  | 0 |
|                    |  | 20 |  | Yes | Yes | Yes |     |   |
| CA_20A-38A-40D     | -  | 38 |  | Yes | Yes | Yes | Yes |   |
|                    |  | 40 | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     | 75  | 0 |
| CA_20A-38A-40D     | -  | 20 |  | Yes | Yes | Yes |     |   |
|                    |  | 38 |  | Yes | Yes | Yes | Yes |   |



|                    |                                    |    |  |     |     |     |     |     |     |   |
|--------------------|------------------------------------|----|--|-----|-----|-----|-----|-----|-----|---|
|                    |                                    | 40 | See CA_40D Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_21A-28A-42A     | CA_21A-28A, CA_21A-42A, CA_28A-42A | 21 |  |     | Yes | Yes | Yes |     | 45  | 0 |
|                    |                                    | 28 |  |     | Yes | Yes |     |     |     |   |
|                    |                                    | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_21A-28A-42C     | CA_21A-28A, CA_21A-42A, CA_28A-42A | 21 |  |     | Yes | Yes | Yes |     | 65  | 0 |
|                    |                                    | 28 |  |     | Yes | Yes |     |     |     |   |
|                    |                                    | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_25A-26A-41A     | -                                  | 25 |  | Yes | Yes | Yes | Yes | Yes | 55  | 0 |
|                    |                                    | 26 | Yes  | Yes | Yes | Yes | Yes |     |     |   |
|                    |                                    | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_25A-25A-26A-41A | -                                  | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     | 65  | 0 |
|                    |                                    | 26 |  | Yes | Yes |     |     |     |     |   |
|                    |                                    | 41 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_25A-25A-26A-41C | -                                  | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     | 85  | 0 |
|                    |                                    | 26 |  | Yes | Yes |     |     |     |     |   |
|                    |                                    | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_25A-26A-41C     | -                                  | 25 |  | Yes | Yes | Yes | Yes | Yes | 75  | 0 |
|                    |                                    | 26 | Yes  | Yes | Yes | Yes | Yes |     |     |   |
|                    |                                    | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_25A-25A-26A-41D | -                                  | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     | 105 | 0 |
|                    |                                    | 26 |  | Yes | Yes |     |     |     |     |   |
|                    |                                    | 41 | See CA_41D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_25A-25A-26A-41E | -                                  | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     | 125 | 0 |
|                    |                                    | 26 |  | Yes | Yes |     |     |     |     |   |
|                    |                                    | 41 | See CA_41E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_25A-25A-26A-41F | -                                  | 25 | See CA_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     | 145 | 0 |
|                    |                                    | 26 |  | Yes | Yes |     |     |     |     |   |
|                    |                                    | 41 | See CA_41F Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_28A-41A-42A     | CA_41A-42A                         | 28 |  |     | Yes | Yes |     |     | 50  | 0 |
|                    |                                    | 41 |  |     |     | Yes | Yes | Yes |     |   |
|                    |                                    | 42 |  |     |     | Yes | Yes | Yes |     |   |
| CA_28A-41A-42A-42A | -                                  | 28 |  |     | Yes | Yes |     |     | 70  | 0 |
|                    |                                    | 41 |  |     |     | Yes | Yes | Yes |     |   |
|                    |                                    | 42 | See CA_42A-42A Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_28A-41A-42C     | CA_41A-42A, CA_42C                 | 28 |  |     | Yes | Yes |     |     | 70  | 0 |
|                    |                                    | 41 |  |     |     | Yes | Yes | Yes |     |   |
|                    |                                    | 42 | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
| CA_28A-41A-42A-42C | CA_42C                             | 28 |  |     | Yes | Yes |     |     | 90  | 0 |
|                    |                                    | 41 |  |     |     | Yes | Yes | Yes |     |   |
|                    |                                    | 42 | See CA_42A-42C Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_28A-41A-42C-42C | CA_42C                             | 28 |  |     | Yes | Yes |     |     | 110 | 0 |
|                    |                                    | 41 |  |     |     | Yes | Yes | Yes |     |   |
|                    |                                    | 42 | See CA_42C-42C Bandwidth Combination Set 1 in Table 5.6A.1-3 |     |     |     |     |     |     |   |
| CA_28A-41C-42A     | CA_41A-42A                         | 28 |  |     | Yes | Yes |     |     | 70  | 0 |
|                    |                                    | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |
|                    |                                    | 42 |  |     |     | Yes | Yes | Yes |     |   |
|                    | CA_42C                             | 28 |  |     | Yes | Yes |     |     | 90  | 0 |

|                    |            |    |  |  |     |     |     |     |     |   |
|--------------------|------------|----|--|--|-----|-----|-----|-----|-----|---|
| CA_28A-41C-42C     |            | 41 | See CA_41C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
|                    |            | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_29A-30A-66A     | -          | 29 |  |  | Yes | Yes |     |     | 40  | 0 |
|                    |            | 30 |  |  | Yes | Yes |     |     |     |   |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_29A-30A-66A-66A | -          | 29 |  |  | Yes | Yes |     |     | 60  | 0 |
|                    |            | 30 |  |  | Yes | Yes |     |     |     |   |
|                    |            | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |  |     |     |     |     |     |   |
| CA_29A-46A-66A     | -          | 29 |  |  | Yes | Yes |     |     | 50  | 0 |
|                    |            | 46 |  |  |     |     |     | Yes |     |   |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_29A-66A-70A     | -          | 29 |  |  | Yes | Yes |     |     | 45  | 0 |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    |            | 70 |  |  | Yes | Yes | Yes |     |     |   |
| CA_29A-66A-66A-70A | -          | 29 |  |  | Yes | Yes |     |     | 65  | 0 |
|                    |            | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3     |  |     |     |     |     |     |   |
|                    |            | 70 |  |  | Yes | Yes | Yes |     |     |   |
| CA_29A-66A-70C     | -          | 29 |  |  | Yes | Yes |     |     | 55  | 0 |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    |            | 70 | See CA_70C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
| CA_29A-66A-66A-70C | -          | 29 |  |  | Yes | Yes |     |     | 75  | 0 |
|                    |            | 66 | See the CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |
|                    |            | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_29A-66C-70A     | -          | 29 |  |  | Yes | Yes |     |     | 65  | 0 |
|                    |            | 66 | See CA_66C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     |     |   |
|                    |            | 70 |  |  | Yes | Yes | Yes |     |     |   |
| CA_29A-66C-70C     | -          | 29 |  |  | Yes | Yes |     |     | 75  | 0 |
|                    |            | 66 | See the CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
|                    |            | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
| CA_32A-42A-43A     | -          | 32 |  |  | Yes | Yes | Yes | Yes | 60  | 0 |
|                    |            | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    |            | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_46A-48A-66A     | CA_48A-66A | 46 |  |  |     |     |     | Yes | 60  | 0 |
|                    |            | 48 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_46A-48A-71A     | -          | 46 |  |  |     |     |     | Yes | 60  | 0 |
|                    |            | 48 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    |            | 71 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_46C-48A-48A-71A | -          | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1         |  |     |     |     |     | 100 | 0 |
|                    |            | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3     |  |     |     |     |     |     |   |
|                    |            | 71 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_46A-48C-66A     | CA_48A-66A | 46 |  |  |     |     |     | Yes | 80  | 0 |
|                    |            | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_46A-48D-66A     | -          | 46 |  |  |     |     |     | Yes | 100 | 0 |
|                    |            | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |
|                    |            | 66 |  |  | Yes | Yes | Yes | Yes |     |   |
|                    | -          | 46 |  |  |     |     |     | Yes | 120 | 0 |

|                    |            |    |  |  |     |     |     |    |     |     |
|--------------------|------------|----|--|--|-----|-----|-----|----|-----|-----|
| CA_46A-48E-66A     |            | 48 | See the CA_48E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46C-48A-66A     | CA_48A-66A | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 80  | 0  |     |     |
|                    |            | 48 |  |  | Yes | Yes |     |    | Yes | Yes |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46C-48C-66A     | CA_48A-66A | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 100 | 0  |     |     |
|                    |            | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46C-48D-66A     | -          | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 120 | 0  |     |     |
|                    |            | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46C-48E-66A     | -          | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 140 | 0  |     |     |
|                    |            | 48 | See the CA_48E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46D-48A-66A     | CA_48A-66A | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 100 | 0  |     |     |
|                    |            | 48 |  |  | Yes | Yes |     |    | Yes | Yes |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46D-48C-66A     | CA_48A-66A | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 120 | 0  |     |     |
|                    |            | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46E-48A-66A     | -          | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 120 | 0  |     |     |
|                    |            | 48 |  |  | Yes | Yes |     |    | Yes | Yes |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46E-48C-66A     | -          | 46 | See the CA_46E Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 140 | 0  |     |     |
|                    |            | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |    |     |     |
|                    |            | 66 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46A-48A-48A-71A | -          | 46 |  |  |     |     | Yes | 80 | 0   |     |
|                    |            | 48 | See CA_48A-48A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |    |     |     |
|                    |            | 71 |  |  | Yes | Yes | Yes |    |     | Yes |
| CA_46A-48C-71A     | -          | 46 |  |  |     |     | Yes | 80 | 0   |     |
|                    |            | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |    |     |     |
|                    |            | 71 |  |  | Yes | Yes | Yes |    |     | Yes |
| CA_46C-48A-71A     | -          | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     | 80  | 0  |     |     |
|                    |            | 48 |  |  | Yes | Yes |     |    | Yes | Yes |
|                    |            | 71 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_46C-48C-71A     | -          | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     | 100 | 0  |     |     |
|                    |            | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |    |     |     |
|                    |            | 71 |  |  | Yes | Yes |     |    | Yes | Yes |
| CA_66A-70A-71A     | -          | 66 |  |  | Yes | Yes | Yes | 55 | 0   |     |
|                    |            | 70 |  |  | Yes | Yes | Yes |    |     |     |
|                    |            | 71 |  |  | Yes | Yes | Yes |    |     | Yes |
| CA_66C-70A-71A     | -          | 66 | See the CA_66C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     | 75  | 0  |     |     |
|                    |            | 70 |  |  | Yes | Yes |     |    | Yes |     |
|                    |            | 71 |  |  | Yes | Yes |     |    | Yes | Yes |

|                    |   |    |  |  |     |     |     |     |    |   |
|--------------------|---|----|--|--|-----|-----|-----|-----|----|---|
| CA_66A-70C-71A     | - | 66 |  |  | Yes | Yes | Yes | Yes | 65 | 0 |
|                    |   | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |    |   |
|                    |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66A-66A-70A-71A | - | 66 | See the CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     | 75 | 0 |
|                    |   | 70 |  |  | Yes | Yes | Yes |     |    |   |
|                    |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66A-66A-70C-71A | - | 66 | See the CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     | 85 | 0 |
|                    |   | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |    |   |
|                    |   | 71 |  |  | Yes | Yes | Yes | Yes |    |   |
| CA_66C-70C-71A     | - | 66 | See the CA_66C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     | 85 | 0 |
|                    |   | 70 | See the CA_70C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |    |   |
|                    |   | 71 |  |  |     | Yes | Yes | Yes |    |   |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.

NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

NOTE 4: A terminal which supports a DL CA configuration shall support all the lower order fallback DL CA combinations and it shall support at least one bandwidth combination set for each of the constituent lower order DL combinations containing all the bandwidths specified within each specific combination set of the upper order DL combination.

NOTE 5: Uplink CA configurations are the configurations supported by the present release of specifications.

NOTE 6: If the UE supports any uplink CA configuration for corresponding downlink CA configuration it shall support this uplink CA configuration.

NOTE 7: UL carrier shall be supported in Band 3 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

NOTE 8: UL carrier shall be supported in Band 20 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

NOTE 9: UL carrier is only supported on Band 1 or Band 3 not Band 41 because the fall back mode 1UL/2DL CA\_1A-41A has the limitation that UL carrier is only supported on Band 1.

NOTE 10: UL carrier is only supported on Band 1 or Band 42 not Band 41 because the fall back mode 1UL/2DL CA\_1A-41A has the limitation that UL carrier is only supported on Band 1.

NOTE 11: UL carrier is only supported on Band 1 or Band 5 not Band 41 because the fall back mode 1UL/2DL CA\_1A-41A has the limitation that UL carrier is only supported on Band 1.

NOTE 12: Power imbalance between downlink carriers on Band 20 and Band 28 is assumed to be within [6dB].

NOTE 13: UL carrier shall be supported in Band 8 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

NOTE 14: UL carrier shall be supported in Band 28 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

NOTE 15: Power imbalance between downlink carriers on Band 20 and Band 28 is assumed to be within [6dB].

NOTE 16: UL carrier shall be supported in Band 1 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

**Table 5.6A.1-2b: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (four bands)**

| E-UTRA CA configuration / Bandwidth combination set |  |              |         |       |       |        |        |        |                                    |                           |    |   |
|---|--|--------------|---------|-------|-------|--------|--------|--------|------------------------------------|---------------------------|----|---|
| E-UTRA CA Configuration                             | Uplink CA configurations (NOTE 5)  | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |    |   |
| CA_1A-3A-5A-7A                                      | CA_1A-3A, CA_1A-5A <sup>6</sup> , CA_1A-7A, CA_3A-5A, CA_3A-7A, CA_5A-7A | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 70                                 | 0                         |    |   |
|   |  | 3            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |    |   |
|   |  | 5            |         |       | Yes   | Yes    |        |        |                                    |                           |    |   |
|   |  |              |         | 7     |       |        |        | Yes    | Yes                                | Yes                       | 70 | 1 |
|   |  |              |         | 1     |       |        | Yes    | Yes    | Yes                                | Yes                       |    |   |
|   |  |              |         | 3     |       |        | Yes    | Yes    | Yes                                | Yes                       |    |   |
|   |  |              |         | 5     |       |        | Yes    | Yes    |                                    |                           |    |   |
|   |  | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |    |   |

|                              |   |    |  |    |     |     |     |     |     |     |
|------------------------------|---|----|--|----|-----|-----|-----|-----|-----|-----|
| CA_1A-3A-3A-5A-7A            | -   | 1  |  |    | Yes | Yes | Yes |     | 85  | 0   |
|                              |   | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3     |    |     |     |     |     |     |     |
|                              |   | 5  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 7  |  |    | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-5A-7A-7A            | CA_1A-3A,<br>CA_1A-5A <sup>6</sup> ,<br>CA_1A-7A,<br>CA_3A-5A,<br>CA_3A-7A,<br>CA_5A-7A | 1  |  |    | Yes | Yes | Yes | Yes | 90  | 0   |
|                              |   | 3  |  |    |     | Yes | Yes | Yes |     |     |
|                              |   | 5  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3     |    |     |     |     |     |     |     |
| CA_1A-3A-5A-28A              | -   | 1  |  |    | Yes | Yes | Yes |     | 65  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 5  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 28 |  |    | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-5A-40A              | CA_1A-3A,<br>CA_1A-5A <sup>6</sup> ,<br>CA_3A-5A  | 1  |  |    | Yes | Yes | Yes | Yes | 70  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 5  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 40 |  |    |     | Yes | Yes | Yes |     |     |
| CA_1A-3A-5A-41A <sup>8</sup> | -   | 1  |  |    | Yes | Yes | Yes | Yes | 70  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 5  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 41 |  |    |     |     |     | Yes |     |     |
| CA_1A-3A-7A-7A-26A           | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-26A,<br>CA_3A-7A,<br>CA_3A-26A,<br>CA_7A-26A            | 1  |  |    | Yes | Yes | Yes | Yes | 95  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 7  | See the CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3 |    |     |     |     |     |     |     |
|                              |   | 26 |  |    | Yes | Yes | Yes |     |     |     |
| CA_1A-3A-7A-8A               | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-8A,<br>CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A               | 1  |  |    | Yes | Yes | Yes | Yes | 70  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 7  |  |    |     | Yes | Yes | Yes |     |     |
|                              |   | 8  |  |    | Yes | Yes |     |     |     |     |
|                              |   | 70 | 1  | 1  |     |     | Yes | Yes | Yes | Yes |
|                              |   |    |  | 3  |     |     | Yes | Yes | Yes | Yes |
|                              |   |    |  | 7  |     |     | Yes | Yes | Yes | Yes |
|                              |   |    |  | 8  |     |     | Yes | Yes |     |     |
| CA_1A-3C-7A-8A               | -   | 1  |  |    | Yes | Yes | Yes | Yes | 90  | 0   |
|                              |   | 3  | See the CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |    |     |     |     |     |     |     |
|                              |   | 7  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 8  |  |    | Yes | Yes |     |     |     |     |
| CA_1A-3A-3A-7A-8A            | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-8A,<br>CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A               | 1  |  |    | Yes | Yes | Yes | Yes | 90  | 0   |
|                              |   | 3  | See the CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |    |     |     |     |     |     |     |
|                              |   | 7  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 8  |  |    | Yes | Yes |     |     |     |     |
| CA_1A-3A-7A-7A-8A            | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-8A,<br>CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A               | 1  |  |    | Yes | Yes | Yes | Yes | 90  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 7  | See the CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 |    |     |     |     |     |     |     |
|                              |   | 8  |  |    | Yes | Yes |     |     |     |     |
| CA_1A-3A-3A-7A-7A-8A         | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-8A,<br>CA_3A-7A,<br>CA_3A-8A,<br>CA_7A-8A               | 1  |  |    | Yes | Yes | Yes | Yes | 110 | 0   |
|                              |   | 3  | See the CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |    |     |     |     |     |     |     |
|                              |   | 7  | See the CA_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 |    |     |     |     |     |     |     |
|                              |   | 8  |  |    | Yes | Yes |     |     |     |     |
| CA_1A-3A-7A-20A              | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-20A,<br>CA_3A-7A,<br>CA_3A-20A,<br>CA_7A-20A            | 1  |  |    | Yes | Yes | Yes | Yes | 80  | 0   |
|                              |   | 3  |  |    | Yes | Yes | Yes | Yes |     |     |
|                              |   | 7  |  |    |     | Yes | Yes | Yes |     |     |
|                              |   | 80 | 1  | 20 |     |     | Yes | Yes | Yes | Yes |
|                              |   |    |  | 1  |     |     | Yes | Yes | Yes | Yes |
|                              |   |    |  | 3  |     |     | Yes | Yes | Yes | Yes |

|                    |  |    |  |  |     |     |     |     |     |   |  |
|--------------------|--|----|--|--|-----|-----|-----|-----|-----|---|--|
|                    |  | 7  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-7C-20A    | -  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  |    |  |  |     |     |     |     |     |   |  |
| CA_1A-3C-7A-20A    | -  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 7  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-3A-7A-20A | -  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |   |  |
|                    |  | 7  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-7A-7A-20A | -  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  | See CA_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 |  |     |     |     |     |     |   |  |
|                    |  | 20 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-7A-26A    | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-26A,<br>CA_3A-7A<br>CA_3A-26A,<br>CA_7A-26A                          | 1  |  |  | Yes | Yes | Yes | Yes | 75  | 0 |  |
|                    |  | 3  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 26 |  |  | Yes | Yes | Yes |     |     |   |  |
| CA_1A-3A-7A-28A    | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-28A,<br>CA_3A-7A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_7A-28A           | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |  |
|                    |  | 3  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 7  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 28 |  |  | Yes | Yes | Yes | Yes | 80  | 1 |  |
|                    |  | 1  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  |  |  |     | Yes | Yes | Yes |     |   |  |
| CA_1A-3C-7A-28A    | CA_3C  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 7  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-3A-7C-28A    | CA_1A-3A,<br>CA_1A-7A,<br>CA_1A-28A,<br>CA_3A-7A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_7A-28A,<br>CA_7C | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |  |
|                    |  | 3  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 28 |  |  |     | Yes | Yes | Yes |     |   |  |
| CA_1A-3C-7C-28A    | CA_3C<br>CA_7C   | 1  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |  |
|                    |  | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 7  | See CA_7C Bandwidth Combination Set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-1A-3A-7A-28A | -  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     | 100 | 0 |  |
|                    |  | 3  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  |  |  |     | Yes | Yes | Yes |     |   |  |
|                    |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_1A-1A-3A-7C-28A | CA_7C  | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     | 120 | 0 |  |
|                    |  | 3  |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                    |  | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |   |  |
|                    |  | 28 |  |  | Yes | Yes | Yes | Yes |     |   |  |

|                              |                |    |  |  |     |     |     |     |     |     |
|------------------------------|----------------|----|--|--|-----|-----|-----|-----|-----|-----|
| CA_1A-1A-3C-7A-28A           | CA_3C          | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     | 120 | 0   |     |
|                              |                | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-1A-3C-7C-28A           | CA_3C<br>CA_7C | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     | 140 | 0   |     |
|                              |                | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-1A-3A-3A-7A-28A        | -              | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     | 120 | 0   |     |
|                              |                | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-1A-3A-3A-7C-28A        | CA_7C          | 1  | See CA_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     | 140 | 0   |     |
|                              |                | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                              |                | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_1A-3A-3A-7A-28A           | -              | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                              |                | 3  | See CA_3A-3A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-3A-7C-28A           | CA_7C          | 1  |  |  | Yes | Yes | Yes | Yes | 120 | 0   |
|                              |                | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                              |                | 7  | See CA_7C Bandwidth combination set 2 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-7A-7A-28A           | -              | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 7  | See CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3 |  |     |     |     |     |     |     |
|                              |                | 28 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-7A-32A              | -              | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 32 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-7A-38A <sup>9</sup> | -              | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 38 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3C-7A-38A <sup>9</sup> | -              | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                              |                | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 38 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-7A-40A              | -              | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 40 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_1A-3A-7A-40C              | -              | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |
|                              |                | 7  |  |  | Yes | Yes | Yes |     |     |     |
|                              |                | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1   |  |     |     |     |     |     |     |
| CA_1A-3A-7A-42A              | -              | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                              |                | 3  |  |  | Yes | Yes | Yes | Yes |     |     |

|                  |   |    |  |     |     |     |     |     |     |   |
|------------------|---|----|--|-----|-----|-----|-----|-----|-----|---|
|                  |   | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                  |   | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-7A-46A  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 80  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 46 |  |     |     |     |     | Yes |     |   |
| CA_1A-3A-7A-46C  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 100 | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-3A-7A-46D  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 120 | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-3A-7A-46E  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 140 | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 46 | See CA_46E Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-3A-8A-40A  | CA_1A-3A,<br>CA_1A-8A,<br>CA_3A-8A                  | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  | Yes | Yes | Yes |     |     |     |   |
|                  |   | 40 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-8A-11A  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 60  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 11 |  |     | Yes | Yes |     |     |     |   |
| CA_1A-3A-8A-20A  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 20 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-8A-28A  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-8A-38A  | CA_1A-3A<br>CA_1A-8A<br>CA_3A-8A                    | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 38 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-8A-42A  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-8A-42C  | -   | 1  |  |     | Yes | Yes | Yes | Yes | 90  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 8  |  |     | Yes | Yes |     |     |     |   |
|                  |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-3A-11A-28A | -   | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 11 |  |     | Yes | Yes |     |     |     |   |
|                  |   | 28 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-18A-42A | -   | 1  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 18 |  |     | Yes | Yes | Yes |     |     |   |
|                  |   | 42 |  |     | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-18A-42C | -   | 1  |  |     | Yes | Yes | Yes | Yes | 95  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 18 |  |     | Yes | Yes | Yes |     |     |   |
|                  |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-3A-19A-21A | CA_1A-3A,<br>CA_1A-19A <sup>6</sup> ,<br>CA_1A-21A, | 1  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |
|                  |   | 3  |  |     | Yes | Yes | Yes | Yes |     |   |
|                  |   | 19 |  |     | Yes | Yes | Yes |     |     |   |



|                                  |  |    |   |  |     |     |     |     |     |   |     |
|----------------------------------|--|----|---|--|-----|-----|-----|-----|-----|---|-----|
|                                  | CA_3A-19A,<br>CA_3A-21A,<br>CA_19A-21A   | 21 |   |  | Yes | Yes | Yes |     |     |   |     |
| CA_1A-3A-19A-42A                 | CA_1A-3A,<br>CA_1A-19A <sup>6</sup> ,<br>CA_1A-42A,<br>CA_3A-19A,<br>CA_3A-42A,<br>CA_19A-42A <sup>6</sup> | 1  |   |  | Yes | Yes | Yes | Yes | 75  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 19 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 42 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-3A-19A-21A              | CA_1A-3A<br>CA_1A-19A <sup>6</sup><br>CA_1A-21A,<br>CA_3A-19A<br>CA_3A-21A<br>CA_19A-21A                   | 1  |   |  | Yes | Yes | Yes | Yes | 90  | 0 |     |
|                                  |  | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3    |  |     |     |     |     |     |   |     |
|                                  |  | 19 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 21 |   |  | Yes | Yes | Yes |     |     |   |     |
| CA_1A-3A-19A-42C                 | CA_1A-3A,<br>CA_1A-19A <sup>6</sup> ,<br>CA_1A-42A,<br>CA_3A-19A,<br>CA_3A-42A,<br>CA_19A-42A <sup>6</sup> | 1  |   |  | Yes | Yes | Yes | Yes | 95  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 19 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1      |  |     |     |     |     |     |   |     |
| CA_1A-3A-20A-28A <sup>7</sup>    | -  | 1  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 20 |   |  |     | Yes | Yes | Yes |     |   |     |
|                                  |  | 28 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-3A-20A-28A <sup>7</sup> | -  | 1  |   |  | Yes | Yes | Yes | Yes | 100 | 0 |     |
|                                  |  | 3  | See CA_3A-3A Bandwidth combination set 0 in in Table 5.6A.1-3 |  |     |     |     |     |     |   |     |
|                                  |  | 20 |   |  |     | Yes | Yes | Yes |     |   | Yes |
|                                  |  | 28 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-20A-32A                 | -  | 1  |   |  | Yes | Yes | Yes | Yes | 70  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 20 |   |  |     | Yes |     |     |     |   |     |
|                                  |  | 32 |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 1  |   |  | Yes | Yes | Yes |     | 55  | 1 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 20 |   |  | Yes |     |     |     |     |   |     |
|                                  |  | 32 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-20A-42A                 | -  | 1  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 20 |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 42 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-20A-43A                 | -  | 1  |   |  | Yes | Yes | Yes |     | 55  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 20 |   |  | Yes |     |     |     |     |   |     |
|                                  |  | 43 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-21A-28A                 | CA_1A-3A,<br>CA_1A-21A,<br>CA_1A-28A,<br>CA_3A-21A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_21A-28A              | 1  |   |  | Yes | Yes | Yes | Yes | 65  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 21 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 28 |   |  | Yes | Yes |     |     |     |   |     |
| CA_1A-3A-21A-42A                 | CA_1A-3A,<br>CA_1A-21A,<br>CA_1A-42A,<br>CA_3A-21A,<br>CA_3A-42A,<br>CA_21A-42A                            | 1  |   |  | Yes | Yes | Yes | Yes | 75  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 21 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 42 |   |  | Yes | Yes | Yes | Yes |     |   |     |
| CA_1A-3A-21A-42C                 | CA_1A-3A,<br>CA_1A-21A,<br>CA_1A-42A,<br>CA_3A-21A,<br>CA_3A-42A,<br>CA_21A-42A                            | 1  |   |  | Yes | Yes | Yes | Yes | 95  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 21 |   |  | Yes | Yes | Yes |     |     |   |     |
|                                  |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1      |  |     |     |     |     |     |   |     |
| CA_1A-3A-28A-40A                 | -  | 1  |   |  | Yes | Yes | Yes | Yes | 80  | 0 |     |
|                                  |  | 3  |   |  | Yes | Yes | Yes | Yes |     |   |     |
|                                  |  | 28 |   |  | Yes | Yes | Yes | Yes |     |   |     |

|                   |   |    |  |  |     |     |     |     |     |   |
|-------------------|---|----|--|--|-----|-----|-----|-----|-----|---|
|                   |   | 40 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-28A-40C  | -   | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_1A-3A-28A-42A  | CA_1A-3A,<br>CA_1A-28A,<br>CA_1A-42A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_3A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes | 70  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 28 |  |  | Yes | Yes |     |     |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-28A-42C  | CA_1A-3A,<br>CA_1A-28A,<br>CA_1A-42A,<br>CA_3A-28A <sup>6</sup> ,<br>CA_3A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes | 90  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 28 |  |  | Yes | Yes |     |     |     |   |
|                   |   | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_1A-3A-32A-42A  | -   | 1  |  |  | Yes | Yes | Yes |     | 70  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes |     |     |   |
|                   |   | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-32A-43A  | -   | 1  |  |  | Yes | Yes | Yes |     | 70  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes |     |     |   |
|                   |   | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-41A-42A  | CA_1A-3A<br>CA_1A-42A<br>CA_3A-42A  | 1  |  |  | Yes | Yes | Yes | Yes | 80  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-41C-42A  | CA_1A-3A<br>CA_1A-42A<br>CA_3A-42A  | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-3A-41A-42C  | CA_1A-3A<br>CA_1A-42A<br>CA_1A-42C<br>CA_3A-42A<br>CA_3A-42C<br>CA_42C                        | 1  |  |  | Yes | Yes | Yes | Yes | 100 | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_1A-3A-41C-42C  | CA_1A-3A,<br>CA_1A-42A,<br>CA_1A-42C,<br>CA_3A-42A,<br>CA_3A-42C<br>CA_42C                    | 1  |  |  | Yes | Yes | Yes | Yes | 120 | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
|                   |   | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |
| CA_1A-3A-42A-43A  | -   | 1  |  |  | Yes | Yes | Yes |     | 70  | 0 |
|                   |   | 3  |  |  | Yes | Yes | Yes |     |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-5A-7A-28A   | -   | 1  |  |  | Yes | Yes |     |     | 65  | 0 |
|                   |   | 5  |  |  | Yes | Yes |     |     |     |   |
|                   |   | 7  |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 28 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-20A-32A-42A | -   | 1  |  |  | Yes | Yes | Yes |     | 60  | 0 |
|                   |   | 20 |  |  | Yes |     |     |     |     |   |
|                   |   | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 42 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-20A-32A-43A | -   | 1  |  |  | Yes | Yes | Yes |     | 60  | 0 |
|                   |   | 20 |  |  | Yes |     |     |     |     |   |
|                   |   | 32 |  |  | Yes | Yes | Yes | Yes |     |   |
|                   |   | 43 |  |  | Yes | Yes | Yes | Yes |     |   |
| CA_1A-7A-8A-20A   | -   | 1  |  |  | Yes | Yes | Yes | Yes | 70  | 0 |
|                   |   | 7  |  |  |     | Yes | Yes | Yes |     |   |
|                   |   | 8  |  |  | Yes | Yes |     |     |     |   |

|                               |  |    |  |     |     |     |     |     |     |   |
|-------------------------------|--|----|--|-----|-----|-----|-----|-----|-----|---|
|                               |  | 20 |  |     | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-8A-40A               | -  | 1  |  | Yes | Yes | Yes | Yes |     | 70  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 40 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-5A-7A-46A               | CA_1A-5A <sup>6</sup> ,<br>CA_1A-7A,<br>CA_5A-7A   | 1  |  | Yes | Yes | Yes | Yes |     | 70  | 0 |
|                               |  | 5  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 46 |  |     |     |     |     | Yes |     |   |
| CA_1A-5A-7A-46C               | -  | 1  |  | Yes | Yes | Yes | Yes |     | 90  | 0 |
|                               |  | 5  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-7A-8A-40C               | -  | 1  |  | Yes | Yes | Yes | Yes |     | 90  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-7A-20A-28A <sup>7</sup> | -  | 1  |  | Yes | Yes | Yes | Yes |     | 80  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 20 |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 28 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-20A-32A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 70  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |
|                               |  | 20 |  | Yes | Yes |     |     |     |     |   |
|                               |  | 32 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-20A-42A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 80  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 20 |  | Yes | Yes | Yes | Yes |     |     |   |
|                               |  | 42 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-28A-40A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 80  | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 28 |  | Yes | Yes | Yes | Yes |     |     |   |
|                               |  | 40 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-7A-28A-40C              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 100 | 0 |
|                               |  | 7  |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 28 |  | Yes | Yes | Yes | Yes |     |     |   |
|                               |  | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-8A-11A-28A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 60  | 0 |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 11 |  | Yes | Yes |     |     |     |     |   |
|                               |  | 28 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-8A-11A-42A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 60  | 0 |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 11 |  | Yes | Yes |     |     |     |     |   |
|                               |  | 42 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-8A-11A-42C              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 80  | 0 |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 11 |  | Yes | Yes |     |     |     |     |   |
|                               |  | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |     |   |
| CA_1A-8A-20A-28A              | -  | 1  |  | Yes | Yes | Yes | Yes |     | 70  | 0 |
|                               |  | 8  |  | Yes | Yes |     |     |     |     |   |
|                               |  | 20 |  |     | Yes | Yes | Yes |     |     |   |
|                               |  | 28 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-19A-21A-42A             | CA_1A-19A <sup>6</sup> ,<br>CA_1A-21A,<br>CA_1A-42A,<br>CA_19A-21A,<br>CA_19A-42A <sup>6</sup> ,<br>CA_21A-42A | 1  |  | Yes | Yes | Yes | Yes |     | 70  | 0 |
|                               |  | 19 |  | Yes | Yes | Yes |     |     |     |   |
|                               |  | 21 |  | Yes | Yes | Yes |     |     |     |   |
|                               |  | 42 |  | Yes | Yes | Yes | Yes |     |     |   |
| CA_1A-19A-21A-42C             | CA_1A-19A <sup>6</sup> ,<br>CA_1A-21A,<br>CA_1A-42A,   | 1  |  | Yes | Yes | Yes | Yes |     | 90  | 0 |
|                               |  | 19 |  | Yes | Yes | Yes |     |     |     |   |
|                               |  | 21 |  | Yes | Yes | Yes |     |     |     |   |

|                      |  |    |  |  |     |     |     |     |
|----------------------|--|----|--|--|-----|-----|-----|-----|
|                      | CA_19A-21A,<br>CA_19A-42A <sup>6</sup> ,<br>CA_21A-42A                             | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |
| CA_1A-21A-28A-42A    | CA_1A-21A,<br>CA_1A-28A,<br>CA_1A-42A,<br>CA_21A-28A,<br>CA_21A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 21 |  |  | Yes | Yes | Yes |     |
|                      |  | 28 |  |  | Yes | Yes |     |     |
|                      |  | 42 |  |  | Yes | Yes | Yes | Yes |
| CA_1A-21A-28A-42C    | CA_1A-21A,<br>CA_1A-28A,<br>CA_1A-42A,<br>CA_21A-28A,<br>CA_21A-42A,<br>CA_28A-42A | 1  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 21 |  |  | Yes | Yes | Yes |     |
|                      |  | 28 |  |  | Yes | Yes |     |     |
|                      |  | 42 | See CA_42C Bandwidth combination set 0 in Table 5.6A.1-1   |  |     |     |     |     |
| CA_1A-32A-42A-43A    | -  | 1  |  |  | Yes | Yes | Yes |     |
|                      |  | 32 |  |  | Yes | Yes | Yes | Yes |
|                      |  | 42 |  |  | Yes | Yes | Yes | Yes |
|                      |  | 43 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-2A-5A-12A-66A  | -  | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |
|                      |  | 5  |  |  | Yes | Yes |     |     |
|                      |  | 12 |  |  | Yes | Yes |     |     |
|                      |  | 66 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-2A-5A-30A-66A  | -  | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |
|                      |  | 5  |  |  | Yes | Yes |     |     |
|                      |  | 30 |  |  | Yes | Yes |     |     |
|                      |  | 66 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-2A-7A-12A-66A  | -  | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |
|                      |  | 7  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 12 |  |  | Yes | Yes |     |     |
|                      |  | 66 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-2A-12A-30A-66A | -  | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |
|                      |  | 12 |  |  | Yes | Yes |     |     |
|                      |  | 30 |  |  | Yes | Yes |     |     |
|                      |  | 66 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-2A-14A-30A-66A | CA_2A-14A<br>CA_14A-30A<br>CA_14A-66A  | 2  | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 |  |     |     |     |     |
|                      |  | 14 |  |  | Yes | Yes |     |     |
|                      |  | 30 |  |  | Yes | Yes |     |     |
|                      |  | 66 |  |  | Yes | Yes | Yes | Yes |
| CA_2A-4A-5A-12A      | -  | 2  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 4  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 5  |  |  | Yes | Yes |     |     |
|                      |  | 12 |  |  | Yes | Yes |     |     |
| CA_2A-4A-5A-29A      | CA_2A-4A   | 2  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 4  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 5  |  |  | Yes | Yes |     |     |
|                      |  | 29 |  |  | Yes | Yes |     |     |
| CA_2A-4A-5A-30A      | -  | 2  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 4  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 5  |  |  | Yes | Yes |     |     |
|                      |  | 30 |  |  | Yes | Yes |     |     |
| CA_2A-4A-5B-30A      | -  | 2  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 4  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 5  | See CA_5B Bandwidth combination set 0 in Table 5.6A.1-1    |  |     |     |     |     |
|                      |  | 30 |  |  | Yes | Yes |     |     |
| CA_2A-4A-7A-12A      | -  | 2  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 4  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 7  |  |  | Yes | Yes | Yes | Yes |
|                      |  | 12 |  |  | Yes | Yes |     |     |
|                      | -  | 2  |  |  | Yes | Yes | Yes | Yes |

|                      |   |    |  |     |     |     |     |     |     |     |   |
|----------------------|---|----|--|-----|-----|-----|-----|-----|-----|-----|---|
| CA_2A-4A-12A-30A     |   | 4  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 12 |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 30 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-4A-29A-30A     | - | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0   |   |
|                      |   | 4  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 29 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5A-7A-28A      | - | 30 |  |     | Yes | Yes |     |     | 70  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 7  |  |     |     | Yes | Yes | Yes |     |     |   |
| CA_2A-5A-12A-66A     | - | 28 |  |     | Yes | Yes | Yes | Yes | 60  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 12 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5A-30A-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 60  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 30 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5A-30A-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 60  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 30 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5A-30A-66A-66A | - | 66 |  |     | Yes | Yes | Yes | Yes | 80  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 30 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5B-30A-66A     | - | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     | 70  | 0 |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  | See CA_5B Bandwidth Combination Set 0 in Table 5.6A.1-1      |     |     |     |     |     |     |     |   |
|                      |   | 30 |  |     | Yes | Yes |     |     |     |     |   |
| CA_2A-5A-46A-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 70  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 |  |     |     |     |     | Yes |     |     |   |
| CA_2A-5A-46C-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 90  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |   |
| CA_2A-5A-46D-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 110 | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |   |
| CA_2A-5A-46E-66A     | - | 66 |  |     | Yes | Yes | Yes | Yes | 130 | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |   |
| CA_2A-5A-46A-66A-66A | - | 66 |  |     | Yes | Yes | Yes | Yes | 90  | 0   |   |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 |  |     |     |     |     | Yes |     |     |   |
| CA_2A-5A-46C-66A-66A | - | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |     | 110 | 0 |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |   |
| CA_2A-5A-46D-66A-66A | - | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |     |     |     |     |     |     | 130 | 0 |
|                      |   | 2  |  |     | Yes | Yes | Yes | Yes |     |     |   |
|                      |   | 5  |  |     | Yes | Yes |     |     |     |     |   |
|                      |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |   |
| CA_2A-66A            |   | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 70  | 0   |   |

|                      |  |    |  |     |     |     |     |     |     |   |  |
|----------------------|--|----|--|-----|-----|-----|-----|-----|-----|---|--|
| CA_2A-5A-48A-66A     | CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A<br>CA_2A-5A              | 5  |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-5A-48A-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A<br>CA_2A-5A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                      |  | 5  |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |  |
| CA_2A-5A-48C-66A     | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A<br>CA_2A-5A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                      |  | 5  |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A1-1      |     |     |     |     |     |     |   |  |
|                      |  | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-5A-48C-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A             | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 110 | 0 |  |
|                      |  | 5  |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 | See CA_48C Bandwidth combination set 0 in Table 5.6A1-1      |     |     |     |     |     |     |   |  |
|                      |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |  |
| CA_2A-5A-48D-66A     | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A<br>CA_2A-5A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 110 | 0 |  |
|                      |  | 5  |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A1-1      |     |     |     |     |     |     |   |  |
|                      |  | 66 | Yes  | Yes | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-5A-48D-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_5A-66A<br>CA_5A-48A<br>CA_2A-5A | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 130 | 0 |  |
|                      |  | 5  | Yes  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 48 | See CA_48D Bandwidth combination set 0 in Table 5.6A1-1      |     |     |     |     |     |     |   |  |
|                      |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3 |     |     |     |     |     |     |   |  |
| CA_2A-7A-12A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                      |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 12 |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7A-12B-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 75  | 0 |  |
|                      |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 12 | See CA_12B Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7A-13A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                      |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 13 |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7C-13A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                      |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1      |     |     |     |     |     |     |   |  |
|                      |  | 13 |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7A-26A-66A     | -  | 2  |  | Yes | Yes | Yes | Yes | Yes | 75  | 0 |  |
|                      |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 26 |  | Yes | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 66 |  | Yes | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7A-29A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                      |  | 7  |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      |  | 29 |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
| CA_2A-7C-29A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                      |  | 7  | See CA_7C Bandwidth combination set 1 in Table 5.6A.1-1      |     |     |     |     |     |     |   |  |
|                      |  | 29 |  |     | Yes | Yes |     |     |     |   |  |
|                      |  | 66 |  |     | Yes | Yes | Yes | Yes |     |   |  |
|                      | -  |    |  |     | Yes | Yes | Yes | Yes | 90  | 0 |  |

|                       |   |    |  |  |     |     |     |     |     |     |
|-----------------------|---|----|--|--|-----|-----|-----|-----|-----|-----|
| CA_2A-7A-7A-29A-66A   |   | 7  | See CA_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3   |  |     |     |     |     |     |     |
|                       |   | 29 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 66 |  |  | Yes | Yes | Yes |     |     | Yes |
| CA_2A-7A-46A-66A      | -   | 2  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                       |   | 7  |  |  | Yes | Yes | Yes | Yes |     |     |
|                       |   | 46 |  |  |     | Yes |     | Yes |     |     |
| CA_2A-12A-30A-66A     | -   | 2  |  |  | Yes | Yes | Yes | Yes | 60  | 0   |
|                       |   | 12 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 30 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-12A-30A-66A-66A | -   | 2  |  |  | Yes | Yes | Yes | Yes | 80  | 0   |
|                       |   | 12 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 30 |  |  | Yes | Yes |     |     |     |     |
| CA_2A-13A-46A-66A     | CA_2A-13A   | 2  |  |  | Yes | Yes | Yes | Yes | 70  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 |  |  |     |     |     | Yes |     |     |
| CA_2A-13A-46C-66A     | CA_2A-13A   | 2  |  |  | Yes | Yes | Yes | Yes | 90  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-13A-46D-66A     | CA_2A-13A   | 2  |  |  | Yes | Yes | Yes | Yes | 110 | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-5A-46E-66A      | -   | 2  |  |  | Yes | Yes | Yes | Yes | 130 | 0   |
|                       |   | 5  |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-13A-46A-66A-66A | -   | 2  |  |  | Yes | Yes | Yes | Yes | 90  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 |  |  |     |     |     | Yes |     |     |
| CA_2A-13A-46C-66A-66A | -   | 2  |  |  | Yes | Yes | Yes | Yes | 110 | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 | See CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-13A-46D-66A-66A | -   | 2  |  |  | Yes | Yes | Yes | Yes | 130 | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 46 | See CA_46D Bandwidth combination set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |     |
| CA_2A-13A-48A-66A     | CA_2A-13A<br>CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 2  |  |  | Yes | Yes | Yes | Yes | 70  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 48 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_2A-13A-48A-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A              | 2  |  |  | Yes | Yes | Yes | Yes | 90  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 48 |  |  | Yes | Yes | Yes | Yes |     |     |
| CA_2A-13A-48C-66A     | CA_2A-13A<br>CA_2A-48A  | 2  |  |  | Yes | Yes | Yes | Yes | 90  | 0   |
|                       |   | 13 |  |  | Yes | Yes |     |     |     |     |
|                       |   | 66 | See CA_66A-66A Bandwidth combination set 0 in Table 5.6A.1-3 |  |     |     |     |     |     |     |

|                       |  |    |  |     |     |     |     |     |     |     |
|-----------------------|--|----|--|-----|-----|-----|-----|-----|-----|-----|
|                       | CA_2A-66A<br>CA_13A-66A<br>CA_13A-48A<br>CA_48A-66A              | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes |     |     | Yes |
| CA_2A-13A-48C-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 110 | 0   |
|                       |  | 13 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 48 | See CA_48C Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |     |
| CA_2A-13A-48D-66A     | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 110 | 0   |
|                       |  | 13 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-13A-48D-66A-66A | CA_2A-66A<br>CA_2A-48A<br>CA_48A-66A<br>CA_13A-66A<br>CA_13A-48A | 2  |  |     | Yes | Yes | Yes | Yes | 130 | 0   |
|                       |  | 13 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 48 | See CA_48D Bandwidth combination set 0 in the Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |     |
| CA_2A-13A-46E-66A     | CA_2A-13A  | 2  | Yes  | Yes | Yes | Yes | Yes | Yes | 130 | 0   |
|                       |  | 13 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 46 | See the CA_46E Bandwidth combination set 0 in the Table 5.6A.1-1 |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-13A-48A-48A-66A | CA_2A-13A<br>CA_13A-66A  | 2  |  |     | Yes | Yes | Yes | Yes | 90  | 0   |
|                       |  | 13 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 48 | See CA_48A-48A Bandwidth combination set 0 in the Table 5.6A.1-3 |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-14A-30A-66A     | CA_2A-14A<br>CA_14A-30A<br>CA_14A-66A                            | 2  |  |     | Yes | Yes |     |     | 60  | 0   |
|                       |  | 14 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 30 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-14A-30A-66A-66A | CA_2A-14A<br>CA_14A-30A<br>CA_14A-66A                            | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0   |
|                       |  | 14 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 30 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 66 | See CA_66A-66A Bandwidth Combination Set 0 in Table 5.6A.1-3     |     |     |     |     |     |     |     |
| CA_2A-29A-30A-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 60  | 0   |
|                       |  | 29 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 30 |  |     | Yes | Yes |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-46A-48A-66A     | CA_2A-48A<br>CA_48A-66A  | 2  |  |     | Yes | Yes | Yes | Yes | 80  | 0   |
|                       |  | 46 |  |     |     |     |     | Yes |     |     |
|                       |  | 48 |  |     | Yes | Yes | Yes | Yes |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-46A-48C-66A     | CA_2A-48A<br>CA_48A-66A  | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0   |
|                       |  | 46 |  |     |     |     |     | Yes |     |     |
|                       |  | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-46A-48D-66A     | -  | 2  |  |     | Yes | Yes | Yes | Yes | 120 | 0   |
|                       |  | 46 |  |     |     |     |     | Yes |     |     |
|                       |  | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 66 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-46C-48A-66A     | CA_2A-48A<br>CA_48A-66A  | 2  |  |     | Yes | Yes | Yes | Yes | 100 | 0   |
|                       |  | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |
|                       |  | 48 |  |     | Yes | Yes | Yes | Yes |     |     |
| CA_2A-46C-48C-66A     | CA_2A-48A<br>CA_48A-66A  | 2  |  |     | Yes | Yes | Yes | Yes | 120 | 0   |
|                       |  | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     |     |     |     |



|                               |                         |    |  |     |     |     |     |   |
|-------------------------------|-------------------------|----|--|-----|-----|-----|-----|---|
|                               |                         | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     |     |   |
|                               |                         | 66 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 2  |  | Yes | Yes | Yes | Yes |   |
| CA_2A-46C-48D-66A             | -                       | 46 | See the CA_46C Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     | 140 | 0 |
|                               |                         | 48 | See the CA_48D Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     |     |   |
|                               |                         | 66 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 2  |  | Yes | Yes | Yes | Yes |   |
| CA_2A-46D-48A-66A             | CA_2A-48A<br>CA_48A-66A | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     | 120 | 0 |
|                               |                         | 48 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 66 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 2  |  | Yes | Yes | Yes | Yes |   |
| CA_2A-46D-48C-66A             | CA_2A-48A<br>CA_48A-66A | 46 | See the CA_46D Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     | 140 | 0 |
|                               |                         | 48 | See the CA_48C Bandwidth combination set 0 in Table 5.6A.1-1 |     |     |     |     |   |
|                               |                         | 66 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 2  |  | Yes | Yes | Yes | Yes |   |
| CA_2A-46E-48A-66A             | CA_2A-48A<br>CA_48A-66A | 46 | See CA_46E Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     | 140 | 0 |
|                               |                         | 48 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 66 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-5A-7A-28A               | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 5  |  | Yes | Yes |     |     |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 28 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-5A-7C-28A               | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 5  |  | Yes | Yes |     |     |   |
|                               |                         | 7  | See CA_7C Bandwidth Combination Set 1 in Table 5.6A.1-1      |     |     |     | 90  | 0 |
|                               |                         | 28 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-3A-5A-7A-28A            | -                       | 3  | See CA_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3   |     |     |     | 90  | 0 |
|                               |                         | 5  |  | Yes | Yes |     |     |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 28 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-7A-8A-20A               | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 8  |  | Yes | Yes |     |     |   |
|                               |                         | 20 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-7A-8A-38A <sup>9</sup>  | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 8  |  | Yes | Yes |     |     |   |
|                               |                         | 38 |  | Yes | Yes | Yes | Yes |   |
| CA_3C-7A-8A-38A <sup>1</sup>  | -                       | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1      |     |     |     | 90  | 0 |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 8  |  | Yes | Yes |     |     |   |
|                               |                         | 38 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-7A-8A-40A               | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 8  |  | Yes | Yes |     |     |   |
|                               |                         | 40 |  | Yes | Yes | Yes | Yes |   |
| CA_3A-7A-8A-40C               | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 8  |  | Yes | Yes |     |     |   |
|                               |                         | 40 | See CA_40C Bandwidth combination set 1 in Table 5.6A.1-1     |     |     |     | 90  | 0 |
| CA_3A-7A-20A-28A <sup>7</sup> | -                       | 3  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 7  |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 20 |  | Yes | Yes | Yes | Yes |   |
|                               |                         | 28 |  | Yes | Yes | Yes | Yes |   |

|                               |                                      |    |   |     |     |     |     |     |   |
|-------------------------------|--------------------------------------|----|---|-----|-----|-----|-----|-----|---|
| CA_3C-7A-20A-28A <sup>7</sup> | -                                    | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     | 100 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 20 |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   |     | Yes | Yes | Yes |     |   |
| CA_3A-7A-20A-32A              | CA_3A-7A,<br>CA_3A-20A,<br>CA_7A-20A | 3  |   | Yes | Yes | Yes | Yes | 80  | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 20 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 32 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-20A-42A              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 80  | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 20 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 42 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-28A-38A <sup>9</sup> | -                                    | 3  |   | Yes | Yes | Yes | Yes | 80  | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 38 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3C-7A-28A-38A <sup>9</sup> | -                                    | 3  | See CA_3C Bandwidth combination set 0 in Table 5.6A.1-1     |     |     |     |     | 100 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 38 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-28A-40A              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 80  | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 40 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-7A-28A-40C              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 100 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 40 | See CA_40C Bandwidth combination set 0 in Table 5.6A.1-1    |     |     |     |     |     |   |
| CA_3A-7A-32A-46A              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 80  | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 32 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 46 |   |     |     |     | Yes |     |   |
| CA_3A-7A-32A-46C              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 100 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 32 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 46 | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     |     |     |   |
| CA_3A-7A-32A-46D              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 120 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 32 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 46 | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1    |     |     |     |     |     |   |
| CA_3A-7A-32A-46E              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 140 | 0 |
|                               |                                      | 7  |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 32 |   | Yes | Yes | Yes | Yes |     |   |
|                               |                                      | 46 | See CA_46E of Bandwidth Combination Set 0 in Table 5.6A.1-1 |     |     |     |     |     |   |
| CA_3A-8A-11A-28A              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 60  | 0 |
|                               |                                      | 8  |   | Yes | Yes |     |     |     |   |
|                               |                                      | 11 |   | Yes | Yes |     |     |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-8A-20A-28A              | -                                    | 3  |   | Yes | Yes | Yes | Yes | 70  | 0 |
|                               |                                      | 8  |   | Yes | Yes |     |     |     |   |
|                               |                                      | 20 |   |     | Yes | Yes | Yes |     |   |
|                               |                                      | 28 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-19A-21A-42A             | -                                    | 3  |   | Yes | Yes | Yes | Yes | 70  | 0 |
|                               |                                      | 19 |   | Yes | Yes | Yes |     |     |   |
|                               |                                      | 21 |   | Yes | Yes | Yes |     |     |   |
|                               |                                      | 42 |   | Yes | Yes | Yes | Yes |     |   |
| CA_3A-19A-21A-42C             | -                                    | 3  |   | Yes | Yes | Yes | Yes | 90  | 0 |
|                               |                                      | 19 |   | Yes | Yes | Yes |     |     |   |
|                               |                                      | 21 |   | Yes | Yes | Yes |     |     |   |

|                   |                       |    |  |  |     |     |     |     |     |   |  |
|-------------------|-----------------------|----|--|--|-----|-----|-----|-----|-----|---|--|
|                   |                       | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
| CA_3A-20A-32A-42A | -                     | 3  |  |  | Yes | Yes | Yes |     | 60  | 0 |  |
|                   |                       | 20 |  |  | Yes |     |     |     |     |   |  |
|                   |                       | 32 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                   |                       | 42 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_3A-20A-32A-43A | -                     | 3  |  |  | Yes | Yes | Yes |     | 60  | 0 |  |
|                   |                       | 20 |  |  | Yes |     |     |     |     |   |  |
|                   |                       | 32 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                   |                       | 43 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_3A-21A-28A-42A | -                     | 3  |  |  | Yes | Yes | Yes | Yes | 65  | 0 |  |
|                   |                       | 21 |  |  | Yes | Yes | Yes |     |     |   |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 42 |  |  | Yes | Yes | Yes | Yes |     |   |  |
| CA_3A-21A-28A-42C | -                     | 3  |  |  | Yes | Yes | Yes | Yes | 85  | 0 |  |
|                   |                       | 21 |  |  | Yes | Yes | Yes |     |     |   |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
| CA_3A-28A-41A-42A | CA_3A-41A, CA_41A-42A | 3  |  |  | Yes | Yes | Yes | Yes | 70  | 0 |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 41 |  |  |     | Yes | Yes | Yes |     |   |  |
|                   |                       | 42 |  |  |     | Yes | Yes | Yes |     |   |  |
| CA_3A-28A-41A-42C | CA_42C                | 3  |  |  | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 41 |  |  |     | Yes | Yes | Yes |     |   |  |
|                   |                       | 42 | See CA_42C Bandwidth combination set 1 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
| CA_3A-28A-41C-42A | -                     | 3  |  |  | Yes | Yes | Yes | Yes | 90  | 0 |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 41 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1     |  |     |     |     |     |     |   |  |
|                   |                       | 42 |  |  |     | Yes | Yes | Yes |     |   |  |
| CA_3A-28A-41C-42C | CA_42C                | 3  |  |  | Yes | Yes | Yes | Yes | 110 | 0 |  |
|                   |                       | 28 |  |  | Yes | Yes |     |     |     |   |  |
|                   |                       | 41 | See the CA_41C Bandwidth combination set 0 in Table 5.6A.1-1 |  |     |     |     |     |     |   |  |
|                   |                       | 42 | See the CA_42C Bandwidth combination set 1 in Table 5.6A.1-1 |  |     |     |     |     |     |   |  |
| CA_3A-32A-42A-43A | -                     | 3  |  |  | Yes | Yes | Yes |     | 75  | 0 |  |
|                   |                       | 32 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                   |                       | 42 |  |  | Yes | Yes | Yes | Yes |     |   |  |
|                   |                       | 43 |  |  | Yes | Yes | Yes | Yes |     |   |  |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.

NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

NOTE 4: A terminal which supports a DL CA configuration shall support all the lower order fallback DL CA combinations and it shall support at least one bandwidth combination set for each of the constituent lower order DL combinations containing all the bandwidths specified within each specific combination set of the upper order DL combination.

NOTE 5: Uplink CA configurations are the configurations supported by the present release of specifications.

NOTE 6: If the UE supports any uplink CA configuration for corresponding downlink CA configuration it shall support this uplink CA configuration.

NOTE 7: Power imbalance between downlink carriers on Band 20 and Band 28 is assumed to be within [6dB].

NOTE 8: UL carrier is only supported on Band 1, Band 3 or Band 5 not Band 41 because the fall back mode 2DL/1UL CA\_1A-41A has the limitation that UL carrier is only supported on Band 1.

NOTE 9: UL carrier shall be supported in Band 1, 3, 8 or 28 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within [6dB].

**Table 5.6A.1-2c: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (five bands)**

|   |
|---|
| E-UTRA CA configuration / Bandwidth combination set |
|---|

| E-UTRA CA Configuration          | Uplink CA configurations (NOTE 5) | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
|----------------------------------|-----------------------------------|--------------|---------|-------|-------|--------|--------|--------|------------------------------------|---------------------------|
| CA_1A-3A-5A-7A-28A               | -                                 | 1            |         |       | Yes   | Yes    | Yes    |        | 85                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 5            |         |       | Yes   | Yes    |        |        |                                    |                           |
|                                  |                                   | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 28           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-7A-8A-20A               | -                                 | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 90                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 8            |         |       | Yes   | Yes    |        |        |                                    |                           |
|                                  |                                   | 20           |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-7A-20A-28A <sup>7</sup> | -                                 | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 100                                | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 20           |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 28           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-7A-20A-32A              | -                                 | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 100                                | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 20           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 32           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-7A-20A-42A              | -                                 | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 100                                | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 7            |         |       |       | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 20           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 42           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-8A-11A-28A              | -                                 | 1            |         |       | Yes   | Yes    | Yes    | Yes    | 80                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 8            |         |       | Yes   | Yes    |        |        |                                    |                           |
|                                  |                                   | 11           |         |       | Yes   | Yes    |        |        |                                    |                           |
|                                  |                                   | 28           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-20A-32A-42A             | -                                 | 1            |         |       | Yes   | Yes    | Yes    |        | 75                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    |        |                                    |                           |
|                                  |                                   | 20           |         |       | Yes   |        |        |        |                                    |                           |
|                                  |                                   | 32           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 42           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-20A-32A-43A             | -                                 | 1            |         |       | Yes   | Yes    | Yes    |        | 75                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    |        |                                    |                           |
|                                  |                                   | 20           |         |       | Yes   |        |        |        |                                    |                           |
|                                  |                                   | 32           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 43           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
| CA_1A-3A-32A-42A-43A             | -                                 | 1            |         |       | Yes   | Yes    | Yes    |        | 90                                 | 0                         |
|                                  |                                   | 3            |         |       | Yes   | Yes    | Yes    |        |                                    |                           |
|                                  |                                   | 32           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 42           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |
|                                  |                                   | 43           |         |       | Yes   | Yes    | Yes    | Yes    |                                    |                           |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.

NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

NOTE 4: A terminal which supports a DL CA configuration shall support all the lower order fallback DL CA combinations and it shall support at least one bandwidth combination set for each of the constituent lower order DL combinations containing all the bandwidths specified within each specific combination set of the upper order DL combination.

NOTE 5: Uplink CA configurations are the configurations supported by the present release of specifications.

NOTE 6: If the UE supports uplink CA for corresponding downlink CA it shall support this uplink CA configuration.

NOTE 7: Power imbalance between downlink carriers on Band 20 and Band 28 is assumed to be within [6dB].

**Table 5.6A.1-3: E-UTRA CA configurations and bandwidth combination sets defined for non-contiguous intra-band CA (with two sub-blocks)**

| E-UTRACA configuration | Uplink CA configurations (NOTE 1) | E-UTRA CA configuration / Bandwidth combination set         |  |  |                                      |                                      |                                    |                           |
|------------------------|-----------------------------------|---|--|--|--------------------------------------|--------------------------------------|------------------------------------|---------------------------|
|                        |                                   | Component carriers in order of increasing carrier frequency |  |  |                                      |                                      | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
|                        |                                   | Channel bandwidths for carrier [MHz]                        | Channel bandwidths for carrier [MHz]                     | Channel bandwidths for carrier [MHz]                     | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |                                    |                           |
| CA_1A-1A               | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 0                         |
| CA_2A-2A               | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 0                         |
| CA_3A-3A               | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 0                         |
|                        |                                   | 5, 10   | 5, 10, 15, 20  |  |                                      |                                      | 30                                 | 1                         |
|                        |                                   | 5   | 3  |  |                                      |                                      | 10                                 | 2                         |
|                        |                                   | 3, 5  | 5  |  |                                      |                                      |                                    |                           |
| CA_4A-4A               | CA_4A-4A                          | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 0                         |
|                        |                                   | 5, 10   | 5, 10  |  |                                      |                                      | 20                                 | 1                         |
| CA_5A-5A               | -                                 | 5,10  | 5,10   |  |                                      |                                      | 20                                 | 0                         |
|                        |                                   | 3   | 5  |  |                                      |                                      | 8                                  | 1                         |
| CA_7A-7A               | -                                 | 5   | 15   |  |                                      |                                      | 40                                 | 0                         |
|                        |                                   | 10  | 10, 15   |  |                                      |                                      |                                    |                           |
|                        |                                   | 15  | 15, 20   |  |                                      |                                      |                                    |                           |
|                        |                                   | 20  | 20   |  |                                      |                                      | 40                                 | 1                         |
|                        |                                   | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 30                                 | 2                         |
|                        |                                   | 10, 15, 20  | 10, 15, 20   |  |                                      |                                      | 40                                 | 3                         |
| CA_12A-12A             | -                                 | 5   | 5  |  |                                      |                                      | 10                                 | 0                         |
| CA_23A-23A             | -                                 | 5   | 10   |  |                                      |                                      | 15                                 | 0                         |
| CA_25A-25A             | -                                 | 5, 10   | 5, 10  |  |                                      |                                      | 20                                 | 0                         |
|                        |                                   | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 1                         |
| CA_40A-40A             | -                                 | 10, 20  | 10, 20   |  |                                      |                                      | 40                                 | 0                         |
|                        |                                   | 10,15,20  | 10,15,20   |  |                                      |                                      | 40                                 | 1                         |
| CA_40A-40C             | CA_40C                            | 20  | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  |                                      |                                      | 60                                 | 0                         |
|                        |                                   | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1    |  | 20   |                                      |                                      |                                    |                           |
| CA_40C-40C             | CA_40C                            | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1    |  | See CA_40C Bandwidth Combination Set 1 in Table 5.6A.1-1 |                                      |                                      | 80                                 | 0                         |
| CA_41A-41A             | -                                 | 10, 15, 20  | 10, 15, 20   |  |                                      |                                      | 40                                 | 0                         |
|                        |                                   | 5, 10, 15, 20   | 5, 10, 15, 20  |  |                                      |                                      | 40                                 | 1                         |
| CA_41A-41C             | CA_41C                            | 5, 10, 15, 20   | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  |                                      |                                      | 60                                 | 0                         |

|                         |        |  |  |  |    |     |   |  |
|-------------------------|--------|--|--|--|----|-----|---|--|
|                         |        | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | 5, 10, 15, 20  |  |    |     |   |  |
| CA_41A-41D              | CA_41C | 5, 10, 15, 20  | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 80 | 0   |   |  |
|                         |        | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |    |     |   |  |
| CA_41C-41C              | CA_41C | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 80 | 0   |   |  |
| CA_41C-41D              | CA_41C | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |    | 100 | 0 |  |
|                         |        | See CA_41D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | See CA_41C Bandwidth Combination Set 0 in Table 5.6A.1-1 |    |     |   |  |
| CA_42A-42A              | -      | 5, 10, 15, 20  | 5, 10, 15, 20  |  |    | 40  | 0 |  |
|                         |        | 10, 15, 20   | 10, 15, 20   |  |    | 40  | 1 |  |
| CA_42A-42C              | CA_42C | 5, 10, 15, 20  | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 60 | 0   |   |  |
|                         |        | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |    |     |   |  |
|                         |        | 10, 15, 20   | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  | 60 | 1   |   |  |
|                         |        | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  | 10, 15, 20   |    |     |   |  |
| CA_42A-42D              | -      | 5, 10, 15, 20  | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |    | 80  | 0 |  |
|                         |        | See CA_42D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |    |     |   |  |
| CA_42C-42C              | CA_42C | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 |    | 80  | 0 |  |
|                         |        | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  | See CA_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 |    | 80  | 1 |  |
| CA_43A-43A              | -      | 5, 10, 15, 20  | 5, 10, 15, 20  |  |    | 40  | 0 |  |
| CA_46A-46A <sup>2</sup> | -      | 20   | 20   |  |    | 40  | 0 |  |
| CA_46A-46C <sup>2</sup> | -      | 20   | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 60 | 0   |   |  |
|                         |        | See CA_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 20   |    |     |   |  |
| CA_46A-46D <sup>2</sup> | -      | 20   | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |    | 80  | 0 |  |
|                         |        | See CA_46D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |  | 20 |     |   |  |
| CA_48A-48A              | -      | 5, 10, 15, 20  | 5, 10, 15, 20  |  |    | 40  | 0 |  |
| CA_48A-48C              | -      | 5, 10, 15, 20  | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 60 | 0   |   |  |
|                         |        | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |    |     |   |  |
| CA_48A-48D              | -      | 5, 10, 15, 20  | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |    | 80  | 0 |  |
|                         |        | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |    |     |   |  |

|            |        |  |  |  |               |     |   |
|------------|--------|--|--|--|---------------|-----|---|
| CA_48C-48C | CA_48C | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 80            | 0   |   |
| CA_48C-48D | -      | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 100           | 0   |   |
|            |        | See CA_48D Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | See CA_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 |               |     |   |
| CA_48A-48E | -      | 5, 10, 15, 20  | See CA_48E Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |               | 100 | 0 |
|            |        | See CA_48E Bandwidth Combination Set 0 in Table 5.6A.1-1 |  |  | 5, 10, 15, 20 |     |   |
| CA_66A-66A | -      | 5, 10, 15, 20  | 5, 10, 15, 20  |  | 40            | 0   |   |
| CA_66A-66B | -      | 5, 10, 15, 20  | See CA_66B Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 40            | 0   |   |
|            |        | See CA_66B Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |               |     |   |
| CA_66A-66C | -      | 5, 10, 15, 20  | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 60            | 0   |   |
|            |        | See CA_66C Bandwidth Combination Set 0 in Table 5.6A.1-1 |  | 5, 10, 15, 20  |               |     |   |

NOTE 1: Uplink CA configurations are the configurations supported by the present release of specifications.

NOTE 2: Restricted to E-UTRA operation when inter-band carrier aggregation is configured. The downlink operating band is paired with the uplink operating band (external) of the carrier aggregation configuration that is supporting the configured Pcell.

**Table 5.6A.1-4: E-UTRA CA configurations and bandwidth combination sets defined for non-contiguous intra-band CA (with three sub-blocks)**

| E-UTRACA configuration | Uplink CA configurations (NOTE 1) | E-UTRA CA configuration / Bandwidth combination set         |  |  |                                      |                                      | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
|------------------------|-----------------------------------|---|--|--|--------------------------------------|--------------------------------------|------------------------------------|---------------------------|
|                        |                                   | Component carriers in order of increasing carrier frequency |  |  |                                      |                                      |                                    |                           |
|                        |                                   | Channel bandwidths for carrier [MHz]                        | Channel bandwidths for carrier [MHz]                     | Channel bandwidths for carrier [MHz]                     | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |                                    |                           |
| CA_25A-25A-25A         | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  | 5, 10, 15, 20  |                                      |                                      | 60                                 | 0                         |
| CA_41A-41A-41A         | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  | 5, 10, 15, 20  |                                      |                                      | 60                                 | 0                         |
| CA_41A-41A-41C         | CA_41C                            | 5, 10, 15, 20   | 5, 10, 15, 20  | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 |                                      |                                      | 80                                 | 0                         |
|                        |                                   | 5, 10, 15, 20   | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 |  | 5, 10, 15, 20                        |                                      |                                    |                           |
|                        |                                   | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1    |  | 5, 10, 15, 20  | 5, 10, 15, 20                        |                                      |                                    |                           |
| CA_48A-48A-48A         | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  | 5, 10, 15, 20  |                                      |                                      | 60                                 | 0                         |
| CA_66A-66A-66A         | -                                 | 5, 10, 15, 20   | 5, 10, 15, 20  | 5, 10, 15, 20  |                                      |                                      | 60                                 | 0                         |

**Table 5.6A.1-5: E-UTRA CA configurations and bandwidth combination sets defined for non-contiguous intra-band CA (with four sub-blocks)**

| E-UTRACA configuration | Uplink CA configurations (NOTE 1) | E-UTRA CA configuration / Bandwidth combination set         |                    |                    |                    |                    | Maximum aggregated | Bandwidth combination set |
|------------------------|-----------------------------------|---|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|
|                        |                                   | Component carriers in order of increasing carrier frequency |                    |                    |                    |                    |                    |                           |
|                        |                                   | Channel bandwidths  | Channel bandwidths | Channel bandwidths | Channel bandwidths | Channel bandwidths |                    |                           |

|                        |   | for carrier<br>[MHz] | for carrier<br>[MHz] | for carrier<br>[MHz] | for carrier<br>[MHz] | for carrier<br>[MHz] | bandwidth<br>[MHz] |   |
|------------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|---|
| CA_48A-48A-<br>48A-48A | - | 5, 10, 15, 20        | 5, 10, 15,<br>20     | 5, 10, 15,<br>20     | 5, 10, 15,<br>20     |                      | 80                 | 0 |

## 5.6B Channel bandwidth for UL-MIMO

The requirements specified in subclause 5.6 are applicable to UE supporting UL-MIMO.

### 5.6B.1 Void

## 5.6C Channel bandwidth for Dual Connectivity

For E-UTRA DC bands specified in 5.5C, the corresponding E-UTRA CA configurations in 5.6A.1, i.e., dual uplink inter-band carrier aggregation with uplink assigned to two E-UTRA bands, are applicable to Dual Connectivity.

NOTE 1: Requirements for the dual connectivity configurations are defined in the section corresponding E-UTRA uplink CA configurations, unless otherwise specified.

NOTE 2: For TDD inter-band dual connectivity configurations, requirements are applicable only for synchronous operation.

### 5.6C.1 Void

**Table 5.6C.1-1: Void**

**Table 5.6C.1-2: Void**

## 5.6D Channel bandwidth for ProSe

### 5.6D.1 Channel bandwidths per operating band for ProSe

The ProSe combination of channel bandwidths and operating bands is shown in Table 5.6D.1-1 and Table 5.6D.1-2. The transmission bandwidth configuration in Table 5.6D.1-1 and Table 5.6D.1-2 shall be supported for each of the specified channel bandwidths. The same (symmetrical) channel bandwidth is specified for both the TX and RX path.

**Table 5.6D.1-1 ProSe Direct Discovery channel bandwidth**

| E-UTRA<br>ProSe<br>Band | E-UTRA ProSe band / ProSe channel bandwidth |       |       |        |        |        |
|-------------------------|---|-------|-------|--------|--------|--------|
|                         | 1.4 MHz                                     | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 2                       |   |       | Yes   | Yes    | Yes    | Yes    |
| 3                       |   |       | Yes   | Yes    | Yes    | Yes    |
| 4                       |   |       | Yes   | Yes    | Yes    | Yes    |
| 7                       |   |       | Yes   | Yes    | Yes    | Yes    |
| 14                      |   |       | Yes   | Yes    |        |        |
| 20                      |   |       | Yes   | Yes    | Yes    | Yes    |
| 26                      |   |       | Yes   | Yes    | Yes    |        |
| 28                      |   |       | Yes   | Yes    | Yes    | Yes    |
| 31                      |   |       | Yes   |        |        |        |
| 41                      |   |       | Yes   | Yes    | Yes    | Yes    |



|    |  |  |     |     |     |  |
|----|--|--|-----|-----|-----|--|
| 68 |  |  | Yes | Yes | Yes |  |
| 72 |  |  | Yes |     |     |  |

Table 5.6D.1-2 ProSe Direct Communication channel bandwidth

| E-UTRA ProSe band / ProSe channel bandwidth |         |       |       |        |        |        |
|---|---------|-------|-------|--------|--------|--------|
| E-UTRA ProSe Band                           | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 3   |         |       |       | Yes    |        |        |
| 7   |         |       |       | Yes    |        |        |
| 14  |         |       |       | Yes    |        |        |
| 20  |         |       |       | Yes    |        |        |
| 26  |         |       |       | Yes    |        |        |
| 28  |         |       |       | Yes    |        |        |
| 31  |         |       | Yes   |        |        |        |
| 68  |         |       | Yes   | Yes    |        |        |
| 72  |         |       | Yes   |        |        |        |

## 5.6F Channel bandwidth for category NB1 and NB2

Channel bandwidth for Category NB1 and NB2 is 200 kHz.

For category NB1 and NB2, requirements in present document are specified for the channel bandwidth listed in Table 5.6F-1.

**Table 5.6F-1: Transmission bandwidth configuration  $N_{RB}$ ,  $N_{tone\ 15kHz}$  and  $N_{tone\ 3.75kHz}$  in NB1 and NB2 channel bandwidth**

|  |            |
|--|------------|
| <b>Channel bandwidth<br/><math>BW_{Channel}</math> [kHz]</b> | <b>200</b> |
| Transmission bandwidth configuration $N_{RB}$                | 1          |
| Transmission bandwidth configuration $N_{tone\ 15kHz}$       | 12         |
| Transmission bandwidth configuration $N_{tone\ 3.75kHz}$     | 48         |

Figure 5.6F-1 shows the relation between the Category NB1/NB2 channel bandwidth ( $BW_{Channel}$ ) and the Category NB1/NB2 transmission bandwidth configuration ( $N_{tone}$ ). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at  $F_C \pm BW_{Channel}/2$ .

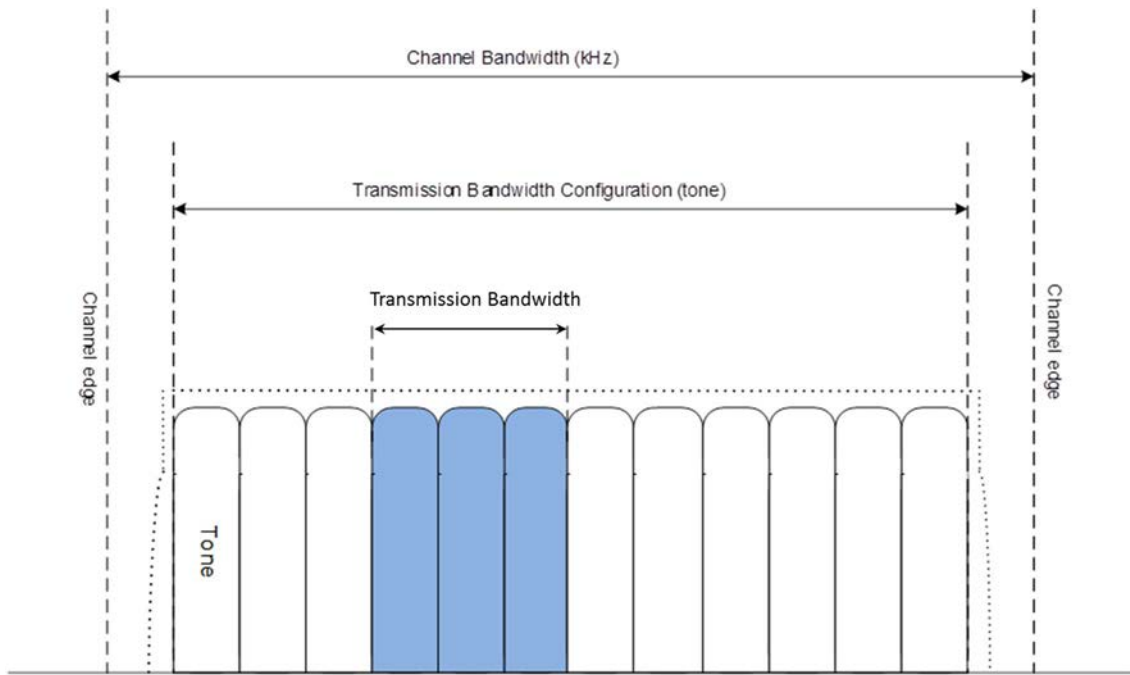


Figure 5.6F-1 Definition of Channel Bandwidth and Transmission Bandwidth configuration

## 5.6G Channel bandwidth for V2X Communication

### 5.6G.1 Channel bandwidths per operating band for V2X Communication

E-UTRA V2X Communication channel bandwidths and operating band is shown in Table 5.6G.1-1. The same (symmetrical) channel bandwidth is specified for both the TX and RX path.

Table 5.6G.1-1: V2X Communication channel bandwidth

| E-UTRA V2X band / V2X channel bandwidth |         |       |       |        |        |        |
|---|---------|-------|-------|--------|--------|--------|
| E-UTRA V2X Operating Band               | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 47                                      |         |       |       | Yes    |        | Yes    |

For V2X inter-band con-current operation, the V2X Communication channel bandwidths for each operating band is specified in Table 5.6G.1-2.

Table 5.6G.1-2: Inter-band con-current V2X configurations and bandwidth combination sets

| Inter-band con-current V2X configuration | Inter-band con-current V2X configuration for TX | E-UTRA or V2X operating Bands | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum bandwidth [MHz] | Bandwidth combination set |
|--|---|-------------------------------|---|-------|-------|--------|--------|--------|-------------------------|---------------------------|
| V2X_3A-47A                               | V2X_3A-47A                                      | 3                             | Yes   | Yes   | Yes   | Yes    | Yes    | Yes    | 40                      | 0                         |
|  |   | 47                            |   |       |       | Yes    |        | Yes    |                         |                           |
| V2X_3A-47B                               | V2X_3A-47A, V2X_47B                             | 3                             | Yes   | Yes   | Yes   | Yes    | Yes    | Yes    | 40                      | 0                         |
|  |   | 47                            | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |       |       |        |        |        |                         |                           |
| V2X_5A-47A                               | V2X_5A-47A                                      | 5                             |   |       | Yes   | Yes    |        |        | 30                      | 0                         |
|  |   | 47                            |   |       |       | Yes    |        | Yes    |                         |                           |
| V2X_5A-47B                               | V2X_5A-47A,                                     | 5                             | Yes   | Yes   | Yes   | Yes    | Yes    | Yes    | 40                      | 0                         |

|             |                      |    |   |     |     |     |     |     |    |   |
|-------------|----------------------|----|---|-----|-----|-----|-----|-----|----|---|
|             | V2X_47B              | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_7A-47A  | V2X_7A-47A           | 7  |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_7A-47B  | V2X_7A-47A, V2X_47B  | 7  |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_8A-47A  | V2X_8A-47A           | 8  | Yes   | Yes | Yes | Yes |     |     | 30 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_8A-47B  | V2X_8A-47A, V2X_47B  | 8  | Yes   | Yes | Yes | Yes |     |     | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_20A-47A | V2X_20A-47A          | 20 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_20A-47B | V2X_20A-47A, V2X_47B | 20 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_28A-47A |                      | 28 |   | Yes | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_34A-47A | V2X_34A-47A          | 34 |   |     | Yes | Yes | Yes |     | 35 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_34A-47B | V2X_34A-47A, V2X_47B | 34 |   |     | Yes | Yes | Yes |     | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_39A-47A | V2X_39A-47A          | 39 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_39A-47B | V2X_39A-47A, V2X_47B | 39 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_39A-47C | V2X_39A-47A, V2X_47C | 39 |   |     | Yes | Yes | Yes | Yes | 50 | 0 |
|             |                      | 47 | See V2X_47C Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_41A-47A | V2X_41A-47           | 41 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |
| V2X_41A-47B | V2X_41A-47A, V2X_47B | 41 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 | See V2X_47B Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_41A-47C | V2X_41A-47A, V2X_47C | 41 |   |     | Yes | Yes | Yes | Yes | 50 | 0 |
|             |                      | 47 | See V2X_47C Bandwidth combination set 0 in Table 5.6G.1-4 |     |     |     |     |     |    |   |
| V2X_71A-47A |                      | 71 |   |     | Yes | Yes | Yes | Yes | 40 | 0 |
|             |                      | 47 |   |     |     | Yes |     | Yes |    |   |

V2X Bandwidth Class is specified in Table 5.6G.1-3 for V2X intra-band contiguous multi-carrier operation.

**Table 5.6G.1-3: V2X bandwidth classes and corresponding nominal guard bands**

| V2X Bandwidth Class | Aggregated Transmission Bandwidth Configuration | Number of contiguous CC | Nominal Guard Band BW <sub>GB</sub>                             |
|---------------------|---|-------------------------|---|
| A                   | $N_{RB,agg} \leq 100$                           | 1                       | $0.05BW_{Channel(1)} - 0.5\Delta f_1$                           |
| B                   | $25 < N_{RB,agg} \leq 100$                      | 2                       | $[0.05 \max(BW_{Channel(1)}, BW_{Channel(2)}) - 0.5\Delta f_1]$ |
| C                   | $100 < N_{RB,agg} \leq 200$                     | 2                       | $[0.05 \max(BW_{Channel(1)}, BW_{Channel(2)}) - 0.5\Delta f_1]$ |
| C <sub>1</sub>      | $100 < N_{RB,agg} \leq 200$                     | 3                       | $[0.05 \max(BW_{Channel(1)}, BW_{Channel(2)}) - 0.5\Delta f_1]$ |
| D                   | $200 < N_{RB,agg} \leq 300$                     | 3                       | NOTE 3  |
| E                   | $300 < N_{RB,agg} \leq 400$                     | 4                       | NOTE 3  |
| F                   | $400 < N_{RB,agg} \leq 500$                     | 5                       | NOTE 3  |
| I                   | $700 < N_{RB,agg} \leq 800$                     | 8                       | NOTE 3  |

|  |
|--|
| NOTE 1: $BW_{Channel(j)}$ , $j = 1, 2, 3, 4$ is the channel bandwidth of an E-UTRA component carrier according to Table 5.6-1 and $\Delta f_1 = \Delta f$ for the downlink with $\Delta f$ the subcarrier spacing while $\Delta f_1 = 0$ for the uplink. |
| NOTE 2: Void   |
| NOTE 3: Applicable for later releases.   |

For V2X intra-band multi-carrier operation, the V2X communication channel bandwidths for each operating band is specified in Table 5.6G.1-4.

**Table 5.6G.1-4: V2X intra-band multi-carrier configurations**

|  |   | V2X multi-carrier configuration / Bandwidth combination set |                                      |                                      |                                      |                                      |                                    |                           |
|--|---|---|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|---------------------------|
| V2X intra-band multi-carrier configuration | V2X intra-band multi-carrier configuration for TX | Component carriers in order of increasing carrier frequency |                                      |                                      |                                      |                                      | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
|  |   | Channel bandwidths for carrier [MHz]                        | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |                                    |                           |
| V2X_47B                                    | V2X_47B   | 10  | 10                                   |                                      |                                      |                                      | 20                                 | 0                         |
| V2X_47C                                    | V2X_47C   | 10  | 20                                   |                                      |                                      |                                      | 30                                 | 0                         |
|  |   | 20  | 10                                   |                                      |                                      |                                      |                                    |                           |
| V2X_47C1                                   | V2X_47B   | 10  | 10                                   | 10                                   |                                      |                                      | 30                                 | 0                         |

## 5.7 Channel arrangement

### 5.7.1 Channel spacing

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent E-UTRA carriers is defined as following:

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2$$

where  $BW_{Channel(1)}$  and  $BW_{Channel(2)}$  are the channel bandwidths of the two respective E-UTRA carriers. The channel spacing can be adjusted to optimize performance in a particular deployment scenario.

#### 5.7.1A Channel spacing for CA

For intra-band contiguous carrier aggregation with two or more component carriers, the nominal channel spacing between two adjacent E-UTRA component carriers is defined as the following unless stated otherwise:

$$\text{Nominal channel spacing} = \left\lceil \frac{BW_{Channel(1)} + BW_{Channel(2)} - 0.1|BW_{Channel(1)} - BW_{Channel(2)}|}{0.6} \right\rceil 0.3 \text{ [MHz]}$$

where  $BW_{Channel(1)}$  and  $BW_{Channel(2)}$  are the channel bandwidths of the two respective E-UTRA component carriers according to Table 5.6-1 with values in MHz. The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of 300 kHz less than the nominal channel spacing to optimize performance in a particular deployment scenario.

For intra-band contiguous carrier aggregation with two or more component carriers in Band 46, the requirements apply for both 19.8 MHz and 20.1 MHz nominal carrier spacing between two 20 MHz component carriers, and for 15.0 MHz nominal carrier spacing between 10 MHz and 20 MHz component carriers.

For intra-band non-contiguous carrier aggregation the channel spacing between two or more E-UTRA component carriers in different sub-blocks shall be larger than the nominal channel spacing defined in this subclause.

### 5.7.1F Channel spacing for category NB1 and NB2

Nominal channel spacing for UE category NB1 and NB2 in stand-alone mode is 200 kHz. For in-band and guard-band cases the nominal channel spacing between two adjacent category NB1 or NB2 carriers is 180 kHz.

### 5.7.2 Channel raster

The channel raster is 100 kHz for all bands, which means that the carrier centre frequency must be an integer multiple of 100 kHz.

#### 5.7.2A Channel raster for CA

For carrier aggregation the channel raster is 100 kHz for all bands, which means that the carrier centre frequency must be an integer multiple of 100 kHz.

#### 5.7.2F Channel raster for category NB1 and NB2

Channel raster for category NB1 and NB2 in-band, guard-band and standalone operation is 100 kHz.

### 5.7.3 Carrier frequency and EARFCN

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 – 262143. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where  $F_{DL\_low}$  and  $N_{Offs-DL}$  are given in Table 5.7.3-1 and  $N_{DL}$  is the downlink EARFCN.

$$F_{DL} = F_{DL\_low} + 0.1(N_{DL} - N_{Offs-DL})$$

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where  $F_{UL\_low}$  and  $N_{Offs-UL}$  are given in Table 5.7.3-1 and  $N_{UL}$  is the uplink EARFCN.

$$F_{UL} = F_{UL\_low} + 0.1(N_{UL} - N_{Offs-UL})$$

**Table 5.7.3-1: E-UTRA channel numbers**

| E-UTRA Operating Band | Downlink            |               |                   | Uplink              |               |                   |
|-----------------------|---------------------|---------------|-------------------|---------------------|---------------|-------------------|
|                       | $F_{DL\_low}$ (MHz) | $N_{Offs-DL}$ | Range of $N_{DL}$ | $F_{UL\_low}$ (MHz) | $N_{Offs-UL}$ | Range of $N_{UL}$ |
| 1                     | 2110                | 0             | 0 – 599           | 1920                | 18000         | 18000 – 18599     |
| 2                     | 1930                | 600           | 600 – 1199        | 1850                | 18600         | 18600 – 19199     |
| 3                     | 1805                | 1200          | 1200 – 1949       | 1710                | 19200         | 19200 – 19949     |
| 4                     | 2110                | 1950          | 1950 – 2399       | 1710                | 19950         | 19950 – 20399     |
| 5                     | 869                 | 2400          | 2400 – 2649       | 824                 | 20400         | 20400 – 20649     |
| 6                     | 875                 | 2650          | 2650 – 2749       | 830                 | 20650         | 20650 – 20749     |
| 7                     | 2620                | 2750          | 2750 – 3449       | 2500                | 20750         | 20750 – 21449     |
| 8                     | 925                 | 3450          | 3450 – 3799       | 880                 | 21450         | 21450 – 21799     |
| 9                     | 1844.9              | 3800          | 3800 – 4149       | 1749.9              | 21800         | 21800 – 22149     |
| 10                    | 2110                | 4150          | 4150 – 4749       | 1710                | 22150         | 22150 – 22749     |
| 11                    | 1475.9              | 4750          | 4750 – 4949       | 1427.9              | 22750         | 22750 – 22949     |
| 12                    | 729                 | 5010          | 5010 – 5179       | 699                 | 23010         | 23010 – 23179     |
| 13                    | 746                 | 5180          | 5180 – 5279       | 777                 | 23180         | 23180 – 23279     |
| 14                    | 758                 | 5280          | 5280 – 5379       | 788                 | 23280         | 23280 – 23379     |
| ...                   |                     |               |                   |                     |               |                   |
| 17                    | 734                 | 5730          | 5730 – 5849       | 704                 | 23730         | 23730 – 23849     |
| 18                    | 860                 | 5850          | 5850 – 5999       | 815                 | 23850         | 23850 – 23999     |
| 19                    | 875                 | 6000          | 6000 – 6149       | 830                 | 24000         | 24000 – 24149     |
| 20                    | 791                 | 6150          | 6150 – 6449       | 832                 | 24150         | 24150 – 24449     |
| 21                    | 1495.9              | 6450          | 6450 – 6599       | 1447.9              | 24450         | 24450 – 24599     |
| 22                    | 3510                | 6600          | 6600 – 7399       | 3410                | 24600         | 24600 – 25399     |
| 23                    | 2180                | 7500          | 7500 – 7699       | 2000                | 25500         | 25500 – 25699     |
| 24                    | 1525                | 7700          | 7700 – 8039       | 1626.5              | 25700         | 25700 – 26039     |
| 25                    | 1930                | 8040          | 8040 – 8689       | 1850                | 26040         | 26040 – 26689     |

|                 |          |       |               |        |        |                 |
|-----------------|----------|-------|---------------|--------|--------|-----------------|
| 26              | 859      | 8690  | 8690 – 9039   | 814    | 26690  | 26690 – 27039   |
| 27              | 852      | 9040  | 9040 – 9209   | 807    | 27040  | 27040 – 27209   |
| 28              | 758      | 9210  | 9210 – 9659   | 703    | 27210  | 27210 – 27659   |
| 29 <sup>2</sup> | 717      | 9660  | 9660 – 9769   | N/A    |        |                 |
| 30              | 2350     | 9770  | 9770 – 9869   | 2305   | 27660  | 27660 – 27759   |
| 31              | 462.5    | 9870  | 9870 – 9919   | 452.5  | 27760  | 27760 – 27809   |
| 32 <sup>2</sup> | 1452     | 9920  | 9920 – 10359  | N/A    |        |                 |
| 33              | 1900     | 36000 | 36000 – 36199 | 1900   | 36000  | 36000 – 36199   |
| 34              | 2010     | 36200 | 36200 – 36349 | 2010   | 36200  | 36200 – 36349   |
| 35              | 1850     | 36350 | 36350 – 36949 | 1850   | 36350  | 36350 – 36949   |
| 36              | 1930     | 36950 | 36950 – 37549 | 1930   | 36950  | 36950 – 37549   |
| 37              | 1910     | 37550 | 37550 – 37749 | 1910   | 37550  | 37550 – 37749   |
| 38              | 2570     | 37750 | 37750 – 38249 | 2570   | 37750  | 37750 – 38249   |
| 39              | 1880     | 38250 | 38250 – 38649 | 1880   | 38250  | 38250 – 38649   |
| 40              | 2300     | 38650 | 38650 – 39649 | 2300   | 38650  | 38650 – 39649   |
| 41              | 2496     | 39650 | 39650 – 41589 | 2496   | 39650  | 39650 – 41589   |
| 42              | 3400     | 41590 | 41590 – 43589 | 3400   | 41590  | 41590 – 43589   |
| 43              | 3600     | 43590 | 43590 – 45589 | 3600   | 43590  | 43590 – 45589   |
| 44              | 703      | 45590 | 45590 – 46589 | 703    | 45590  | 45590 – 46589   |
| 45              | 1447     | 46590 | 46590 – 46789 | 1447   | 46590  | 46590 – 46789   |
| 46              | 5150     | 46790 | 46790 – 54539 | 5150   | 46790  | 46790 – 54539   |
| 47              | 5855     | 54540 | 54540 – 55239 | 5855   | 54540  | 54540 – 55239   |
| 48              | 3550     | 55240 | 55240 – 56739 | 3550   | 55240  | 55240 – 56739   |
| 49              | 3550     | 56740 | 56740 – 58239 | 3550   | 56740  | 56740 – 58239   |
| 50              | 1432     | 58240 | 58240 – 59089 | 1432   | 58240  | 58240 – 59089   |
| 51              | 1427     | 59090 | 59090 – 59139 | 1427   | 59090  | 59090 – 59139   |
| 52              | 3300     | 59140 | 59140 – 60139 | 3300   | 59140  | 59140 – 60139   |
| 53              | 2483.5   | 60140 | 60140 – 60254 | 2483.5 | 60140  | 60140 – 60254   |
| ...             |          |       |               |        |        |                 |
| 64              | Reserved |       |               |        |        |                 |
| 65              | 2110     | 65536 | 65536 – 66435 | 1920   | 131072 | 131072 – 131971 |
| 66 <sup>5</sup> | 2110     | 66436 | 66436 – 67335 | 1710   | 131972 | 131972 – 132671 |
| 67 <sup>2</sup> | 738      | 67336 | 67336 – 67535 | N/A    |        |                 |
| 68              | 753      | 67536 | 67536 – 67835 | 698    | 132672 | 132672 – 132971 |
| 69 <sup>2</sup> | 2570     | 67836 | 67836 – 68335 | N/A    |        |                 |
| 70 <sup>6</sup> | 1995     | 68336 | 68336 – 68585 | 1695   | 132972 | 132972 – 133121 |
| 71              | 617      | 68586 | 68586 – 68935 | 663    | 133122 | 133122 – 133471 |
| 72              | 461      | 68936 | 68936 – 68985 | 451    | 133472 | 133472 – 133521 |
| 73              | 460      | 68986 | 68986 – 69035 | 450    | 133522 | 133522 – 133571 |
| 74              | 1475     | 69036 | 69036 – 69465 | 1427   | 133572 | 133572 – 134001 |
| 75 <sup>2</sup> | 1432     | 69466 | 69466 – 70315 | N/A    |        |                 |
| 76 <sup>2</sup> | 1427     | 70316 | 70316 – 70365 | N/A    |        |                 |
| 85              | 728      | 70366 | 70366 – 70545 | 698    | 134002 | 134002 – 134181 |
| 87              | 420      | 70546 | 70546 – 70595 | 410    | 134182 | 134182 – 134231 |
| 88              | 422      | 70596 | 70596 – 70645 | 412    | 134232 | 134232 – 134281 |

NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.

NOTE 2: Restricted to E-UTRA operation when carrier aggregation is configured.

NOTE 3: For ProSe and V2X the corresponding UL channel number are also specified for the DL for the associated ProSe/V2X operating bands i.e. ProSe\_F<sub>UL</sub> = F<sub>UL</sub> and ProSe\_F<sub>DL</sub> = F<sub>UL</sub>; V2X\_F<sub>UL</sub> = F<sub>DL</sub> and V2X\_F<sub>DL</sub> = F<sub>UL</sub>.

NOTE 4: Requirements for uplink operations are not specified in this version of the specification.

NOTE 5: The range 2180-2200 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured.

NOTE 6: The range 2010-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 300 MHz. The range 2005-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 295 MHz.

### 5.7.3F Carrier frequency and EARFCN for category NB1 and NB2

The carrier frequency of category NB1/NB2 in the downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 – 262143 and the Offset of category NB1/NB2 Channel Number to EARFCN in the range  $\{-10,-9,-8,-7,-6,-5,-4,-3,-2,-1,-0.5,0,1,2,3,4,5,6,7,8,9\}$  for FDD and in the range  $\{-10,-9,-8.5,-8,-7,-6,-5,-4.5,-4,-3,-2,-1,-0.5,0,1,2,3,3.5,4,5,6,7,7.5,8,9\}$  for TDD. The relation between EARFCN, Offset of category NB1/NB2 Channel Number to EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where  $F_{DL}$  is the downlink carrier frequency of category NB1/NB2,  $F_{DL\_low}$  and  $N_{Offs-DL}$  are given in table 5.7.3-1,  $N_{DL}$  is the downlink EARFCN,  $M_{DL}$  is the Offset of category NB1/NB2 Channel Number to downlink EARFCN.

$$F_{DL} = F_{DL\_low} + 0.1(N_{DL} - N_{Offs-DL}) + 0.0025*(2M_{DL}+1)$$

The carrier frequency of category NB1/NB2 in the uplink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 –262143, and the Offset of category NB1/NB2 Channel Number to EARFCN in the range  $\{-10,-9,-8,-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9\}$  for FDD and in the range  $\{-11,-10,-9.5,-9,-8.5,-8,-7.5,-7,-6.5,-6,-5.5,-5,-4.5,-4,-3.5,-3,-2.5,-2,-1.5,-1,-0.5,0,0.5,1,1.5,2,2.5,3,3.5,4,4.5,5,5.5,6,6.5,7,7.5,8,8.5,9,9.5,10,11\}$  for TDD. The relation between EARFCN, Offset of category NB1/NB2 Channel Number to EARFCN and the carrier frequency in MHz for the uplink is given by the following equation, where  $F_{UL}$  is the uplink carrier frequency of category NB1/NB2,  $F_{UL\_low}$  and  $N_{Offs-UL}$  are given in table 5.7.3-1,  $N_{UL}$  is the uplink EARFCN,  $M_{UL}$  is the Offset of category NB1/NB2 Channel Number to uplink EARFCN.

$$F_{UL} = F_{UL\_low} + 0.1(N_{UL} - N_{Offs-UL}) + 0.0025*(2M_{UL})$$

NOTE 1: For category NB1/NB2,  $N_{DL}$  or  $N_{UL}$  is different than the value of EARFCN that corresponds to E-UTRA downlink or uplink carrier frequency for in-band and guard band operation.

NOTE 2: For FDD  $M_{DL} = -0.5$  is not applicable for in-band and guard band operation. For TDD  $M_{DL} \{-0.5,+3.5,-4.5,+7.5,-8.5\}$  is not applicable for in-band and guard band operation.

NOTE 3: For the carrier including NPSS/NSSS for in-band and guard band operation,  $M_{DL}$  is selected from  $\{-2,-1,0,1\}$ .

NOTE 4: For the carrier including NPSS/NSSS for stand-alone operation,  $M_{DL} = -0.5$ .

### 5.7.4 TX–RX frequency separation

a) The default E-UTRA TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation is specified in Table 5.7.4-1 for the TX and RX channel bandwidths defined in Table 5.6.1-1

**Table 5.7.4-1: Default UE TX-RX frequency separation**

| E-UTRA Operating Band | TX – RX carrier centre frequency separation |
|-----------------------|---|
| 1                     | 190 MHz                                     |
| 2                     | 80 MHz.                                     |
| 3                     | 95 MHz.                                     |
| 4                     | 400 MHz                                     |
| 5                     | 45 MHz                                      |
| 6                     | 45 MHz                                      |
| 7                     | 120 MHz                                     |
| 8                     | 45 MHz                                      |
| 9                     | 95 MHz                                      |
| 10                    | 400 MHz                                     |
| 11                    | 48 MHz                                      |
| 12                    | 30 MHz                                      |
| 13                    | -31 MHz                                     |
| 14                    | -30 MHz                                     |
| 17                    | 30 MHz                                      |
| 18                    | 45 MHz                                      |
| 19                    | 45 MHz                                      |
| 20                    | -41 MHz                                     |

| E-UTRA Operating Band | TX – RX carrier centre frequency separation |
|-----------------------|---|
| 21                    | 48 MHz                                      |
| 22                    | 100 MHz                                     |
| 23                    | 180 MHz                                     |
| 24                    | -101.5 <sup>1</sup> , -120.5 MHz            |
| 25                    | 80 MHz                                      |
| 26                    | 45 MHz                                      |
| 27                    | 45 MHz                                      |
| 28                    | 55 MHz                                      |
| 30                    | 45 MHz                                      |
| 31                    | 10 MHz                                      |
| 65                    | 190 MHz                                     |
| 66                    | 400 MHz                                     |
| 68                    | 55 MHz                                      |
| ...                   |   |
| 70                    | 295, 300MHz <sup>1</sup>                    |
| 71                    | -46 MHz                                     |
| 72                    | 10 MHz                                      |
| 73                    | 10 MHz                                      |
| 74                    | 48 MHz                                      |
| 85                    | 30 MHz                                      |
| 87                    | 10 MHz                                      |
| 88                    | 10 MHz                                      |

NOTE 1: Default TX-RX carrier centre frequency separation.

b) The use of other TX channel to RX channel carrier centre frequency separation is not precluded and is intended to form part of a later release.

### 5.7.4A TX–RX frequency separation for CA

For intra-band contiguous carrier aggregation, the same TX-RX frequency separation as specified in Table 5.7.4-1 is applied to PCC and SCC, respectively.

### 5.7.4E TX–RX frequency separation for category M1 and M2

For the category M1 and M2 TX-RX frequency separation is flexible within the assigned channel bandwidth of E-UTRA carrier with the TX-RX frequency separation of the E-UTRA carriers as specified in Table 5.7.4-1.

### 5.7.4F TX–RX frequency separation for category NB1 and NB2

For in-band and guard-band operation mode, the category NB1 and NB2 TX-RX frequency separation is flexible within the assigned channel bandwidth of E-UTRA carrier with the TX-RX frequency separation of the E-UTRA carriers as specified in Table 5.7.4-1. For stand-alone operation mode the default TX-RX frequency separation is the same as Table 5.7.4-1.

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## 6 Transmitter characteristics

### 6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single or multiple transmit antenna(s). For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

Unless otherwise stated, NB1 and NB2 requirements specified for an E-UTRA band shall also apply for the re-farmed NR band (e.g. if NB1/NB2 requirements are specified for E-UTRA band 1, they shall also apply for NR band n1).



## 6.2 Transmit power

### 6.2.1 Void

### 6.2.2 UE maximum output power

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non CA configuration unless otherwise stated. The period of measurement shall be at least as defined in Table 6.2.2-0.

**Table 6.2.2-0: Measurement period for UE maximum output power**

| TTI pattern | Minimum measurement period |
|-------------|----------------------------|
| Subframe    | 1ms                        |
| Slot        | 70S                        |
| Subslot     | 20S, 30S                   |

**Table 6.2.2-1: UE Power Class**

| EUTRA band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm)   | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|------------|---------------|----------------|---------------|----------------|-----------------|----------------|---------------|----------------|
| 1          |               |                |               |                | 23              | $\pm 2$        |               |                |
| 2          |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 3          | 31            | +2/-3          |               |                | 23              | $\pm 2^2$      |               |                |
| 4          |               |                |               |                | 23              | $\pm 2$        |               |                |
| 5          |               |                |               |                | 23              | $\pm 2$        |               |                |
| 6          |               |                |               |                | 23              | $\pm 2$        |               |                |
| 7          |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 8          |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 9          |               |                |               |                | 23              | $\pm 2$        |               |                |
| 10         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 11         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 12         |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 13         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 14         | 31            | +2/-3          |               |                | 23              | $\pm 2$        |               |                |
| 17         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 18         |               |                |               |                | 23              | $\pm 2^5$      |               |                |
| 19         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 20         | 31            | +2/-3          |               |                | 23              | $\pm 2^2$      |               |                |
| 21         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 22         |               |                |               |                | 23              | $+2/-3.5^2$    |               |                |
| 23         |               |                |               |                | 23 <sup>6</sup> | $\pm 2^6$      |               |                |
| 24         |               |                |               |                | 23              | $+2/-3^2$      |               |                |
| 25         |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 26         |               |                |               |                | 23              | $\pm 2^2$      |               |                |
| 27         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 28         | 31            | +2/-3          |               |                | 23              | $+2/-2.5$      |               |                |
| 30         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 31         | 31            | +2/-3          |               |                | 23              | $\pm 2$        |               |                |
| ...        |               |                |               |                |                 |                |               |                |
| 33         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 34         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 35         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 36         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 37         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 38         |               |                | 26            | $\pm 2$        | 23              | $\pm 2$        |               |                |
| 39         |               |                |               |                | 23              | $\pm 2$        |               |                |
| 40         |               |                | 26            | $\pm 2$        | 23              | $\pm 2$        |               |                |
| 41         |               |                | 26            | $\pm 2^2$      | 23              | $\pm 2^2$      |               |                |
| 42         |               |                | 26            | $+2/-3$        | 23              | $+2/-3$        |               |                |

|  |    |       |    |    |    |                 |  |  |
|--|----|-------|----|----|----|-----------------|--|--|
| 43   |    |       |    |    | 23 | +2/-3           |  |  |
| 44   |    |       |    |    | 23 | +2/[-3]         |  |  |
| 45   |    |       |    |    | 23 | ±2              |  |  |
| ...  |    |       |    |    |    |                 |  |  |
| 47   |    |       | 26 | ±2 | 23 | ±2              |  |  |
| 48   |    |       |    |    | 23 | +2/-3           |  |  |
| 50   |    |       |    |    | 23 | ±2              |  |  |
| 51   |    |       |    |    | 23 | ±2              |  |  |
| 52   |    |       |    |    | 23 | +2/-3           |  |  |
| 53   |    |       |    |    | 23 | ±2              |  |  |
| 65   |    |       |    |    | 23 | ±2              |  |  |
| 66   |    |       |    |    | 23 | ±2              |  |  |
| 68   |    |       |    |    | 23 | ±2              |  |  |
| ...  |    |       |    |    |    |                 |  |  |
| 70   |    |       |    |    | 23 | ±2              |  |  |
| 71   |    |       |    |    | 23 | +2/-2.5         |  |  |
| 72   | 31 | +2/-3 |    |    | 23 | ±2              |  |  |
| 73   |    |       |    |    | 23 | ±2              |  |  |
| 74   |    |       |    |    | 23 | ±2              |  |  |
| 85   |    |       |    |    | 23 | ±2 <sup>2</sup> |  |  |
| 87   | 31 | +2/-3 |    |    | 23 | ±2              |  |  |
| 88   | 31 | +2/-3 |    |    | 23 | ±2              |  |  |
| NOTE 1: Void<br>NOTE 2: <sup>2</sup> refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB<br>NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.<br>NOTE 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance<br>NOTE 5: For a UE that supports both Band 18 and Band 26, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB for transmission bandwidths confined within 815 MHz and 818 MHz.<br>NOTE 6: When NS_20 is signalled, the total output power within 2000-2005 MHz shall be limited to 7 dBm.<br>NOTE 7: Void.<br>NOTE 8: Generally, PC1 UE is not targeted for smartphone form factor.<br>NOTE 9: Void. |    |       |    |    |    |                 |  |  |

The default power class  $P_{PowerClass\_Default}$  for an operating band is Power Class 3 unless otherwise stated.

For a power class 2 capable UE operating on Band 41, when an IE  $P-max$  as defined in TS 36.331 [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6, the requirements for power class 2 are not applicable, and the corresponding requirements for a power class 3 UE shall apply.

For each supported frequency band other than Band 14 and Band 41, the UE shall:

- if the UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:
  - if the band is a TDD band whose frame configuration is 0 or 6; or
  - if the IE  $P-Max$  as defined in TS 36.331 [7] is not provided; or
  - if the IE  $P-Max$  as defined in TS 36.331 [7] is provided and set to the maximum output power of the default power class or lower;
    - meet all requirements for the default power class of the operating band in which the UE is operating and set its configured transmitted power as specified in sub-clause 6.2.5;
- else (i.e the IE  $P-Max$  as defined in TS 36.331 [7] is provided and set to the higher value than the maximum output power of the default power class):
  - meet all requirements for the supported power class and set its configured transmitted power class as specified in sub-clause 6.2.5;

## 6.2.2A UE maximum output power for CA

The following UE Power Classes define the maximum output power for any transmission bandwidth within the aggregated channel bandwidth.

The maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least as defined in Table 6.2.2A-0a.

**Table 6.2.2A-0a: Measurement period for UE maximum output power for CA**

| TTI pattern | Minimum measurement period |
|-------------|----------------------------|
| Subframe    | 1ms                        |
| Slot        | 7OS                        |
| Subslot     | 2OS, 3OS                   |

For inter-band carrier aggregation with one uplink component carrier assigned to one E-UTRA band the requirements in subclause 6.2.2 apply. For inter-band carrier aggregation with two uplink contiguous component carrier assigned to one E-UTRA band the requirements specified in Table 6.2.2A-1 apply for that band. For inter-band carrier aggregation with one uplink component carrier assigned to one E-UTRA band in Band 38, 40, 41 or 42, the requirements for power class 2 are not applicable and the corresponding requirements for a power class 3 UE shall apply. For inter-band carrier aggregation with one uplink component carrier assigned to one E-UTRA band in Band 3, 20, 28, or 31, the requirements for power class 1 are not applicable and the corresponding requirements for a power class 3 UE shall apply.

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, UE maximum output power shall be measured over all component carriers from different bands. If each band has separate antenna connectors, maximum output power is measured as the sum of maximum output power at each UE antenna connector. The maximum output power is specified in Table 6.2.2A-0.

For E-UTRA CA bands including an uplink LAA Scell in Band 46, the UE shall meet the following additional requirements for transmission within the frequency ranges 5150-5350 MHz and 5470-5725 MHz:

- a maximum mean power density of 10 dBm in any 1 MHz band when the network signaling value NS\_28 or NS\_29 is indicated in the LAA Scell;
- a maximum mean power density of 11 dBm in any 1 MHz band when the network signaling value NS\_30 is indicated in the LAA Scell;

the following additional requirements for transmission within the frequency range 5230-5250 MHz:

- a maximum mean power density of 4 dBm in any 1 MHz band when the network signaling value NS\_31 is indicated in the LAA Scell;

the following additional requirements for transmission within the frequency ranges 5150-5230 MHz, 5250-5350 MHz, 5470-5725 MHz and 5725-5850 MHz:

- a maximum mean power density of 10 dBm in any 1 MHz band when the network signaling value NS\_31 is indicated in the LAA Scell;

where the said network signaling values are specified in clause 6.2.4.

**Table 6.2.2A-0: UE Power Class for uplink interband CA (two bands)**

| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB)     | Class 4 (dBm) | Tolerance (dB) |
|-------------------------|---------------|----------------|---------------|----------------|---------------|--------------------|---------------|----------------|
| CA_1A-3A                |               |                |               |                | 23            | +2/-3 <sup>2</sup> |               |                |
| CA_1A-5A                |               |                |               |                | 23            | +2/-3              |               |                |
| CA_1A-7A                |               |                |               |                | 23            | +2/-3 <sup>2</sup> |               |                |
| CA_1A-8A                |               |                |               |                | 23            | +2/-3 <sup>2</sup> |               |                |
| CA_1A-11A               |               |                |               |                | 23            | +2/-3 <sup>5</sup> |               |                |
| CA_1A-18A               |               |                |               |                | 23            | +2/-3 <sup>5</sup> |               |                |
| CA_1A-19A               |               |                |               |                | 23            | +2/-3              |               |                |
| CA_1A-20A               |               |                |               |                | 23            | +2/-3              |               |                |

|            |  |  |  |    |                    |  |  |
|------------|--|--|--|----|--------------------|--|--|
| CA_1A-21A  |  |  |  | 23 | +2/-3              |  |  |
| CA_1A-26A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_1A-28A  |  |  |  | 23 | +2/-3              |  |  |
| CA_1A-42A  |  |  |  | 23 | +2/-3              |  |  |
| CA_1A-42C  |  |  |  | 23 | +2/-3              |  |  |
| CA_2A-4A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-5A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-7A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-12A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-13A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-14A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-30A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_2A-46A  |  |  |  | 23 | +2/-3              |  |  |
| CA_2A-48A  |  |  |  | 23 | +2/-3              |  |  |
| CA_2A-49A  |  |  |  | 23 | +2/-3              |  |  |
| CA_2A-66A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-5A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-7A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-8A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-11A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-18A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-19A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-20A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-21A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-26A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-28A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-40A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-41C  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-42A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_3A-42C  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_4A-5A   |  |  |  | 23 | +2/-3              |  |  |
| CA_4A-7A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_4A-12A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_4A-13A  |  |  |  | 23 | +2/-3              |  |  |
| CA_4A-17A  |  |  |  | 23 | +2/-3              |  |  |
| CA_4A-28A  |  |  |  | 23 | +2/-3              |  |  |
| CA_5A-7A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_5A-12A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_5A-17A  |  |  |  | 23 | +2/-3              |  |  |
| CA_5A-30A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_5A-40A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_5A-66A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_7A-8A   |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_7A-20A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_7A-26A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_7A-28A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_8A-39A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_8A-41A  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_11A-18A |  |  |  | 23 | +2/-3              |  |  |
| CA_11A-26A |  |  |  | 23 | +2/-3              |  |  |
| CA_12A-30A |  |  |  | 23 | +2/-3              |  |  |
| CA_12A-66A |  |  |  | 23 | +2/-3              |  |  |
| CA_13A-66A |  |  |  | 23 | +2/-3              |  |  |
| CA_14A-30A |  |  |  | 23 | +2/-3              |  |  |
| CA_14A-66A |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_18A-28A |  |  |  | 23 | +2/-3              |  |  |
| CA_19A-21A |  |  |  | 23 | +2/-3              |  |  |
| CA_19A-42A |  |  |  | 23 | +2/-3              |  |  |
| CA_21A-28A |  |  |  | 23 | +2/-3              |  |  |
| CA_21A-42A |  |  |  | 23 | +2/-3              |  |  |
| CA_25A-26A |  |  |  | 23 | +2/-3              |  |  |
| CA_25A-41A |  |  |  | 23 | +2/-3              |  |  |
| CA_26A-46A |  |  |  | 23 | +2/-3              |  |  |
| CA_26A-48A |  |  |  | 23 | +2/-3              |  |  |
| CA_28A-41A |  |  |  | 23 | +2/-3              |  |  |

|  |  |  |  |  |    |                    |  |  |
|--|--|--|--|--|----|--------------------|--|--|
| CA_28A-42A   |  |  |  |  | 23 | +2/-3              |  |  |
| CA_30A-66A   |  |  |  |  | 23 | +2/-3              |  |  |
| CA_39A-41A   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_39A-41C   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_39C-41A   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_40A-42A   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_41A-42A   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_41A-42C   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_41C-42A   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| CA_41C-42C   |  |  |  |  | 23 | +2/-3 <sup>2</sup> |  |  |
| NOTE 1: Void   |  |  |  |  |    |                    |  |  |
| NOTE 2: <sup>2</sup> refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB |  |  |  |  |    |                    |  |  |
| NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance   |  |  |  |  |    |                    |  |  |
| NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).   |  |  |  |  |    |                    |  |  |
| NOTE 5: For a UE that supports both Band 18 and Band 26, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB for transmission bandwidths confined within 815 MHz and 818 MHz.  |  |  |  |  |    |                    |  |  |

For uplink intra-band contiguous carrier aggregation the maximum output power is specified in Table 6.2.2A-1. For downlink intra-band contiguous carrier aggregation with a single uplink component carrier configured in the E-UTRA band, the maximum output power is specified in Table 6.2.2-1.

For a power class 2 capable UE operating with intra-band uplink contiguous CA bandwidth class C on Band 41, when an IE P-max as defined in TS 36.331 [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6, the requirements for power class 2 are not applicable, and the corresponding requirements for a power class 3 UE shall apply.

**Table 6.2.2A-1: CA UE Power Class for intraband contiguous CA**

| E-UTRA CA Configuration   | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB)     | Class 3 (dBm) | Tolerance (dB)     | Class 4 (dBm) | Tolerance (dB) |
|---|---------------|----------------|---------------|--------------------|---------------|--------------------|---------------|----------------|
| CA_1C   |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_3C   |               |                |               |                    | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_5B   |               |                |               |                    | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_7C   |               |                |               |                    | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_8B   |               |                |               |                    | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_38C  |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_39C  |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_40C  |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_40D  |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_41C  |               |                | 26            | +2/-2 <sup>2</sup> | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_41D  |               |                |               |                    | 23            | +2/-2 <sup>2</sup> |               |                |
| CA_42C  |               |                |               |                    | 23            | +2/-3              |               |                |
| CA_48B  |               |                |               |                    | 23            | +2/-3              |               |                |
| CA_48C  |               |                |               |                    | 23            | +2/-3              |               |                |
| CA_66B  |               |                |               |                    | 23            | +2/-2              |               |                |
| CA_66C  |               |                |               |                    | 23            | +2/-2              |               |                |
| NOTE 1: Void  |               |                |               |                    |               |                    |               |                |
| NOTE 2: If all transmitted resource blocks (Figure 5.6A-1) over all component carriers are confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or/and $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB |               |                |               |                    |               |                    |               |                |
| NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance  |               |                |               |                    |               |                    |               |                |
| NOTE 4: For intra-band contiguous carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).   |               |                |               |                    |               |                    |               |                |

For intra-band non-contiguous carrier aggregation with one uplink carrier on the PCC, the requirements in subclause 6.2.2 apply. For intra-band non-contiguous carrier aggregation with two uplink carriers the maximum output power is specified in Table 6.2.2A-2.

**Table 6.2.2A-2: UE Power Class for intraband non-contiguous CA**

| E-UTRA CA Configuration  | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|--|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|
| CA_4A-4A   |               |                |               |                | 23            | +2/-2          |               |                |
| NOTE 1: For transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB<br>NOTE 2: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance<br>NOTE 3: For intra-band non-contiguous carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE). |               |                |               |                |               |                |               |                |

### 6.2.2B UE maximum output power for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2.2B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least as defined in Table 6.2.2B-0.

**Table 6.2.2B-0: Measurement period for UE maximum output power for UL-MIMO**

| TTI pattern | Minimum measurement period |
|-------------|----------------------------|
| Subframe    | 1ms                        |
| Slot        | 7OS                        |
| Subslot     | 2OS, 3OS                   |

**Table 6.2.2B-1: UE Power Class for UL-MIMO in closed loop spatial multiplexing scheme**

| EUTRA band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB)       | Class 4 (dBm) | Tolerance (dB) |
|------------|---------------|----------------|---------------|----------------|---------------|----------------------|---------------|----------------|
| 1          |               |                |               |                | 23            | +2/-3                |               |                |
| 2          |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 3          |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 4          |               |                |               |                | 23            | +2/-3                |               |                |
| 5          |               |                |               |                | 23            | +2/-3                |               |                |
| 6          |               |                |               |                | 23            | +2/-3                |               |                |
| 7          |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 8          |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 9          |               |                |               |                | 23            | +2/-3                |               |                |
| 10         |               |                |               |                | 23            | +2/-3                |               |                |
| 11         |               |                |               |                | 23            | +2/-3                |               |                |
| 12         |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 13         |               |                |               |                | 23            | +2/-3                |               |                |
| 14         |               |                |               |                | 23            | +2/-3                |               |                |
| 17         |               |                |               |                | 23            | +2/-3                |               |                |
| 18         |               |                |               |                | 23            | +2/-3                |               |                |
| 19         |               |                |               |                | 23            | +2/-3                |               |                |
| 20         |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 21         |               |                |               |                | 23            | +2/-3                |               |                |
| 22         |               |                |               |                | 23            | +2/-4.5 <sup>2</sup> |               |                |
| 23         |               |                |               |                | 23            | +2/-3                |               |                |
| 24         |               |                |               |                | 23            | +2/-4 <sup>2</sup>   |               |                |
| 25         |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 26         |               |                |               |                | 23            | +2/-3 <sup>2</sup>   |               |                |
| 27         |               |                |               |                | 23            | +2/-3                |               |                |
| 28         |               |                |               |                | 23            | +2/[-3]              |               |                |
| 30         |               |                |               |                | 23            | +2/-3                |               |                |
| 31         | 31            | +2/-3          |               |                | 23            | +2/-3                |               |                |
| ...        |               |                |               |                |               |                      |               |                |
| 33         |               |                |               |                | 23            | +2/-3                |               |                |

|  |    |       |    |                    |    |                    |  |  |
|--|----|-------|----|--------------------|----|--------------------|--|--|
| 34   |    |       |    |                    | 23 | +2/-3              |  |  |
| 35   |    |       |    |                    | 23 | +2/-3              |  |  |
| 36   |    |       |    |                    | 23 | +2/-3              |  |  |
| 37   |    |       |    |                    | 23 | +2/-3              |  |  |
| 38   |    |       | 26 | +2/-3              | 23 | +2/-3              |  |  |
| 39   |    |       |    |                    | 23 | +2/-3              |  |  |
| 40   |    |       | 26 | +2/-3              | 23 | +2/-3              |  |  |
| 41   |    |       | 26 | +2/-3 <sup>2</sup> | 23 | +2/-3 <sup>2</sup> |  |  |
| 42   |    |       | 26 | +2/-4              | 23 | +2/-4              |  |  |
| 43   |    |       |    |                    | 23 | +2/-4              |  |  |
| 44   |    |       |    |                    | 23 | +2/[-3]            |  |  |
| 45   |    |       |    |                    | 23 | +2/-3              |  |  |
| 48   |    |       |    |                    | 23 | +2/-3              |  |  |
| 50   |    |       |    |                    | 23 | +2/-3              |  |  |
| 51   |    |       |    |                    | 23 | +2/-3              |  |  |
| 52   |    |       |    |                    | 23 | +2/-3              |  |  |
| 53   |    |       |    |                    | 23 | +2/-3              |  |  |
| ...  |    |       |    |                    |    |                    |  |  |
| 65   |    |       |    |                    | 23 | +2/-3              |  |  |
| 66   |    |       |    |                    | 23 | +2/-3              |  |  |
| 68   |    |       |    |                    | 23 | +2/-3              |  |  |
| ..   |    |       |    |                    |    |                    |  |  |
| 70   |    |       |    |                    | 23 | +2/-3              |  |  |
| 71   |    |       |    |                    | 23 | +2/-3              |  |  |
| 72   | 31 | +2/-3 |    |                    | 23 | +2/-3              |  |  |
| 73   |    |       |    |                    | 23 | +2/-3              |  |  |
| 74   |    |       |    |                    | 23 | +2/-3              |  |  |
| NOTE 1: Void   |    |       |    |                    |    |                    |  |  |
| NOTE 2: <sup>2</sup> refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB |    |       |    |                    |    |                    |  |  |
| NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.  |    |       |    |                    |    |                    |  |  |
| NOTE 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance   |    |       |    |                    |    |                    |  |  |
| NOTE 5: Void.  |    |       |    |                    |    |                    |  |  |

The default power class for an operating band is Power Class 3 unless otherwise stated.

For a power class 2 capable UE operating on Band 41, when an IE  $P_{max}$  as defined in TS 36.331 [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6, the requirements for power class 2 are not applicable and the corresponding requirements for a power class 3 UE shall apply.

For each supported frequency band other than Band 41, the UE shall:

- if the UE supports a different power class than the UE default power class for the band and the supported power class enables the higher maximum output power than that of the default power class:
  - if the band is a TDD band whose frame configuration is 0 or 6; or
  - if the IE  $P_{Max}$  as defined in TS 36.331 [7] is not provided; or
  - if the IE  $P_{Max}$  as defined in TS 36.331 [7] is provided and set to the maximum output power of the default power class or lower;
    - meet all requirements for the default power class of the operating band in which the UE is operating and set its configured transmitted power as specified in sub-clause 6.2.5;
  - else (i.e the IE  $P_{Max}$  as defined in TS 36.331 [7] is provided and set to the higher value than the maximum output power of the default power class):
    - meet all requirements for the supported power class and set its configured transmitted power as specified in sub-clause 6.2.5;

**Table 6.2.2B-2: UL-MIMO configuration in closed-loop spatial multiplexing scheme**

| Transmission mode | DCI format   | Codebook Index   |
|-------------------|--------------|------------------|
| Mode 2            | DCI format 4 | Codebook index 0 |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.2 apply.

### 6.2.2C Void

<reserved for future use>

### 6.2.2D UE maximum output power for ProSe

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the UE maximum output power shall be as specified in Table 6.2.2A-0 in subclause 6.2.2A for the corresponding inter-band aggregation with uplink assigned to two bands.

If UE is configured to operate on single E-UTRA ProSe sidelink band or E-UTRA uplink band specified in Table 5.5D-1, the requirements in subclause 6.2.2 apply.

### 6.2.2E UE maximum output power for Category M1 and M2 UE

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non CA configuration and UL-MIMO unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

**Table 6.2.2E-1: UE Power Class**

| EUTRA band | Class 2 (dBm)   | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) | Class 6 (dBm) | Tolerance (dB) |
|------------|-----------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|
| 1          |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 2          |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 3          |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 4          |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 5          |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 7          |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 8          |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 11         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 12         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 13         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 14         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 18         |                 |                | 23            | $\pm 2^5$      | 20            | $\pm 2^5$      | 14            | $\pm 2.5$      |
| 19         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 20         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 21         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 25         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 26         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 27         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 28         |                 |                | 23            | +2/-2.5        | 20            | +2/-2.5        | 14            | $\pm 2.5$      |
| 31         | 26 <sup>7</sup> | $\pm 2$        | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| ...        |                 |                |               |                |               |                |               |                |
| 39         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 40         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 41         |                 |                | 23            | $\pm 2^2$      | 20            | $\pm 2^2$      | 14            | $\pm 2.5$      |
| 42         |                 |                | 23            | +2/-3          | 20            | +2/-3          | 14            | $\pm 2.5$      |
| 43         |                 |                | 23            | +2/-3          | 20            | +2/-3          | 14            | $\pm 2.5$      |
| ...        |                 |                |               |                |               |                |               |                |
| 71         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 72         | 26 <sup>7</sup> | $\pm 2$        | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 73         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 74         |                 |                | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |



|  |  |  |    |           |    |           |    |           |
|--|--|--|----|-----------|----|-----------|----|-----------|
| 85   |  |  | 23 | $\pm 2^2$ | 20 | $\pm 2^2$ | 14 | $\pm 2.5$ |
| 87   |  |  | 23 | $\pm 2$   | 20 | $\pm 2$   | 14 | $\pm 2.5$ |
| 88   |  |  | 23 | $\pm 2$   | 20 | $\pm 2$   | 14 | $\pm 2.5$ |
| NOTE 1: Void   |  |  |    |           |    |           |    |           |
| NOTE 2: <sup>2</sup> refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB |  |  |    |           |    |           |    |           |
| NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.  |  |  |    |           |    |           |    |           |
| NOTE 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance   |  |  |    |           |    |           |    |           |
| NOTE 5: For a UE that supports both Band 18 and Band 26, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB for transmission bandwidths confined within 815 MHz and 818 MHz.  |  |  |    |           |    |           |    |           |
| NOTE 6: Void   |  |  |    |           |    |           |    |           |
| NOTE 7: Applicable for category M1 and M2 HD-FDD UE  |  |  |    |           |    |           |    |           |

## 6.2.2F UE maximum output power for category NB1 and NB2

Category NB1 and NB2 UE Power Classes are specified in Table 6.2.2F-1 and define the maximum output power for any transmission bandwidth within the category NB1 and NB2 channel bandwidth. For 3.75 kHz sub-carrier spacing the maximum output power is defined as mean power of measurement which period is atleast one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15kHz sub-carrier spacing the maximum output power is defined as mean power of measurement which period is atleast one sub-frame (1ms).

**Table 6.2.2F-1: UE Power Class**

| EUTRA band | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) | Class 6 (dBm) | Tolerance (dB) |
|------------|---------------|----------------|---------------|----------------|---------------|----------------|
| 1          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 2          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 3          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 4          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 5          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 7          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 8          | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 11         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 12         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 13         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 14         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 17         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 18         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 19         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 20         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 21         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 25         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 26         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 28         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 31         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 41         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 42         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 43         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 65         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 66         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 70         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 71         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 72         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 73         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 74         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 85         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 87         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |
| 88         | 23            | $\pm 2$        | 20            | $\pm 2$        | 14            | $\pm 2.5$      |

## 6.2.2G UE maximum output power for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the allowed V2X UE maximum output power for shall be as applied in Table 6.2.2-1 in subclause 6.2.2.

For V2X UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the UE maximum output power shall be as specified in Table 6.2.2G-1 in subclause 6.2.2G for the corresponding inter-band con-current operation with uplink assigned to two bands.

**Table 6.2.2G-1: Inter-band con-current V2X UE Power Class (two bands)**

| V2X con-current band Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB)     | Class 4 (dBm) | Tolerance (dB) |
|------------------------------------|---------------|----------------|---------------|----------------|---------------|--------------------|---------------|----------------|
| V2X_3A-47A                         |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_5A-47A                         |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_7A-47A                         |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_8A-47A                         |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_20A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_28A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_34A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_39A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_41A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |
| V2X_71A-47A                        |               |                |               |                | 23            | +2/-3 <sup>4</sup> |               |                |

NOTE 1: The con-current band combinations is used for V2X Service.  
NOTE 2:  $P_{\text{PowerClass}}$  is the maximum UE power specified without taking into account the tolerance  
NOTE 3: For inter-band con-current aggregation the maximum power requirement apply to the total transmitted power over all component carriers (per UE).  
NOTE 4: <sup>4</sup> refers to the transmission bandwidths (Figure 5.6-1) confined within  $F_{\text{UL\_low}}$  and  $F_{\text{UL\_low}} + 4$  MHz or  $F_{\text{UL\_high}} - 4$  MHz and  $F_{\text{UL\_high}}$ , the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB

For intra-band contiguous multi-carrier operation, the maximum output power is defined in Table 6.2.2G-2.

**Table 6.2.2G-2: V2X UE Power Class for intra-band contiguous multi-carrier operation**

| V2X intra-band multi-carrier configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|--|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|
| V2X_47B                                    |               |                |               |                | 23            | ±2             |               |                |
| V2X_47C                                    |               |                |               |                | 23            | ±2             |               |                |

NOTE 1:  $P_{\text{PowerClass}}$  is the maximum UE power specified without taking into account the tolerance  
NOTE 2: For intra-band multi-carrier operation, the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).

When a UE is configured for E-UTRA V2X sidelink transmissions in Band 47, the UE shall meet the following additional requirements for transmission within the frequency ranges 5855-5925 MHz:

- The maximum mean power spectral density shall be restricted to 23 dBm/MHz EIRP when the network signaling value NS<sub>33</sub> or NS<sub>34</sub> is indicated.

where the network signaling values are specified in clause 6.2.4G.

NOTE: The PSD limit in EIRP shall be converted to conducted requirement depend on the supported post antenna connector gain  $G_{\text{post connector}}$  declared by the UE following the principle described in annex I.

For V2X UE supporting Transmit Diversity, if the UE transmits on two connectors at the same time, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2.2G-3. The

maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1ms).

**Table 6.2.2G-3: V2X UE Power Class for Transmit Diversity scheme**

| E-UTRA band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|-------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|
| 47          |               |                | 26            | +2/-3          | 23            | +2/-3          |               |                |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2.2-1 shall apply to the active antenna connector.

### 6.2.3 UE maximum output power for modulation / channel bandwidth

For UE Power Class 1, 2 and 3, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2-1 due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1.

**Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3**

| Modulation | Channel bandwidth / Transmission bandwidth (N <sub>RB</sub> ) |         |       |        |        |        | MPR (dB) |
|------------|---|---------|-------|--------|--------|--------|----------|
|            | 1.4 MHz   | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | > 5   | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 1      |
| 16 QAM     | ≤ 5   | ≤ 4     | ≤ 8   | ≤ 12   | ≤ 16   | ≤ 18   | ≤ 1      |
| 16 QAM     | > 5   | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 2      |
| 64 QAM     | ≤ 5   | ≤ 4     | ≤ 8   | ≤ 12   | ≤ 16   | ≤ 18   | ≤ 2      |
| 64 QAM     | > 5   | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 3      |
| 256 QAM    | ≥ 1   |         |       |        |        |        | ≤ 5      |

For PRACH, PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For each TTI pattern, the MPR shall be evaluated per T<sub>eval</sub> period as specified in table 6.2.3-2 and given by the maximum value taken over the transmission(s) within that period; the maximum MPR over T<sub>REF</sub> is then applied for T<sub>REF</sub>.

**Table 6.2.3-2: MPR evaluation period**

| TTI pattern | T <sub>REF</sub> | T <sub>eval</sub>                      |
|-------------|------------------|--|
| Subframe    | 1 subframe       | 1 slot                                 |
| Slot        | 7 OS             | Min(T <sub>no_hopping</sub> , 7OS)     |
| Sublot      | 2 OS, 3OS        | Min(T <sub>no_hopping</sub> , 2OS/3OS) |

For UE Power Class 1 and 3 transmissions with non-contiguous resource allocation in single component carrier, the allowed Maximum Power Reduction (MPR) for the maximum output power in table 6.2.2-1, is specified as follows

$$\text{MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where M<sub>A</sub> is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 8.00 - 10.12A && ; 0.00 < A \leq 0.33 \\ &5.67 - 3.07A && ; 0.33 < A \leq 0.77 \\ &3.31 && ; 0.77 < A \leq 1.00 \end{aligned}$$

Where M<sub>A</sub> is defined as follows for 256 QAM

$$\begin{aligned} M_A &= 8.00 - 10.12A && ; 0.00 < A \leq 0.25 \\ &5.50 && ; 0.25 < A < 1.00 \end{aligned}$$

Where

$$A = N_{RB\_alloc} / N_{RB}$$

CEIL $\{M_A, 0.5\}$  means rounding upwards to closest 0.5dB, i.e. MPR  $\in [3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0]$

The allowed MPR for transmission on an Scell in Band 46 or Band 49 within a component carrier of a nominal channel bandwidth of 10 MHz or 20 MHz is in accordance with 6.2.3-1 for  $RIV = '11111'$  (10 MHz) and  $L = 10$  (20 MHz) with  $L$  defined in Clause 8.1.4 of [6]. For all other possible values of the  $RIV$  defined in Clause 8.1.4 of [6] the allowed MPR is 2.5 dB for QPSK modulation, 3 dB for 16QAM modulation and 4 dB for 64QAM modulation (256QAM is FFS).

For a power class 2 capable UE operating on Band 41, when an IE  $P-max$  as defined in [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6, the requirements for power class 2 are not applicable, and the corresponding requirements for a power class 3 UE shall apply.

For each supported frequency band other than Band 14 and Band 41, the UE shall:

- if the UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:
  - if the band is a TDD band whose frame configuration is 0 or 6; or
  - if the IE  $P-Max$  as defined in TS 36.331 [7] is not provided; or
  - if the IE  $P-Max$  as defined in TS 36.331 [7] is provided and set to the maximum output power of the default power class or lower;
    - meet all requirements for the default power class of the operating band in which the UE is operating and set its configured transmitted power as specified in sub-clause 6.2.5;
  - else (i.e the IE  $P-Max$  as defined in TS 36.331 [7] is provided and set to the higher value than the maximum output power of the default power class):
    - meet all requirements for the supported power class and set its configured transmitted power class as specified in sub-clause 6.2.5.

For UE Power Class 2 transmissions with non-contiguous resource allocation in single component carrier, the allowed Maximum Power Reduction (MPR) for the maximum output power is not specified in this version of the specification.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5 apply.

### 6.2.3A UE Maximum Output power for modulation / channel bandwidth for CA

For inter-band carrier aggregation with one uplink component carrier assigned to one E-UTRA band, the requirements in subclause 6.2.3 apply. For inter-band carrier aggregation with two uplink contiguous component carrier assigned to one E-UTRA band specified in this clause for intra-band contiguous carrier aggregation apply for that band.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the requirements in subclause 6.2.3 apply for each uplink component carrier.

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 due to higher order modulation and contiguously aggregated transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3A-1 for UE power class 3 CA bandwidth classes B and C, in Table 6.2.3A-1a for UE power class 2 CA bandwidth class C, and Table 6.2.3A-2 for UE power class 3 CA bandwidth class D. In case the modulation format is different on different component carriers then the MPR is determined by the rules applied to higher order of those modulations.

**Table 6.2.3A-1: Maximum Power Reduction (MPR) for Power Class 3**

| Modulation | CA bandwidth Class B and C / Smallest Component Carrier Transmission Bandwidth Configuration | MPR (dB) |
|------------|--|----------|
|------------|--|----------|

|         | 25 RB  | 50 RB   | 75 RB   | 100 RB  |     |
|---------|--|---|---|---|-----|
| QPSK    | > 8 and ≤ 25   | > 12 and ≤ 50   | > 16 and ≤ 75   | > 18 and ≤ 100  | ≤ 1 |
| QPSK    | > 25   | > 50  | > 75  | > 100   | ≤ 2 |
| 16 QAM  | ≤ 8  | ≤ 12  | ≤ 16  | ≤ 18  | ≤ 1 |
| 16 QAM  | > 8 and ≤ 25   | > 12 and ≤ 50   | > 16 and ≤ 75   | > 18 and ≤ 100  | ≤ 2 |
| 16 QAM  | > 25   | > 50  | > 75  | > 100   | ≤ 3 |
| 64 QAM  | ≤ 8 and allocation wholly contained within a single CC | ≤ 12 and allocation wholly contained within a single CC | ≤ 16 and allocation wholly contained within a single CC | ≤ 18 and allocation wholly contained within a single CC | ≤ 2 |
| 64 QAM  | > 8 or allocation extends across two CC's              | > 12 or allocation extends across two CC's              | > 16 or allocation extends across two CC's              | > 18 or allocation extends across two CC's              | ≤ 3 |
| 256 QAM | ≥ 1  |   |   |   | ≤ 5 |

Table 6.2.3A-1a: Maximum Power Reduction (MPR) for Power Class 2

| Modulation | CA bandwidth Class C / Smallest Component Carrier Transmission Bandwidth Configuration |   |   |   | MPR (dB) |
|------------|--|---|---|---|----------|
|            | 25 RB  | 50 RB   | 75 RB   | 100 RB  |          |
| QPSK       | > 6 and ≤ 25   | > 6 and ≤ 50  | > 6 and ≤ 75  | > 6 and ≤ 100   | ≤ 1      |
| QPSK       | > 25   | > 50  | > 75  | > 100   | ≤ 2      |
| 16 QAM     | ≤ 6  | ≤ 8   | ≤ 16  | ≤ 18  | ≤ 1.5    |
| 16 QAM     | > 6 and ≤ 25   | > 8 and ≤ 50  | > 16 and ≤ 75   | > 18 and ≤ 100  | ≤ 2      |
| 16 QAM     | > 25   | > 50  | > 75  | > 100   | ≤ 3      |
| 64 QAM     | ≤ 8 and allocation wholly contained within a single CC                                 | ≤ 12 and allocation wholly contained within a single CC | ≤ 16 and allocation wholly contained within a single CC | ≤ 18 and allocation wholly contained within a single CC | ≤ 2      |
| 64 QAM     | > 8 or allocation extends across two CC's  | > 12 or allocation extends across two CC's              | > 16 or allocation extends across two CC's              | > 18 or allocation extends across two CC's              | ≤ 3      |
| 256 QAM    | ≥ 1  |   |   |   | ≤ 6      |

Table 6.2.3A-2: Maximum Power Reduction (MPR) for Class 3

| Modulation | CA bandwidth Class D  |                         |                        |                         |                          | MPR (dB) |
|------------|-----------------------|-------------------------|------------------------|-------------------------|--------------------------|----------|
|            | 50 RB + 75 RB + 100RB | 50 RB + 100 RB + 100 RB | 75 RB + 75 RB + 100 RB | 75 RB + 100 RB + 100 RB | 100 RB + 100 RB + 100 RB |          |
| QPSK       | > 12 and ≤ 50         | > 12 and ≤ 50           | > 16 and ≤ 75          | > 16 and ≤ 75           | > 18 and ≤ 100           | ≤ 1      |
| QPSK       | > 50 and ≤ 125        | > 50 and ≤ 150          | > 75 and ≤ 150         | > 75 and ≤ 175          | > 100 and ≤ 200          | ≤ 2      |
| QPSK       | > 125                 | > 150                   | > 150                  | > 175                   | > 200                    | ≤ 3      |
| 16 QAM     | ≤ 12                  | ≤ 12                    | ≤ 16                   | ≤ 16                    | ≤ 18                     | ≤ 1      |
| 16 QAM     | > 12 and ≤ 50         | > 12 and ≤ 50           | > 16 and ≤ 75          | > 16 and ≤ 75           | > 18 and ≤ 100           | ≤ 2      |
| 16 QAM     | > 50 and ≤ 125        | > 50 and ≤ 150          | > 75 and ≤ 150         | > 75 and ≤ 175          | > 100 and ≤ 200          | ≤ 3      |

|         |   |   |   |   |   |       |
|---------|---|---|---|---|---|-------|
| 16 QAM  | > 125   | > 150   | > 150   | >175  | > 200   | ≤ 3.5 |
| 64 QAM  | ≤ 12 allocation wholly contained within a single CC                                       | ≤ 12 and allocation wholly contained within a single CC                                   | ≤ 16 and allocation wholly contained within a single CC                                   | ≤ 16 and allocation wholly contained within a single CC                                   | ≤ 18 and allocation wholly contained within a single CC                                   | ≤ 2   |
| 64 QAM  | > 12 allocation wholly contained within a single CC or allocation extends across two CC's | > 12 allocation wholly contained within a single CC or allocation extends across two CC's | > 16 allocation wholly contained within a single CC or allocation extends across two CC's | > 16 allocation wholly contained within a single CC or allocation extends across two CC's | > 18 allocation wholly contained within a single CC or allocation extends across two CC's | ≤ 3   |
| 64 QAM  | allocation extends across three CC's  | allocation extends across three CC's  | allocation extends across three CC's  | allocation extends across three CC's  | allocation extends across three CC's  | ≤ 4.0 |
| 256 QAM | ≥ 1   |   |   |   |   | ≤ 5.5 |

For PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For UE power class 3 intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 is specified as follows

$$\text{MPR} = \text{CEIL} \{ \min(M_A, M_{\text{IM5}}), 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 8.2 && ; 0 \leq A < 0.025 \\ &9.2 - 40A && ; 0.025 \leq A < 0.05 \\ &8 - 16A && ; 0.05 \leq A < 0.25 \\ &4.83 - 3.33A && ; 0.25 \leq A \leq 0.4, \\ &3.83 - 0.83A && ; 0.4 \leq A \leq 1, \end{aligned}$$

Where  $M_A$  is defined as follows for 256 QAM

$$\begin{aligned} M_A &= 8.2 && ; 0 \leq A < 0.025 \\ &9.2 - 40A && ; 0.025 \leq A < 0.05 \\ &8 - 16A && ; 0.05 \leq A < 0.16 \\ &5.5 && ; 0.16 \leq A < 1 \end{aligned}$$

and  $M_{\text{IM5}}$  is defined as follows

$$\begin{aligned} M_{\text{IM5}} &= 4.5 && ; \Delta_{\text{IM5}} < 1.5 * \text{BW}_{\text{Channel\_CA}} \\ &6.0 && ; 1.5 * \text{BW}_{\text{Channel\_CA}} \leq \Delta_{\text{IM5}} < \text{BW}_{\text{Channel\_CA}}/2 + F_{\text{OOB}} \\ M_A &&& ; \Delta_{\text{IM5}} \geq \text{BW}_{\text{Channel\_CA}}/2 + F_{\text{OOB}} \end{aligned}$$

For UE power class 2 intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 is specified as follows

$$\text{MPR} = \text{CEIL} \{ \min(M_A, M_{IM5}), 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 8.2 && ; 0 \leq A < 0.04 \\ &9.2 - 40A && ; 0.04 \leq A < 0.075 \\ &8 - 16A && ; 0.075 \leq A < 0.25 \\ &4.83 - 3.33A && ; 0.25 \leq A \leq 0.4, \\ &3.83 - 0.83A && ; 0.4 \leq A \leq 1, \end{aligned}$$

Where  $M_A$  is defined FFS for 256 QAM

and  $M_{IM5}$  is defined as follows

$$\begin{aligned} M_{IM5} &= 5.0 && ; \Delta_{IM5} < 1.5 * \text{BW}_{\text{Channel\_CA}} \\ &6.0 && ; 1.5 * \text{BW}_{\text{Channel\_CA}} \leq \Delta_{IM5} < \text{BW}_{\text{Channel\_CA}}/2 + F_{\text{OOB}} \\ M_A &&& ; \Delta_{IM5} \geq \text{BW}_{\text{Channel\_CA}}/2 + F_{\text{OOB}} \end{aligned}$$

For UE power class 3 intra-band contiguous carrier aggregation bandwidth class B with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 is specified as follows

$$\text{MPR} = \text{CEIL} \{ M_A, 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 10.5 - 17.5A && ; 0 \leq A < 0.2 \\ &8.5 - 7.5A && ; 0.2 \leq A < 0.6 \\ &5.5 - 2.5A && ; 0.6 \leq A \leq 1 \end{aligned}$$

Where  $M_A$  is defined as follows for 256 QAM

$$\begin{aligned} M_A &= 10.5 - 17.5A && ; 0 \leq A < 0.2 \\ &8.5 - 7.5A && ; 0.2 \leq A < 0.4 \\ &5.5 && ; 0.4 \leq A \leq 1 \end{aligned}$$

Where

$$A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$$

$$\Delta_{IM5} = \max( | F_{\text{C\_agg}} - (3 * F_{\text{agg\_alloc\_low}} - 2 * F_{\text{agg\_alloc\_high}}) |, | F_{\text{C\_agg}} - (3 * F_{\text{agg\_alloc\_high}} - 2 * F_{\text{agg\_alloc\_low}}) | )$$

$$F_{\text{C\_agg}} = (F_{\text{edge\_high}} + F_{\text{edge\_low}})/2$$

For UE power class 3 intra-band contiguous carrier aggregation bandwidth class D with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.3A-2 is specified as follows

$$\text{MPR} = \text{CEIL} \{ \min(M_A, M_{IM5}), 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 8.2 && ; 0 \leq A < 0.025 \\ &9.2 - 40A && ; 0.025 \leq A < 0.05 \\ &8 - 16A && ; 0.05 \leq A < 0.25 \end{aligned}$$

$$4.0 \quad ; 0.25 \leq A < 1$$

Where  $M_A$  is defined as follows for 256 QAM

$$M_A = \begin{cases} 8.2 & ; 0 \leq A < 0.025 \\ 9.2 - 40A & ; 0.025 \leq A < 0.05 \\ 8 - 16A & ; 0.05 \leq A < 0.16 \\ 5.5 & ; 0.16 \leq A < 1 \end{cases}$$

and  $M_{IM5}$  is defined as follows

$$M_{IM5} = \begin{cases} 4.5 & ; \Delta_{IM5} < 1.5 * BW_{Channel\_CA} \\ 6.0 & ; 1.5 * BW_{Channel\_CA} \leq \Delta_{IM5} < BW_{Channel\_CA}/2 + F_{OOB} \\ M_A & ; \Delta_{IM5} \geq BW_{Channel\_CA}/2 + F_{OOB} \end{cases}$$

$CEIL\{M_A, 0.5\}$  means rounding upwards to closest 0.5dB, i.e.  $MPR \in [3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5]$ .

For intra-band non-contiguous carrier aggregation with one uplink carrier, the requirements in subclause 6.2.3 apply.

For intra-band non-contiguous carrier aggregation with two uplink carriers MPR is specified for E-UTRA CA configurations with a maximum possible  $W_{GAP} \leq 35$  MHz; the allowed MPR is

$$MPR = CEIL \{M_N, 0.5\}$$

where  $M_N$  is defined as follows

$$M_N = \begin{cases} -0.125 N + 18.25 & ; 2 \leq N \leq 50 \\ -0.0333 N + 13.67 & ; 50 < N \leq 200 \end{cases}$$

where  $N = N_{RB\_alloc}$  is the number of allocated resource blocks. Clause 6.2.3 does not apply in addition. E-UTRA CA configurations with a maximum possible  $W_{gap} > 35$  MHz and their corresponding MPR are intended to form part of a later release.

For intra-band carrier aggregation, the MPR is evaluated per  $T_{eval}$  period specified in table 6.2.3A-3 and given by the maximum value taken over the transmission(s) on all component carriers within that period; the maximum MPR over  $T_{REF}$  is then applied for  $T_{REF}$ .

**Table 6.2.3A-3: MPR evaluation period for CA**

| TTI pattern | $T_{REF}$  | $T_{eval}$                             |
|-------------|------------|--|
| Subframe    | 1 subframe | 1 slot                                 |
| Slot        | 7 OS       | $\text{Min}(T_{no\_hopping}, 7OS)$     |
| Sublot      | 2 OS, 3OS  | $\text{Min}(T_{no\_hopping}, 2OS/3OS)$ |

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the requirements specified in subclause 6.2.3 apply for the E-UTRA band supporting one component carrier, and for the E-UTRA band supporting two contiguous component carriers the requirements specified in subclause 6.2.3A apply.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5A apply.

### 6.2.3B UE maximum output power for modulation / channel bandwidth for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2B-1 is specified in Table 6.2.3-1. The requirements



shall be met with UL-MIMO configurations defined in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5B apply.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.3 apply.

### 6.2.3D UE maximum output power for modulation / channel bandwidth for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, this subclause specifies the allowed Maximum Power Reduction (MPR) power for ProSe physical channels and signals due to higher order modulation and transmit bandwidth configuration (resource blocks).

The allowed MPR for the maximum output power for ProSe physical channels PSDCH, PSCCH, PSSCH, and PSBCH shall be as specified in subclause 6.2.3 for PUSCH for the corresponding modulation and transmission bandwidth.

The allowed MPR for the maximum output power for ProSe physical signal PSSS shall be as specified in subclause 6.2.3 for PUSCH QPSK modulation for the corresponding transmission bandwidth.

The allowed MPR for the maximum output power for ProSe physical signal SSSS is specified in Table 6.2.3D-1.

For a power class 2 capable UE operating on Band 41, the corresponding requirements for a power class 3 UE apply when an IE *P-max* as defined in [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6.

For each supported frequency band other than Band 14 and Band 41, the UE shall:

- if the UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:
  - if the band is a TDD band whose frame configuration is 0 or 6; or
  - if the IE *P-Max* as defined in TS 36.331 [7] is not provided; or
  - if the IE *P-Max* as defined in TS 36.331 [7] is provided and set to the maximum output power of the default power class or lower;
    - meet all requirements for the default power class of the operating band in which the UE is operating and set its configured transmitted power as specified in sub-clause 6.2.5;
  - else (i.e the IE *P-Max* as defined in TS 36.331 [7] is provided and set to the higher value than the maximum output power of the default power class):
    - meet all requirements for the supported power class and set its configured transmitted power class as specified in sub-clause 6.2.5.

**Table 6.2.3D-1: Maximum Power Reduction (MPR) for SSSS for Power Class 1, 2 and 3**

| Channel bandwidth | MPR for SSSS (dB) |
|-------------------|-------------------|
| 1.4 MHz           |                   |
| 3.0 MHz           |                   |
| 5.0 MHz           | ≤ 4               |
| 10 MHz            | ≤ 4               |
| 15 MHz            | ≤ 4               |
| 20 MHz            | ≤ 4               |

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.2.3D apply for ProSe transmission and the requirements in subclause 6.2.3 apply for uplink transmission.

### 6.2.3E UE maximum output power for modulation / channel bandwidth for category M1 and M2

For category M1 UE Power Class 3, 5 and 6, the allowed Maximum Power Reduction (MPR) for the maximum output power specified in Table 6.2.2E-1 due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Tables 6.2.3E-1, 6.2.3E-2 and 6.2.3E-5 respectively.

For category M2 UE Power Class 3, 5 and 6, the allowed Maximum Power Reduction (MPR) for the maximum output power specified in Table 6.2.2E-1 due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3E-3, Table 6.2.3E-4 and Table 6.2.3E-6 respectively.

For subPRB allocation of category M1 UE of Power Class 3, there is no MPR applies. For subPRB allocation of category M2 UE of Power Class 3, the allowed MPR due to higher order modulation and transmit bandwidth configuration (subcarrier) is specified in in Table 6.2.3E-7.

**Table 6.2.3E-1: Maximum Power Reduction (MPR) for category M1 UE for Power Class 2 and 3**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |        |        | MPR (dB) |
|------------|---|----------|-------|--------|--------|--------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | >2  | >2       | >1    | >4     | -      | -      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -      | -      | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >1    | >3     | -      | -      | $\leq 1$ |
| 16QAM      | >2  | >2       | >3    | >5     | -      | -      | $\leq 2$ |

NOTE: MPR only applicable for  $N_{RB} \geq 1$

**Table 6.2.3E-2: Maximum Power Reduction (MPR) for category M1 for Power Class 5**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |        |        | MPR (dB) |
|------------|---|----------|-------|--------|--------|--------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | >2  | >2       | >3    | >5     | -      | -      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -      | -      | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >3    | >5     | -      | -      | $\leq 1$ |
| 16QAM      | >2  | >2       | >5    | -      | -      | -      | $\leq 2$ |

NOTE: MPR only applicable for  $N_{RB} \geq 1$

**Table 6.2.3E-3: Maximum Power Reduction (MPR) for category M2 UE for Power Class 2 and 3**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |           |           | MPR (dB) |
|------------|---|----------|-------|--------|-----------|-----------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz    | 20 MHz    |          |
| QPSK       | >2  | >2       | >1    | >4     | > 16      | > 18      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -         | -         | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >1    | >3     | $\leq 16$ | $\leq 18$ | $\leq 1$ |
| 16QAM      | >2  | >2       | >3    | >5     | > 16      | > 18      | $\leq 2$ |

NOTE: MPR only applicable for  $N_{RB} \geq 1$

**Table 6.2.3E-4: Maximum Power Reduction (MPR) for category M2 UE for Power Class 5**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |           |           | MPR (dB) |
|------------|---|----------|-------|--------|-----------|-----------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz    | 20 MHz    |          |
| QPSK       | >2  | >2       | >3    | >5     | > 16      | > 18      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -         | -         | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >3    | >5     | $\leq 16$ | $\leq 18$ | $\leq 1$ |
| 16QAM      | >2  | >2       | >5    | -      | > 16      | > 18      | $\leq 2$ |

NOTE: MPR only applicable for  $N_{RB} \geq 1$

**Table 6.2.3E-5: Maximum Power Reduction (MPR) for category M1 for Power Class 6**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |        |        | MPR (dB) |
|------------|---|----------|-------|--------|--------|--------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | >2  | >2       | >3    | >5     | -      | -      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -      | -      | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >3    | >5     | -      | -      | $\leq 1$ |
| 16QAM      | >2  | >2       | >5    | -      | -      | -      | $\leq 2$ |

**Table 6.2.3E-6: Maximum Power Reduction (MPR) for category M2 UE for Power Class 6**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |          |       |        |           |           | MPR (dB) |
|------------|---|----------|-------|--------|-----------|-----------|----------|
|            | 1.4 MHz   | 3.0 MHz  | 5 MHz | 10 MHz | 15 MHz    | 20 MHz    |          |
| QPSK       | >2  | >2       | >3    | >5     | > 16      | > 18      | $\leq 1$ |
| QPSK       | >5  | >5       | -     | -      | -         | -         | $\leq 2$ |
| 16 QAM     | $\leq 2$  | $\leq 2$ | >3    | >5     | $\leq 16$ | $\leq 18$ | $\leq 1$ |
| 16QAM      | >2  | >2       | >5    | -      | > 16      | > 18      | $\leq 2$ |

**Table 6.2.3E-7: Maximum Power Reduction (MPR) for category M2 UE for Power Class 3 for subPRB allocation**

| Channel bandwidth                      | 5 MHz      |          | 10 MHz     |            | 15MHz    |      |
|--|------------|----------|------------|------------|----------|------|
|  | BPSK       | QPSK     | BPSK       | QPSK       | BPSK     | QPSK |
| WB index for 2 subcarrier transmission | 0          | -        | 0          | 1          | -        | -    |
| MPR                                    | $\leq 0.5$ | -        | $\leq 0.5$ | $\leq 0.5$ | -        | -    |
| WB index for 3 subcarrier transmission | -          | 0        | -          | 0          | 1        | -    |
| MPR                                    | -          | $\leq 2$ | -          | $\leq 2$   | $\leq 2$ | -    |
| WB index for 6 subcarrier transmission | -          | 0        | -          | 0          | 1        | -    |
| MPR                                    | -          | $\leq 1$ | -          | $\leq 1$   | $\leq 1$ | -    |

NOTE: WB is specified in TS 36.211 [4]

For PRACH, PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For each subframe, the MPR is evaluated per slot and given by the maximum value taken over the transmission(s) within the slot; the maximum MPR over the two slots is then applied for the entire subframe.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5 apply.

No other MPR requirement than those specified in tables 6.2.3E-1 and Table 6.2.3E-2 and Table 6.2.3E-5 applies to category M1 and those specified in tables 6.2.3E-3 and Table 6.2.3E-4 and Table 6.2.3E-6 applies to category M2 UE.

### 6.2.3F UE maximum output power for modulation / channel bandwidth for category NB1 and NB2

For UE category NB1 and NB2 power class 3 and 5 the allowed Maximum Power Reduction (MPR) for the maximum output power given in Table 6.2.2F-1 is specified in Table 6.2.3F-1.

**Table 6.2.3F-1: Maximum Power Reduction (MPR) for UE category NB1 and NB2 Power Class 3 and 5**

| Modulation                            | QPSK          |             |               |
|---------------------------------------|---------------|-------------|---------------|
| Tone positions for 3 Tones allocation | 0-2           | 3-5 and 6-8 | 9-11          |
| MPR                                   | $\leq 0.5$ dB | 0 dB        | $\leq 0.5$ dB |
| Tone positions for 6 Tones allocation | 0-5 and 6-11  |             |               |
| MPR                                   | $\leq 1$ dB   | $\leq 1$ dB |               |

|   |        |
|---|--------|
| <b>Tone positions for 12 Tones allocation</b> | 0-11   |
| <b>MPR</b>                                    | ≤ 2 dB |

For UE category NB1 and NB2 power class 6 the allowed Maximum Power Reduction (MPR) for the maximum output power given in Table 6.2.2F-1 is specified in Table 6.2.3F-2.

**Table 6.2.3F-2: Maximum Power Reduction (MPR) for UE category NB1 and NB2 Power Class 6**

|                                    |             |
|------------------------------------|-------------|
| <b>Modulation</b>                  | <b>QPSK</b> |
| <b>MPR for 3 Tones allocation</b>  | ≤ 0.5 dB    |
| <b>MPR for 6 Tones allocation</b>  | ≤ 1 dB      |
| <b>MPR for 12 Tones allocation</b> | ≤ 1.5 dB    |

For the UE maximum output power modified by MPR, the power limits specified in sub-clause 6.2.5F apply.

### 6.2.3G UE maximum output power for modulation / channel bandwidth for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, this subclause specifies the allowed Maximum Power Reduction (MPR) power for V2X physical channels and signals due to PSCCH and PSSCH simultaneous transmission.

#### 6.2.3G.1 MPR for Power class 3 V2X UE

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2.3G.1-1 for power class 3.

**Table 6.2.3G.1-1: Maximum Power Reduction (MPR) for power class 3 V2X Communication (Contiguous PSCCH and PSSCH transmission)**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |         |       |        |        |        | MPR (dB) |
|------------|---|---------|-------|--------|--------|--------|----------|
|            | 1.4 MHz   | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       |   |         |       |        |        |        | ≤ 1.5    |
| 16 QAM     |   |         |       |        |        |        | ≤ 2      |
| 64QAM      |   |         |       |        |        |        | ≤ 3      |

For non-contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for V2X physical channels PSCCH and PSSCH shall be as specified as follows

$$MPR = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = 4.5 \quad ; 0.00 < A \leq 0.2$$

$$5.5 - 5.833A \quad ; 0.2 < A \leq 0.6$$

$$2.0 \quad ; 0.6 < A \leq 1.00$$

Where

$$A = N_{RB\_alloc} / N_{RB}$$

$\text{CEIL}\{M_A, 0.5\}$  means rounding upwards to closest 0.5dB.

The allowed MPR for the maximum output power for V2X physical channels PSBCH and PSSS shall be as specified in subclause 6.2.3 for the corresponding modulation and transmission bandwidth.

The allowed MPR for the maximum output power for V2X physical signal SSSS is specified in Table 6.2.3D-1.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the allowed MPR requirements in subclause 6.2.3G apply for V2X PSSCH and PSCCH transmission. The allowed MPR requirements in subclause 6.2.3D apply for other V2X sidelink transmission (PSBCH/PSSS/SSSS). The MPR requirements in subclause 6.2.3 apply for uplink transmission.

For intra-band contiguous multi-carrier operation bandwidth class B the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2G.1-2 due to higher order modulation is specified as follows.

**Table 6.2.3G.1-2: Void**

$$\text{MPR} = \text{CEIL} \{ M_A, 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} M_A &= 6.5 && ; 0 \leq A < 0.1 \\ &8 - 15A && ; 0.1 \leq A < 0.2 \\ &5.75 - 3.75A && ; 0.2 \leq A < 0.6 \end{aligned}$$

3.5 ;  $0.6 \leq A \leq 1$  For intra-band contiguous multi-carrier operation bandwidth class C the allowed Maximum Power Reduction (MPR) for the maximum output power can be specified as follows. In case the modulation format is different on different component carriers then the MPR is determined by the rules applied to higher order of those modulations.

$$\text{MPR} = \text{CEIL} \{ M_A, 0.5 \}$$

Where  $M_A$  is defined as follows for QPSK, 16 QAM and 64 QAM

$$\begin{aligned} [M_A &= 6.5 && ; 0 \leq A < 0.1 \\ &8.5 - 20A && ; 0.1 \leq A < 0.2 \\ &5.25 - 2.5A && ; 0.2 \leq A < 0.6 \\ &3.5 && ; 0.6 \leq A \leq 1] \end{aligned}$$

### 6.2.3G.2 MPR for Power class 2 V2X UE

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2.3G.2-1 for power class 2.

**Table 6.2.3G.2-1: Maximum Power Reduction (MPR) for power class 2 V2X Communication (Contiguous PSCCH and PSSCH transmission)**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |         |       |        |        |        | MPR (dB)   |
|------------|---|---------|-------|--------|--------|--------|------------|
|            | 1.4 MHz   | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |            |
| QPSK       |   |         |       |        |        |        | $\leq 2$   |
| 16 QAM     |   |         |       |        |        |        | $\leq 2.5$ |
| 64QAM      |   |         |       |        |        |        | $\leq 3$   |

For non-contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for V2X physical channels PSCCH and PSSCH shall be as specified as follows:

$$\text{MPR} = \text{CEIL} \{ M_A, 0.5 \}$$

Where  $M_A$  is defined as follows

$$\begin{aligned} \text{For 10MHz channel bandwidth} \quad M_A &= 4.5 && ; 0.0 < A \leq 0.2 \\ &8.5 - 20.0A && ; 0.2 < A \leq 0.3 \end{aligned}$$

$$2.5 \quad ; 0.3 < A \leq 1.00$$

For 20MHz channel bandwidth  $M_A = 9.0 \quad ; 0.0 < A \leq 0.1$

$$12.0 - 30.0A \quad ; 0.1 < A \leq 0.3$$

$$3.0 \quad ; 0.3 < A \leq 1.00$$

Where

$$A = N_{RB\_alloc} / N_{RB}$$

CEIL{ $M_A$ , 0.5} means rounding upwards to closest 0.5dB.

## 6.2.4 UE maximum output power with additional requirements

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the output power as specified in Table 6.2.2-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For UE Power Class 1, 2 and 3 the specific requirements and identified subclauses are specified in Table 6.2.4-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2.4-1 to 6.2.4-15 are in addition to the allowed MPR requirements specified in subclause 6.2.3.

**Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)**

| Network Signalling value | Requirements (subclause) | E-UTRA Band                      | Channel bandwidth (MHz) | Resources Blocks ( $N_{RB}$ )                  | A-MPR (dB)        |
|--------------------------|--------------------------|----------------------------------|-------------------------|--|-------------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1                      | 1.4, 3, 5, 10, 15, 20   | Table 5.6-1                                    | N/A               |
| NS_03                    | 6.6.2.2.1                | 2, 4, 10, 23, 25, 35, 36, 66, 70 | 3                       | >5   | $\leq 1$          |
|                          |                          |                                  | 5                       | >6   | $\leq 1$          |
|                          |                          |                                  | 10                      | >6   | $\leq 1$          |
|                          |                          |                                  | 15                      | >8   | $\leq 1$          |
|                          |                          |                                  | 20                      | >10  | $\leq 1$          |
| NS_04                    | 6.6.2.2.2, 6.6.3.3.19    | 41                               | 5, 10, 15, 20           | Table 6.2.4-4, Table 6.2.4-4a                  |                   |
| NS_05                    | 6.6.3.3.1                | 1                                | 10, 15, 20              | $\geq 50$ (NOTE1)                              | $\leq 1$ (NOTE1)  |
|                          |                          |                                  | 15, 20                  | Table 6.2.4-18 (NOTE2)                         |                   |
|                          |                          |                                  | 10, 15, 20              | $\geq 50$                                      | $\leq 1$ (NOTE 1) |
|                          |                          |                                  | 15, 20                  | Table 6.2.4-18 (NOTE 2)                        |                   |
|                          |                          | 65 (NOTE 3)                      |                         |  |                   |
| NS_06                    | 6.6.2.2.3                | 12, 13, 14, 17                   | 1.4, 3, 5, 10           | Table 5.6-1                                    | N/A               |
|                          |                          | 85                               | 5, 10                   | Table 5.6-1                                    | N/A               |
| NS_07                    | 6.6.2.2.3, 6.6.3.3.2     | 13                               | 10                      | Table 6.2.4-2                                  |                   |
| NS_08                    | 6.6.3.3.3                | 19                               | 10, 15                  | > 44   | $\leq 3$          |
| NS_09                    | 6.6.3.3.4                | 21                               | 10, 15                  | > 40   | $\leq 1$          |
|                          |                          |                                  |                         | > 55   | $\leq 2$          |
|                          |                          |                                  |                         | > 40   | $\leq 1$          |
|                          |                          |                                  |                         | > 55   | $\leq 2$          |
|                          |                          | 74 (NOTE 6)                      | 10, 15                  |  |                   |
| NS_10                    |                          | 20                               | 15, 20                  | Table 6.2.4-3                                  |                   |
| NS_11                    | 6.6.2.2.1, 6.6.3.3.13    | 23                               | 1.4, 3, 5, 10, 15, 20   | Table 6.2.4-5                                  |                   |
| NS_12                    | 6.6.3.3.5                | 26                               | 1.4, 3, 5, 10, 15       | Table 6.2.4-6                                  |                   |
| NS_13                    | 6.6.3.3.6                | 26                               | 5                       | Table 6.2.4-7                                  |                   |
| NS_14                    | 6.6.3.3.7                | 26                               | 10, 15                  | Table 6.2.4-8                                  |                   |
| NS_15                    | 6.6.3.3.8                | 26                               | 1.4, 3, 5, 10, 15       | Table 6.2.4-9                                  |                   |
|                          |                          |                                  |                         | Table 6.2.4-10                                 |                   |
| NS_16                    | 6.6.3.3.9                | 27                               | 3, 5, 10                | Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13 |                   |
| NS_17                    | 6.6.3.3.10               | 28                               | 3, 5, 10                | Table 5.6-1                                    | N/A               |

|  |                         |                |                          |                                  |          |
|--|-------------------------|----------------|--------------------------|----------------------------------|----------|
| NS_18  | 6.6.3.3.11              | 28             | 5                        | $\geq 2$                         | $\leq 1$ |
|  |                         |                | 10, 15, 20               | $\geq 1$                         | $\leq 4$ |
| NS_19  | 6.6.3.3.12              | 44             | 10, 15, 20               | Table 6.2.4-14                   |          |
| NS_20  | 6.2.2                   | 23             | 5, 10, 15, 20            | Table 6.2.4-15                   |          |
|  | 6.6.2.2.1<br>6.6.3.3.14 |                |                          |                                  |          |
| NS_21  | 6.6.2.2.1               | 30             | 5, 10                    | Table 6.2.4-16                   |          |
|  | 6.6.3.3.15              |                |                          |                                  |          |
| NS_22  | 6.6.3.3.16              | 42(NOTE 8), 43 | 5, 10, 15, 20            | Table 6.2.4-17                   |          |
| NS_23  | 6.6.3.3.17              | 42(NOTE 8), 43 | 5, 10, 15, 20            | N/A                              |          |
| NS_24  | 6.6.3.3.20              | 65 (NOTE 4)    | 5, 10, 15, 20            | Table 6.2.4-19                   |          |
| NS_25  | 6.6.3.3.21              | 65 (NOTE 4)    | 5, 10, 15, 20            | Table 6.2.4-20                   |          |
| NS_26  | 6.6.3.3.22              | 68             | 10, 15                   | Table 6.2.4-21                   |          |
| NS_27  | 6.6.2.2.5,              | 48             | 5, 10, 15, 20            | Table 6.2.4-22                   |          |
|  | 6.6.3.3.23              |                |                          |                                  |          |
| NS_28  | 6.2.2A,                 | 46 (NOTE 5)    | 20                       | Table 6.2.4-23                   |          |
|  | 6.6.2.2.6               |                |                          |                                  |          |
|  | 6.6.3.3.24              |                |                          |                                  |          |
| NS_29  | 6.2.2A,                 | 46 (NOTE 5)    | 20                       | Table 6.2.4-24                   |          |
|  | 6.6.2.3.1a,             |                |                          |                                  |          |
|  | 6.6.3.3.25              |                |                          |                                  |          |
| NS_30  | 6.2.2A,                 | 46 (NOTE 5)    | 20                       | Table 6.2.4-25                   |          |
|  | 6.6.3.3.26              |                |                          |                                  |          |
| NS_31  | 6.2.2A,                 | 46 (NOTE 5)    | 20                       | Table 6.2.4-26                   |          |
|  | 6.6.3.3.27              |                |                          |                                  |          |
| NS_32  | -                       | -              | -                        | -                                | -        |
| ...  |                         |                |                          |                                  |          |
| NS_35  | 6.6.2.2.7               | 71             | 5, 10, 15, 20            | N/A                              |          |
| NS_36  | 6.6.3.3.28              | 68             | 5, 10, 15                | Table 6.2.4-27                   |          |
| NS_38  | 6.6.3.3.29              | 74             | 1.4, 3, 5, 10,<br>15, 20 | Table 6.2.4-28                   |          |
| NS_39  | 6.6.3.3.30              | 74             | 10, 15, 20               | Table 6.2.4-29                   |          |
| NS_40  | 6.6.3.3.31              | 51             | 3, 5                     | Table 6.2.4-30a, Table 6.2.4-30b |          |
| NS_41  | 6.6.3.3.31              | 50             | 3, 5, 10, 15,<br>20      | Table 6.2.4-31                   |          |
| NS_42  | 6.6.3.3.32              | 50             | 3, 5, 10, 15,<br>20      | Table 6.2.4-32                   |          |
| NS_43  | 6.6.2.2.5               | 49             | 20                       | Table 6.2.4-33                   |          |
|  | 6.6.3.3.23              |                |                          |                                  |          |
| NS_44  | 6.6.3.3.33              | 38 (Note 7)    | 5, 10, 15, 20            | Table 6.2.4-34                   |          |
| NS_45  | 6.6.3.3.34              | 53             | 1.4, 3, 5, 10            | N/A                              |          |
| ..   |                         |                |                          |                                  |          |
| NS_56  | 6.6.3.3.35              | 24             | 5, 10                    | Table 6.2.4-34a                  |          |
| <p>NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. A-MPR for operations below this frequency is not covered in this version of specifications except for the channel assignments in NOTE2 as the emissions requirement in 6.6.3.3.1 may not be met. For 10MHz channel bandwidth whose carrier frequency is larger than or equal to 1945 MHz or 15 MHz channel bandwidth whose carrier frequency is larger than or equal to 1947.5 MHz, no A-MPR applies.</p> <p>NOTE 2: Applicable when carrier frequency is 1932.5 MHz for 15MHz channel bandwidth or 1930 MHz for 20MHz channel bandwidth case.</p> <p>NOTE 3: Applicable when the E-UTRA carrier is within 1920-1980 MHz.</p> <p>NOTE 4: Applicable when the upper edge of the channel bandwidth frequency is greater than 1980MHz.</p> <p>NOTE 5: Applicable only for an LAA Scell configured in Band 46.</p> <p>NOTE 6: Applicable when the E-UTRA carrier is within 1447.9 – 1462.9 MHz</p> <p>NOTE 7: Applicable for power class 2 UE in E-UTRA carrier with channel bandwidth is confined within 2570 MHz and 2615 MHz</p> <p>NOTE 8: Not applicable for power class 2 UE in Band 42</p> |                         |                |                          |                                  |          |

**Table 6.2.4-2: A-MPR for "NS\_07"**

| Parameters  | Region A |                 | Region B |         | Region C |
|---|----------|-----------------|----------|---------|----------|
| RB <sub>start</sub>   | 0 - 12   |                 | 13 - 18  | 19 - 42 | 43 - 49  |
| LCRB [RBs]  | 6-8      | 1 to 5 and 9-50 | ≥8       | ≥18     | ≤2       |
| A-MPR [dB]  | ≤ 8      | ≤ 12            | ≤ 12     | ≤ 6     | ≤ 3      |
| NOTE 1; RB <sub>start</sub> indicates the lowest RB index of transmitted resource blocks<br>NOTE 2; LCRB is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping between two regions, notes 1 and 2 apply on a per T <sub>no_hopping</sub> basis.<br>NOTE 4; For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. For intra-slot frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for the slot. For intra-subslot frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for the subslot. |          |                 |          |         |          |

**Table 6.2.4-3: A-MPR for "NS\_10"**

| Channel bandwidth [MHz]   | Parameters          | Region A |
|---|---------------------|----------|
| 15  | RB <sub>start</sub> | 0 - 10   |
|   | LCRB [RBs]          | 1 -20    |
|   | A-MPR [dB]          | ≤ 2      |
| 20  | RB <sub>start</sub> | 0 - 15   |
|   | LCRB [RBs]          | 1 -20    |
|   | A-MPR [dB]          | ≤ 5      |
| NOTE 1: RB <sub>start</sub> indicates the lowest RB index of transmitted resource blocks<br>NOTE 2: LCRB is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping which intersects Region A, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects Region A, notes 1 and 2 apply on a T <sub>no_hopping</sub> basis.<br>NOTE 4: For intra-subframe frequency hopping which intersect Region A, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects Region A, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects Region A, the larger A-MPR value may be applied for the subslot. |                     |          |

**Table 6.2.4-4: A-MPR requirements for "NS\_04" for Power Class 3 UE**

| Channel bandwidth [MHz] | Parameters                       |              |               |         |         |          |     |
|-------------------------|----------------------------------|--------------|---------------|---------|---------|----------|-----|
| 5                       | Fc [MHz]                         | ≤ 2500.5     |               |         |         | > 2500.5 |     |
|                         | RB <sub>start</sub>              | 0 - 8        |               | 9 - 24  |         | 0 - 24   |     |
|                         | LCRB [RBs]                       | > 0          |               | > 0     |         | > 0      |     |
|                         | A-MPR [dB]                       | ≤ 2          |               | 0       |         | 0        |     |
| 10                      | Fc [MHz]                         | ≤ 2504       |               |         |         | > 2504   |     |
|                         | RB <sub>start</sub>              | 0 - 8        |               | 9 - 35  | 36 - 49 | 0 - 49   |     |
|                         | LCRB [RBs]                       | ≤ 15         | > 15 and < 25 | ≥ 25    | N/A     | > 0      | > 0 |
|                         | RB <sub>start</sub> + LCRB [RBs] | N/A          | N/A           | N/A     | ≥ 45    | N/A      | N/A |
|                         | A-MPR [dB]                       | ≤ 3          | ≤ 1           | ≤ 2     | ≤ 1     | 0        | 0   |
| 15                      | Fc [MHz]                         | ≤ 2510.8     |               |         |         | > 2510.8 |     |
|                         | RB <sub>start</sub>              | 0 - 13       |               | 14 - 59 | 60 - 74 | 0 - 74   |     |
|                         | LCRB [RBs]                       | ≤ 18 or ≥ 36 | > 18 and < 36 | N/A     | > 0     | > 0      |     |
|                         | RB <sub>start</sub> + LCRB [RBs] | N/A          | N/A           | ≥ 62    | N/A     | N/A      |     |
|                         | A-MPR [dB]                       | ≤ 3          | ≤ 1           | ≤ 1     | 0       | 0        |     |
| 20                      | Fc [MHz]                         | ≤ 2517.5     |               |         |         | > 2517.5 |     |
|                         | RB <sub>start</sub>              | 0 - 22       |               | 23 - 76 | 77 - 99 | 0 - 99   |     |
|                         | LCRB [RBs]                       | ≤ 18 or ≥ 40 | > 18 and < 40 | N/A     | > 0     | > 0      |     |



|  |                                  |     |     |      |     |     |
|--|----------------------------------|-----|-----|------|-----|-----|
|  | RB <sub>start</sub> + LCRB [RBs] | N/A | N/A | ≥ 86 | N/A | N/A |
|  | A-MPR [dB]                       | ≤ 3 | ≤ 1 | ≤ 1  | 0   | 0   |
| NOTE 1: RB <sub>start</sub> indicates the lowest RB index of transmitted resource blocks   |                                  |     |     |      |     |     |
| NOTE 2: LCRB is the length of a contiguous resource block allocation   |                                  |     |     |      |     |     |
| NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per T <sub>no_hopping</sub> basis.  |                                  |     |     |      |     |     |
| NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot. |                                  |     |     |      |     |     |

**Table 6.2.4-4a: A-MPR requirements for "NS\_04" for Power Class 2 UE**

| Channel bandwidth [MHz]  | Parameters                       |          |               |         |         |        |          |
|--|----------------------------------|----------|---------------|---------|---------|--------|----------|
| 5  | Fc [MHz]                         | ≤ 2500.5 |               |         |         |        | > 2500.5 |
|  | RB <sub>start</sub>              | 0 - 8    |               | 9 - 24  |         | 0 - 24 |          |
|  | LCRB [RBs]                       | > 0      |               | > 0     |         | > 0    |          |
|  | A-MPR [dB]                       | ≤ 3      |               | 0       |         | 0      |          |
| 10   | Fc [MHz]                         | ≤ 2504   |               |         |         |        | > 2504   |
|  | RB <sub>start</sub>              | 0 - 8    |               | 9 - 35  | 36 - 49 | 0 - 49 |          |
|  | LCRB [RBs]                       | ≤ 15     | > 15 and < 25 | ≥ 25    | N/A     | > 0    | > 0      |
|  | RB <sub>start</sub> + LCRB [RBs] | N/A      | N/A           | N/A     | ≥ 45    | N/A    | N/A      |
|  | A-MPR [dB]                       | ≤ 5      | ≤ 2           | ≤ 3     | ≤ 1     | 0      | 0        |
| 15   | Fc [MHz]                         | ≤ 2510.8 |               |         |         |        | > 2510.8 |
|  | RB <sub>start</sub>              | 0 - 13   |               | 14 - 59 | 60 - 74 | 0 - 74 |          |
|  | LCRB [RBs]                       | ≤ 18     | > 18 and < 36 | ≥ 36    | N/A     | > 0    | > 0      |
|  | RB <sub>start</sub> + LCRB [RBs] | N/A      | N/A           | N/A     | ≥ 62    | N/A    | N/A      |
|  | A-MPR [dB]                       | ≤ 5      | ≤ 2           | ≤ 4     | ≤ 3     | 0      | 0        |
| 20   | Fc [MHz]                         | ≤ 2517.5 |               |         |         |        | > 2517.5 |
|  | RB <sub>start</sub>              | 0 - 22   |               | 23 - 76 | 77 - 99 | 0 - 99 |          |
|  | LCRB [RBs]                       | ≤ 18     | > 18 and < 40 | ≥ 40    | N/A     | > 0    | > 0      |
|  | RB <sub>start</sub> + LCRB [RBs] | N/A      | N/A           | N/A     | ≥ 86    | N/A    | N/A      |
|  | A-MPR [dB]                       | ≤ 5      | ≤ 2           | ≤ 4     | ≤ 3     | 0      | 0        |
| NOTE 1: RB <sub>start</sub> indicates the lowest RB index of transmitted resource blocks   |                                  |          |               |         |         |        |          |
| NOTE 2: LCRB is the length of a contiguous resource block allocation   |                                  |          |               |         |         |        |          |
| NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per T <sub>no_hopping</sub> basis.  |                                  |          |               |         |         |        |          |
| NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot. |                                  |          |               |         |         |        |          |

For a power class 2 capable UE operating in Band 41, A-MPR according to Table 6.2.4-4 for power class 3 is allowed when an IE *P-max* as defined in [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6.

**Table 6.2.4-5: A-MPR for "NS\_11"**

| Channel Bandwidth [MHz] | Parameters |       |                 |       |
|-------------------------|------------|-------|-----------------|-------|
| 3                       | Fc [MHz]   | <2004 | ≥2004           |       |
|                         | LCRB [RBs] | 1-15  | >5              |       |
|                         | A-MPR [dB] | ≤5    | ≤ 1             |       |
| 5                       | Fc [MHz]   | <2004 | 2004 ≤ Fc <2007 | ≥2007 |

|    |                      |                             |             |           |                               |      |     |
|----|----------------------|-----------------------------|-------------|-----------|-------------------------------|------|-----|
|    | LCRB [RBs]           | 1-25                        | 1-6 & 15-25 | 8-12      | >6                            |      |     |
|    | A-MPR [dB]           | ≤7                          | ≤4          | 0         | ≤1                            |      |     |
| 10 | F <sub>C</sub> [MHz] | 2005 ≤ F <sub>C</sub> <2015 |             | 2015      |                               |      |     |
|    | RB <sub>start</sub>  | 0-49                        |             | 0-49      |                               |      |     |
|    | LCRB [RBs]           | 1-50                        |             | 1-50      |                               |      |     |
|    | A-MPR [dB]           | ≤12                         |             | 0         |                               |      |     |
| 15 | F <sub>C</sub> [MHz] | <2012.5                     |             |           |                               |      |     |
|    | RB <sub>start</sub>  | 0-4                         | 5-21        | 22-56     | 57-74                         |      |     |
|    | LCRB [RBs]           | ≥1                          | 7-50        | 0-6 & ≥50 | ≤25                           | >25  | >0  |
|    | A-MPR [dB]           | ≤15                         | ≤7          | ≤10       | 0                             | ≤6   | ≤15 |
|    | F <sub>C</sub> [MHz] | 2012.5                      |             |           |                               |      |     |
|    | RB <sub>start</sub>  | 0-12                        | 13-39       | 40-65     | 66-74                         |      |     |
|    | LCRB [RBs]           | ≥1                          | ≥30         | <30       | ≥ (69 – RB <sub>start</sub> ) | ≥1   |     |
|    | A-MPR [dB]           | ≤10                         | ≤6          | 0         | ≤2                            | ≤6.5 |     |
| 20 | F <sub>C</sub> [MHz] | 2010                        |             |           |                               |      |     |
|    | RB <sub>start</sub>  | 0-12                        | 13-29       | 30-68     | 69-99                         |      |     |
|    | LCRB [RBs]           | ≥1                          | 10-60       | 1-9 & >60 | 1-24                          | ≥25  | ≥1  |
|    | A-MPR [dB]           | ≤15                         | ≤7          | ≤10       | 0                             | ≤7   | ≤15 |

Table 6.2.4-6: A-MPR for "NS\_12"

| Channel bandwidth [MHz] | Parameters          | Region A |    | Region B |
|-------------------------|---------------------|----------|----|----------|
| 1.4                     | RB <sub>start</sub> | 0        |    | 1-2      |
|                         | LCRB [RBs]          | ≤3       | ≥4 | ≥4       |
|                         | A-MPR [dB]          | ≤3       | ≤6 | ≤3       |
| 3                       | RB <sub>start</sub> | 0-3      |    | 4-5      |
|                         | LCRB [RBs]          | 1-15     |    | ≥9       |
|                         | A-MPR [dB]          | ≤4       |    | ≤3       |
| 5                       | RB <sub>start</sub> | 0-6      |    | 0-9      |
|                         | LCRB [RBs]          | ≤8       |    | ≥9       |
|                         | A-MPR [dB]          | ≤5       |    | ≤3       |
| 10                      | RB <sub>start</sub> | 0-15     |    | 0-22     |
|                         | LCRB [RBs]          | ≤18      |    | ≥20      |
|                         | A-MPR [dB]          | ≤4       |    | ≤2       |
| 15                      | RB <sub>start</sub> | 0-30     |    | 0-30     |
|                         | LCRB [RBs]          | ≤30      |    | ≥32      |
|                         | A-MPR [dB]          | ≤4       |    | ≤3       |

Table 6.2.4-7: A-MPR for "NS\_13"

| Channel bandwidth [MHz] | Parameters          | Region A |     |
|-------------------------|---------------------|----------|-----|
| 5                       | RB <sub>start</sub> | 0-2      |     |
|                         | LCRB [RBs]          | ≤5       | ≥18 |
|                         | A-MPR [dB]          | ≤3       | ≤2  |

**Table 6.2.4-8: A-MPR for "NS\_14"**

| Channel bandwidth [MHz] | Parameters          | Region A |     |
|-------------------------|---------------------|----------|-----|
| 10                      | RB <sub>start</sub> | 0        |     |
|                         | LCRB [RBs]          | ≤5       | =50 |
|                         | A-MPR [dB]          | ≤3       | ≤1  |
| 15                      | RB <sub>start</sub> | ≤8       |     |
|                         | LCRB [RBs]          | ≤16      | ≥50 |
|                         | A-MPR [dB]          | ≤3       | ≤1  |

**Table 6.2.4-9: A-MPR for "NS\_15" for E-UTRA highest channel edge > 845 MHz and ≤ 849 MHz**

| Channel bandwidth [MHz] | Parameters             | Region A | Region B | Region C |
|-------------------------|------------------------|----------|----------|----------|
| 1.4                     | RB <sub>end</sub> [RB] |          |          | 4-5      |
|                         | A-MPR [dB]             |          |          | ≤3       |
| 3                       | RB <sub>end</sub> [RB] | 0-1      | 8-12     | 13-14    |
|                         | LCRB [RB]              | ≤2       | ≥8       | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤4       | ≤9       |
| 5                       | RB <sub>end</sub> [RB] | 0-4      | 12-19    | 20-24    |
|                         | LCRB [RB]              | ≤2       | ≥8       | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤5       | ≤9       |
| 10                      | RB <sub>end</sub> [RB] | 0-12     | 23-36    | 37-49    |
|                         | LCRB [RB]              | ≤2       | ≥15      | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤6       | ≤9       |
| 15                      | RB <sub>end</sub> [RB] | 0-20     | 26-53    | 54-74    |
|                         | LCRB [RB]              | ≤2       | ≥20      | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤5       | ≤9       |

**Table 6.2.4-10: A-MPR for "NS\_15" for E-UTRA highest channel edge ≤ 845 MHz**

| Channel bandwidth [MHz] | Parameters             | Region A | Region B | Region C |
|-------------------------|------------------------|----------|----------|----------|
| 5                       | RB <sub>end</sub> [RB] |          |          | 19-24    |
|                         | LCRB [RB]              |          |          | ≥18      |
|                         | A-MPR [dB]             |          |          | ≤2       |
| 10                      | RB <sub>end</sub> [RB] | 0-4      | 29-44    | 45-49    |
|                         | LCRB [RB]              | ≤2       | ≥24      | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤4       | ≤9       |
| 15                      | RB <sub>end</sub> [RB] | 0-12     | 44-61    | 62-74    |
|                         | LCRB [RB]              | ≤2       | ≥20      | >0       |
|                         | A-MPR [dB]             | ≤4       | ≤5       | ≤9       |

**Table 6.2.4-11: A-MPR for "NS\_16" with channel lower edge at ≥807 MHz and <808.5 MHz**

| Channel bandwidth [MHz] | Parameter           | Region A | Region B | Region C | Region D | Region E |
|-------------------------|---------------------|----------|----------|----------|----------|----------|
| 3 MHz                   | RB <sub>start</sub> | 0        | 1-2      |          |          |          |
|                         | LCRB [RBs]          | ≥12      | 12       |          |          |          |
|                         | A-MPR [dB]          | ≤2       | ≤1       |          |          |          |
| 5 MHz                   | RB <sub>start</sub> | 0-1      | 2        | 2-9      | 2-5      |          |
|                         | LCRB [RBs]          | 1 - 25   | 12       | 15-18    | 20       |          |

|        |                     |        |       |     |       |       |
|--------|---------------------|--------|-------|-----|-------|-------|
|        | A-MPR [dB]          | ≤5     | ≤1    | ≤2  | ≤3    |       |
| 10 MHz | RB <sub>start</sub> | 0 - 8  | 0-14  |     | 15-20 | 15-24 |
|        | LCRB [RBs]          | 1 - 12 | 15-20 | ≥24 | ≥30   | 24-27 |
|        | A-MPR [dB]          | ≤5     | ≤3    | ≤7  | ≤3    | ≤1    |

**Table 6.2.4-12: A-MPR for "NS\_16" with channel lower edge at ≥808.5 MHz and <812 MHz**

| Channel bandwidth [MHz] | Parameter           | Region A | Region B | Region C | Region D | Region E |
|-------------------------|---------------------|----------|----------|----------|----------|----------|
| 5 MHz                   | RB <sub>start</sub> | 0        | 0-1      | 1-5      |          |          |
|                         | LCRB [RBs]          | 16-20    | ≥24      | 16-20    |          |          |
|                         | A-MPR [dB]          | ≤2       | ≤3       | ≤1       |          |          |
| 10 MHz                  | RB <sub>start</sub> | 0-6      |          | 0-10     | 0-14     | 11-20    |
|                         | LCRB [RBs]          | 1-12     | 15-20    | 24-32    | ≥36      | 24-32    |
|                         | A-MPR [dB]          | ≤5       | ≤2       | ≤4       | ≤5       | ≤1       |

**Table 6.2.4-13: A-MPR for "NS\_16" with channel lower edge at ≥812 MHz**

| Channel bandwidth [MHz] | Parameter           | Region A | Region B | Region C | Region D |
|-------------------------|---------------------|----------|----------|----------|----------|
| 10 MHz                  | RB <sub>start</sub> | 0 - 9    | 0        | 1-14     | 0-5      |
|                         | LCRB [RBs]          | 27-32    | 36-40    | 36-40    | ≥45      |
|                         | A-MPR [dB]          | ≤1       | ≤2       | ≤1       | ≤3       |

**Table 6.2.4-14: A-MPR for "NS\_19"**

| Channel bandwidth [MHz] | Parameters          | Region A | Region B |
|-------------------------|---------------------|----------|----------|
| 10                      | RB <sub>start</sub> |          | 0-6      |
|                         | LCRB [RBs]          |          | ≥40      |
|                         | A-MPR [dB]          |          | ≤1       |
| 15                      | RB <sub>start</sub> | 0-6      |          |
|                         | LCRB [RBs]          | ≤18      | ≥36      |
|                         | A-MPR [dB]          | ≤2       | ≤3       |
| 20                      | RB <sub>start</sub> | 0-14     |          |
|                         | LCRB [RBs]          | ≤40      | ≥45      |
|                         | A-MPR [dB]          | ≤2       | ≤3       |

**Table 6.2.4-15: A-MPR for "NS\_20"**

| Channel Bandwidth [MHz] | Parameters          |          |                      |      |                      |
|-------------------------|---------------------|----------|----------------------|------|----------------------|
| 5                       | Fc [MHz]            | < 2007.5 | 2007.5 ≤ Fc < 2012.5 |      | 2012.5 ≤ Fc ≤ 2017.5 |
|                         | RB <sub>start</sub> | ≤24      | 0-3                  | 4-6  | ≤24                  |
|                         | LCRB [RBs]          | >0       | 15-19                | ≥20  | ≥18                  |
|                         | A-MPR [dB]          | ≤17      | ≤1                   | ≤4   | ≤2                   |
| 10                      | Fc [MHz]            | 2005     |                      |      |                      |
|                         | RB <sub>start</sub> | 0-25     | 26-34                |      | 35-49                |
|                         | LCRB [RBs]          | >0       | 8-15                 | >15  | >0                   |
|                         | A-MPR [dB]          | ≤16      | ≤2                   | ≤5   | ≤6                   |
|                         | Fc [MHz]            | 2015     |                      |      |                      |
|                         | RB <sub>start</sub> | 0-5      |                      | 6-10 |                      |
|                         | LCRB [RBs]          | ≥32      |                      | ≥40  |                      |
| A-MPR [dB]              | ≤4                  |          | ≤2                   |      |                      |

|    |                     |             |             |       |       |       |       |       |
|----|---------------------|-------------|-------------|-------|-------|-------|-------|-------|
| 15 | Fc [MHz]            | 2012.5      |             |       |       |       |       |       |
|    | RB <sub>start</sub> | 0-14        |             | 15-24 |       | 25-39 | 61-74 |       |
|    | LCRB [RBs]          | 1-9 & 40-75 | 10-39       | 24-29 | ≥30   | ≥36   | ≤6    |       |
|    | A-MPR [dB]          | ≤11         | ≤6          | ≤1    | ≤7    | ≤5    | ≤6    |       |
| 20 | Fc [MHz]            | 2010        |             |       |       |       |       |       |
|    | RB <sub>start</sub> | 0-21        | 22-31       |       | 32-38 | 39-49 | 50-68 | 69-99 |
|    | LCRB [RBs]          | >0          | 1-9 & 31-75 | 10-30 | ≥15   | ≥24   | ≥25   | >0    |
|    | A-MPR [dB]          | ≤17         | ≤12         | ≤6    | ≤9    | ≤7    | ≤5    | ≤16   |

NOTE 1: When NS\_20 is signaled the minimum requirements for the 10 MHz bandwidth are specified for E-UTRA UL carrier center frequencies of 2005 MHz or 2015 MHz.  
 NOTE 2: When NS\_20 is signaled the minimum requirements for the 15 MHz channel bandwidth are specified for E-UTRA UL carrier center frequency of 2012.5 MHz.

Table 6.2.4-16: A-MPR for "NS\_21"

| Channel Bandwidth [MHz] | Parameters          | Region A |                 | Region B |                 |
|-------------------------|---------------------|----------|-----------------|----------|-----------------|
| 10                      | RB <sub>start</sub> | 0 – 6    | 0 – 6           | N/A      | N/A             |
|                         | RB <sub>end</sub>   | N/A      | N/A             | 43 – 49  | 43 – 49         |
|                         | LCRB [RBs]          | 1 – 2    | 3 – 12, 32 - 50 | 1 – 2    | 3 – 12, 32 - 50 |
|                         | A-MPR [dB]          | ≤ 4      | ≤ 3             | ≤ 4      | ≤ 3             |

Table 6.2.4-17: A-MPR for "NS\_22"

| Channel bandwidth [MHz] | Parameters                                     | Region A | Region B | Region C | Region D |
|-------------------------|--|----------|----------|----------|----------|
| 5                       | No A-MPR is needed for 5 MHz channel bandwidth |          |          |          |          |
| 10                      | RB <sub>start</sub>                            | 0-13     | 0-17     | ≤ 6      | ≥12      |
|                         | LCRB [RBs]                                     | > 36     | 33-36    | ≤ 32     | ≤ 32     |
|                         | RB <sub>start</sub> + LCRB [RBs]               | N/A      | N/A      | N/A      | ≥44      |
|                         | A-MPR [dB]                                     | ≤ 4      | ≤ 3      | ≤ 3      | ≤ 3      |
| 15                      | RB <sub>start</sub>                            | 0-24     | 0-38     | ≤ 14     | ≥ 23     |
|                         | LCRB [RBs]                                     | > 50     | 37-50    | ≤ 36     | ≤ 36     |
|                         | RB <sub>start</sub> + LCRB [RBs]               | N/A      | N/A      | N/A      | ≥59      |
|                         | A-MPR [dB]                                     | ≤ 5      | ≤ 4      | ≤ 3      | ≤ 3      |
| 20                      | RB <sub>start</sub>                            | 0-35     | 0-51     | ≤ 21     | ≥ 31     |
|                         | LCRB [RBs]                                     | > 64     | 49-64    | ≤ 48     | ≤ 48     |
|                         | RB <sub>start</sub> + LCRB [RBs]               | N/A      | N/A      | N/A      | ≥79      |
|                         | A-MPR [dB]                                     | ≤ 5      | ≤ 4      | ≤ 3      | ≤ 3      |

NOTE 1; RB<sub>start</sub> indicates the lowest RB index of transmitted resource blocks  
 NOTE 2; LCRB is the length of a contiguous resource block allocation  
 NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping between two regions, notes 1 and 2 apply on a per T<sub>no\_hopping</sub> basis.  
 NOTE 4; For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. For intra-slot frequency hopping between two regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping between two regions, the larger A-MPR value may be applied for the subslot.

Table 6.2.4-18: A-MPR for "NS\_05"

| Channel Bandwidth [MHz] | Parameters          |        |        |         |     |       |    |
|-------------------------|---------------------|--------|--------|---------|-----|-------|----|
| 15                      | Fc [MHz]            | 1932.5 |        |         |     |       |    |
|                         | RB <sub>start</sub> | 0-7    | 8 – 66 |         |     | 67-74 |    |
|                         | LCRB [RBs]          | ≥1     | ≤30    | 31 – 54 | >54 | ≤6    | >6 |
|                         | A-MPR [dB]          | ≤11    | 0      | ≤3      | ≤5  | ≤5    | ≤1 |

|    |                     |      |       |         |         |      |       |    |
|----|---------------------|------|-------|---------|---------|------|-------|----|
| 20 | Fc [MHz]            | 1930 |       |         |         |      |       |    |
|    | RB <sub>start</sub> | 0-23 | 24-75 |         |         |      | 76-99 |    |
|    | LCRB [RBs]          | ≥1   | ≤24   | 25 – 40 | 41 – 50 | > 50 | ≤6    | >6 |
|    | A-MPR [dB]          | ≤11  | 0     | ≤3      | ≤5      | ≤10  | ≤5    | ≤1 |

**Table 6.2.4-18E: A-MPR requirements for "NS\_05" for Cat-M2 power class 3 UE**

|  |                  |                  |                  |                  |                  |
|--|------------------|------------------|------------------|------------------|------------------|
| <b>BW [MHz]</b>                                | <b>20</b>        |                  |                  |                  |                  |
| <b>Fc [MHz]</b>                                | <b>1930</b>      |                  |                  |                  |                  |
| <b>(NB<sub>index</sub>,RB<sub>start</sub>)</b> | <b>(0,&lt;6)</b> | <b>(0,&lt;6)</b> | <b>(1,&lt;6)</b> | <b>(2,&lt;6)</b> | <b>(2,&lt;6)</b> |
| <b>LCRB</b>                                    | 9, 12            | ≥15              | ≥15              | 18               | 24               |
| <b>A-MPR [dB]</b>                              | ≤1               | ≤4               | ≤3               | ≤1               | ≤2               |

NOTE 1: NB<sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].

**Table 6.2.4-19: A-MPR for "NS\_24"**

| Channel Bandwidth [MHz] | Parameters          |                      |        |         |         |      |                  |           |
|-------------------------|---------------------|----------------------|--------|---------|---------|------|------------------|-----------|
| 5                       | Fc [MHz]            | Fc > [1987.5]        |        |         |         |      |                  |           |
|                         | RB <sub>start</sub> | 0 - 24               |        |         |         |      |                  |           |
|                         | LCRB [RBs]          | 0 - 24               |        |         |         |      |                  |           |
|                         | A-MPR [dB]          | ≤ 10                 |        |         |         |      |                  |           |
| 10                      | Fc [MHz]            | 1975 < Fc ≤ 1985     |        |         |         |      | 1985 < Fc ≤ 1995 | Fc > 1995 |
|                         | RB <sub>start</sub> | 0 - 1                | 2 - 14 | 15 - 26 | 36 - 49 |      | 0 - 49           | 0 - 49    |
|                         | LCRB [RBs]          | > 10                 | ≥ 35   | N/A     | ≤ 2     | > 11 | 0 - 49           | 0 - 49    |
|                         | RB <sub>end</sub>   | N/A                  | N/A    | > 48    | N/A     | N/A  | N/A              | N/A       |
|                         | A-MPR [dB]          | ≤ 2                  | ≤ 2    | 1       | ≤ 3     | ≤ 1  | ≤ 9              | ≤ 17      |
| 15                      | Fc [MHz]            | 1972.5 < Fc ≤ 1987.5 |        |         |         |      | Fc > 1987.5      |           |
|                         | RB <sub>start</sub> | 0 - 11               |        |         | 12 - 74 |      | 0 - 74           |           |
|                         | LCRB [RBs]          | ≤ 45                 |        | > 45    |         | > 3  |                  | 0 - 74    |
|                         | RB <sub>end</sub>   | N/A                  |        | N/A     |         | ≥ 45 |                  | N/A       |
|                         | A-MPR [dB]          | ≤ 2                  |        | ≤ 8     |         | ≤ 7  |                  | ≤ 17      |
| 20                      | Fc [MHz]            | Fc > 1970            |        |         |         |      |                  |           |
|                         | RB <sub>start</sub> | 0 - 99               |        |         |         |      |                  |           |
|                         | LCRB [RBs]          | 0 - 99               |        |         |         |      |                  |           |
|                         | A-MPR [dB]          | ≤ 17                 |        |         |         |      |                  |           |

**Table 6.2.4-20: A-MPR for "NS\_25"**

| Channel Bandwidth [MHz] | Parameters          |                  |                  |         |           |
|-------------------------|---------------------|------------------|------------------|---------|-----------|
| 5                       | Fc [MHz]            | Fc > [1997.5]    |                  |         |           |
|                         | RB <sub>start</sub> | 0 - 9            |                  | 10 - 24 |           |
|                         | LCRB [RBs]          | > 12             |                  | N/A     |           |
|                         | RB <sub>end</sub>   | N/A              |                  | ≥ 22    |           |
|                         | A-MPR [dB]          | ≤ 5              |                  | ≤ 2     |           |
| 10                      | Fc [MHz]            | 1975 < Fc ≤ 1985 | 1985 < Fc ≤ 1995 |         | Fc > 1995 |

|    |                        |                                  |      |         |      |         |       |         |                         |        |
|----|------------------------|----------------------------------|------|---------|------|---------|-------|---------|-------------------------|--------|
|    | RB <sub>start</sub>    | 0-1                              | 2-49 | 0       |      | 1 - 18  | 19-49 | 0-6     | 7-15                    | 16-49  |
|    | L <sub>CRB</sub> [RBs] | > 10                             | N/A  | ≤ 25    | > 25 | > 25    | N/A   | N/A     | > 20                    | N/A    |
|    | RB <sub>end</sub>      | N/A                              | > 48 | N/A     | N/A  | N/A     | > 42  | N/A     | N/A                     | > 35   |
|    | A-MPR [dB]             | ≤ 1                              | ≤ 1  | ≤ 1     | ≤ 5  | ≤ 5     | ≤ 1   | ≤ 10    | ≤ 7                     | ≤ 11   |
| 15 | F <sub>c</sub> [MHz]   | 1972.5 < F <sub>c</sub> ≤ 1987.5 |      |         |      |         |       |         | F <sub>c</sub> > 1987.5 |        |
|    | RB <sub>start</sub>    | 0 - 4                            |      | 5 - 30  |      | 31 - 62 |       | 63 - 74 |                         | 0 - 74 |
|    | L <sub>CRB</sub> [RBs] | ≥ 15                             |      | ≥ 45    |      | N/A     |       | N/A     |                         | 0 - 74 |
|    | RB <sub>end</sub>      | N/A                              |      | N/A     |      | > 71    |       | N/A     |                         | N/A    |
|    | A-MPR [dB]             | ≤ 4                              |      | ≤ 3     |      | ≤ 1     |       | ≤ 1     |                         | ≤ 13   |
| 20 | F <sub>c</sub> [MHz]   | 1970 < F <sub>c</sub> ≤ 1990     |      |         |      |         |       |         | F <sub>c</sub> > 1990   |        |
|    | RB <sub>start</sub>    | 0 - 13                           |      | 14 - 40 |      | 41 - 99 |       | 0 - 99  |                         |        |
|    | L <sub>CRB</sub> [RBs] | N/A                              |      | ≥ 32    |      | N/A     |       | 0 - 99  |                         |        |
|    | RB <sub>end</sub>      | N/A                              |      | N/A     |      | > 72    |       | N/A     |                         |        |
|    | A-MPR [dB]             | ≤ 11                             |      | ≤ 11    |      | ≤ 13    |       | ≤ 13    |                         |        |

Table 6.2.4-21: A-MPR for "NS\_26"

| Bandwidth (MHz) | RBstart | L <sub>crb</sub> | A-MPR |
|-----------------|---------|------------------|-------|
| 10              | 0 - 10  | ≥ 1              | ≤ 1   |
| 15              | 0 - 17  | ≥ 1              | ≤ 1   |

Table 6.2.4-22: A-MPR for "NS\_27"

| Parameters              |                     |                   |                  |        |
|-------------------------|---------------------|-------------------|------------------|--------|
| Channel bandwidth [MHz] | RB <sub>start</sub> | RB <sub>end</sub> | L <sub>CRB</sub> | A-MPR  |
| 15                      | 0 - 6               |                   | ≤ 15             | ≤ 4 dB |
|                         |                     | 68 - 74           |                  |        |
|                         | ≥ 0                 |                   | ≥ 60             | ≤ 2 dB |
| 20                      | 0 - 12              |                   | ≤ 20             | ≤ 4 dB |
|                         |                     | 87 - 99           |                  |        |
|                         | 13 - 15             |                   | ≤ 3              | ≤ 1 dB |
|                         |                     | 84 - 86           |                  |        |
| ≥ 0                     |                     | ≥ 60              | ≤ 3 dB           |        |

Table 6.2.4-23: A-MPR for "NS\_28"

| Parameters  |  |                            |            |
|---|--|----------------------------|------------|
| Channel Bandwidth [MHz]   | Carrier centre frequency (F <sub>c</sub> ) [MHz]   | Uplink resource allocation | A-MPR [dB] |
| 20  | 5160 ≤ F <sub>c</sub> < 5179.8<br>5320.2 < F <sub>c</sub> ≤ 5340<br>5480 ≤ F <sub>c</sub> < 5499.8 | L = 10 (RIV = 19)          | 9          |
|   |  | Any other RIV              | 8          |
|   | 5680.2 < F <sub>c</sub> ≤ 5715   | L = 10 (RIV = 19)          | 9          |
|   |  | Any other RIV              | 8          |
|   | 5179.8 ≤ F <sub>c</sub> ≤ 5320.2<br>5499.8 ≤ F <sub>c</sub> ≤ 5680.2                               | L = 10 (RIV = 19)          | 2          |
|   |  | Any other RIV              | 2          |
| NOTE 1: The carrier centre frequencies and corresponding EARFCN allowed for operation in Band 46 are specified in [12]. The uplink resource allocation is defined in Clause 8.1.4 of [6]. |  |                            |            |

**Table 6.2.4-24: A-MPR for "NS\_29"**

| Parameters  |  |                            |            |
|---|--|----------------------------|------------|
| Channel Bandwidth [MHz]   | Carrier centre frequency (F <sub>c</sub> ) [MHz] | Uplink resource allocation | A-MPR [dB] |
| 20  | 5179.8 ≤ F <sub>c</sub> ≤ 5320.2                 | L = 10 (RIV = 19)          | 2          |
|   | 5499.8 ≤ F <sub>c</sub> ≤ 5700.2                 | Any other RIV              | 1          |
| NOTE 1: The carrier centre frequencies and corresponding EARFCN allowed for operation in Band 46 are specified in [12]. The uplink resource allocation is defined in Clause 8.1.4 of [6]. |  |                            |            |

**Table 6.2.4-25: A-MPR for "NS\_30"**

| Parameters              |   |                            |            |  |
|-------------------------|---|----------------------------|------------|--|
| Channel Bandwidth [MHz] | Carrier centre frequency (F <sub>c</sub> ) [MHz]  | Uplink resource allocation | A-MPR [dB] |  |
| 20                      | 5160 ≤ F <sub>c</sub> < 5179.8<br>5320.2 < F <sub>c</sub> ≤ 5340  | L = 10 (RIV = 19)          | 15         |  |
|                         |   | Any other RIV              | 16         |  |
|                         | 5179.8 ≤ F <sub>c</sub> < 5199.8<br>5300.2 < F <sub>c</sub> ≤ 5320.2  | L = 10 (RIV = 19)          | 3          |  |
|                         |   | Any other RIV              | 3          |  |
|                         | 5480 ≤ F <sub>c</sub> < 5499.8  | L = 10 (RIV = 19)          | 11         |  |
|                         |   | Any other RIV              | 11         |  |
|                         | 5680.2 < F <sub>c</sub> ≤ 5715  | L = 10 (RIV = 19)          | 6          |  |
|                         |   | Any other RIV              | 6          |  |
|                         | 5199.8 ≤ F <sub>c</sub> ≤ 5300.2<br>5499.8 ≤ F <sub>c</sub> ≤ 5680.2  | L = 10 (RIV = 19)          | 1          |  |
|                         |   | Any other RIV              | N/A        |  |
|                         | NOTE 1: The carrier centre frequencies and corresponding EARFCN allowed for operation in Band 46 are specified in [12]. The uplink resource allocation is defined in Clause 8.1.4 of [6]. The uplink resource allocation is defined in Clause 8.1.4 of [6]. |                            |            |  |

**Table 6.2.4-26: A-MPR for "NS\_31"**

| Channel Bandwidth [MHz] | Carrier centre frequency (F <sub>c</sub> ) [MHz]  | Uplink resource allocation | A-MPR [dB] |
|-------------------------|---|----------------------------|------------|
| 20                      | 5239.8 ≤ F <sub>c</sub> ≤ 5240.2  | L = 10 (RIV = 19)          | 7          |
|                         |   | Any other RIV              | 7          |
|                         | 5160 ≤ F <sub>c</sub> < 5179.8<br>5260 ≤ F <sub>c</sub> < 5279.8<br>5320.2 < F <sub>c</sub> ≤ 5340<br>5480 ≤ F <sub>c</sub> < 5499.8  | L = 10 (RIV = 19)          | 6          |
|                         |   | Any other RIV              | 6          |
|                         |   | L = 10 (RIV = 19)          | 6          |
|                         | 5680.2 < F <sub>c</sub> ≤ 5715<br>5805.2 < F <sub>c</sub> ≤ 5840  | L = 10 (RIV = 19)          | 6          |
|                         |   | Any other RIV              | 6          |
|                         | 5735 ≤ F <sub>c</sub> < 5764.8  | L = 10 (RIV = 19)          | 6          |
|                         |   | Any other RIV              | 6          |
|                         | 5179.8 ≤ F <sub>c</sub> ≤ 5220.2<br>5279.8 ≤ F <sub>c</sub> ≤ 5320.2<br>5499.8 ≤ F <sub>c</sub> ≤ 5680.2<br>5764.8 ≤ F <sub>c</sub> ≤ 5805.2  | L = 10 (RIV = 19)          | 2          |
|                         |   | Any other RIV              | 1          |
|                         | NOTE 1: The carrier centre frequencies and corresponding EARFCN allowed for operation in Band 46 are specified in [12]. The uplink resource allocation is defined in Clause 8.1.4 of [6]. |                            |            |

**Table 6.2.4-27: A-MPR for "NS\_36"**

| Channel Bandwidth [MHz] | Parameters |
|-------------------------|------------|
|-------------------------|------------|



|               |                              |                                |         |         |         |
|---------------|------------------------------|--------------------------------|---------|---------|---------|
| <b>5 MHz</b>  | <b>F<sub>c</sub> [MHz]</b>   | 700.5 ≤ F <sub>c</sub> < 705.5 |         |         |         |
|               | <b>RB<sub>start</sub></b>    | 0                              |         | 1-4     |         |
|               | <b>L<sub>CRB</sub> [RBs]</b> | 1                              | ≥ 15    | 15 - 23 | 24      |
|               | <b>A-MPR [dB]</b>            | ≤ 2                            | ≤ 4     | ≤ 1     | ≤ 3     |
| <b>10 MHz</b> | <b>F<sub>c</sub> [MHz]</b>   | 703 ≤ F <sub>c</sub> < 708     |         |         |         |
|               | <b>RB<sub>start</sub></b>    | 0 - 8                          | 9 - 12  | 13 - 39 | 40 - 43 |
|               | <b>L<sub>CRB</sub> [RBs]</b> | > 0                            | > 12    | > 16    | > 0     |
|               | <b>A-MPR [dB]</b>            | ≤ 10                           | ≤ 8     | ≤ 6     | ≤ 6     |
| <b>15 MHz</b> | <b>F<sub>c</sub> [MHz]</b>   | F <sub>c</sub> = 705.5         |         |         |         |
|               | <b>RB<sub>start</sub></b>    | 0 - 16                         | 17 - 23 | 24 - 56 | 57 - 60 |
|               | <b>L<sub>CRB</sub> [RBs]</b> | > 0                            | > 12    | > 20    | < 6     |
|               | <b>A-MPR [dB]</b>            | ≤ 10                           | ≤ 9     | ≤ 7     | ≤ 6     |

NOTE 1: RB<sub>start</sub> indicates the lowest RB index of transmitted resource blocks  
 NOTE 2: L<sub>CRB</sub> is the length of a contiguous resource block allocation  
 NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping between two regions, notes 1 and 2 apply on a per T<sub>no\_hopping</sub> basis.  
 NOTE 4: For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. For intra-slot frequency hopping between two regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping between two regions, the larger A-MPR value may be applied for the subslot.

Table 6.2.4-28: A-MPR for "NS\_38"

| Channel Bandwidth [MHz] | Carrier centre frequency (F <sub>c</sub> ) [MHz] | Parameters             | Region A |      | Region B |      | Region C |      | Region D |      | Region E |      |
|-------------------------|--|------------------------|----------|------|----------|------|----------|------|----------|------|----------|------|
| 1.4                     | 1427.7 ≤ F <sub>c</sub> < 1429.1                 | A-MPR [dB]             | ≤ [16]   |      |          |      |          |      |          |      |          |      |
| 3                       | 1428.5 ≤ F <sub>c</sub> < 1431.5                 | RB <sub>start</sub>    | 0        |      | 1-2      |      | 3-6      |      |          |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 1        | ≥ 2  | 2        | ≥ 3  | 5-7      | ≥ 8  |          |      |          |      |
|                         |  | A-MPR [dB]             | ≤ 11     | ≤ 16 | ≤ 9      | ≤ 15 | ≤ 12     | ≤ 14 |          |      |          |      |
| 5                       | 1429.5 ≤ F <sub>c</sub> < 1434.5                 | RB <sub>start</sub>    | 0 - 1    |      | 2 - 4    |      | 5 - 7    |      | 8 - 10   |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 2        | ≥ 3  | 4-6      | ≥ 7  | 8-10     | ≥ 11 | 12-14    | ≥ 15 |          |      |
|                         |  | A-MPR [dB]             | ≤ 12     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 12     | ≤ 15 | ≤ 10     | ≤ 12 |          |      |
| 10                      | 1432 ≤ F <sub>c</sub> < 1442                     | RB <sub>start</sub>    | 0        |      | 1 - 4    |      | 5 - 9    |      | 10 - 14  |      | 15 - 21  |      |
|                         |  | L <sub>CRB</sub> [RBs] | 3-4      | ≥ 5  | 5-8      | ≥ 9  | 9-16     | ≥ 17 | 15-23    | ≥ 24 | 24-29    | ≥ 30 |
|                         |  | A-MPR [dB]             | ≤ 13     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 11     | ≤ 14 | ≤ 11     | ≤ 13 |
| 15                      | 1434.5 ≤ F <sub>c</sub> < 1447.5                 | RB <sub>start</sub>    | 0 - 1    |      | 2 - 7    |      | 8 - 17   |      | 18 - 23  |      | 24 - 30  |      |
|                         |  | L <sub>CRB</sub> [RBs] | 5-10     | ≥ 11 | 8-12     | ≥ 13 | 15-25    | ≥ 26 | 26-40    | ≥ 41 | ≥ 36     |      |
|                         |  | A-MPR [dB]             | ≤ 14     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 12     | ≤ 14 | ≤ 12     |      |
| 20                      | 1437 ≤ F <sub>c</sub> < 1450                     | RB <sub>start</sub>    | 0 - 4    |      | 5 - 9    |      | 10 - 19  |      | 20 - 29  |      | 30 - 40  |      |
|                         |  | L <sub>CRB</sub> [RBs] | 6-10     | ≥ 11 | 11-20    | ≥ 21 | 17-32    | ≥ 33 | 28-45    | ≥ 46 | 41-54    | ≥ 55 |
|                         |  | A-MPR [dB]             | ≤ 13     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 12     | ≤ 14 | ≤ 11     | ≤ 13 |

Table 6.2.4-29: A-MPR for "NS\_39"

| Channel Bandwidth [MHz] | Carrier centre frequency (F <sub>c</sub> ) [MHz] | Parameters             | Region A |              |      | Region B | Region C |
|-------------------------|--|------------------------|----------|--------------|------|----------|----------|
| 10                      | 1462 < F <sub>c</sub> ≤ 1465                     | RB <sub>start</sub>    | 43-50    |              |      |          |          |
|                         |  | L <sub>CRB</sub> [RBs] | ≤ 3      | > 3 and ≤ 25 | ≥ 32 |          |          |
|                         |  | A-MPR [dB]             | ≤ 4      | ≤ 3          | ≤ 3  |          |          |
| 15                      |  | RB <sub>start</sub>    | 56-75    |              |      | 64-75    | 60-75    |

|    |                                  |                     |        |               |              |     |
|----|----------------------------------|---------------------|--------|---------------|--------------|-----|
|    | 1456.3 < F <sub>C</sub> ≤ 1462.5 | LCRB [RBs]          | ≥ 36   | ≥ 13 and ≤ 35 | ≥ 5 and ≤ 12 | < 5 |
|    |                                  | A-MPR [dB]          | ≤ 3    | ≤ 2           | ≤ 3          | ≤ 4 |
| 20 | 1450.8 < F <sub>C</sub> ≤ 1460   | RB <sub>start</sub> | 71-100 | >76           |              |     |
|    |                                  | LCRB [RBs]          | ≥ 36   | ≥ 7 and ≤ 35  | < 7          |     |
|    |                                  | A-MPR [dB]          | ≤ 3    | ≤ 3           | ≤ 4          |     |

Table 6.2.4-30a: A-MPR for "NS\_40"

| Channel bandwidth confined to 1427-1432MHz (B51) |  |                     |          |      |          |      |          |      |          |      |
|--|--|---------------------|----------|------|----------|------|----------|------|----------|------|
| Channel bandwidth [MHz]                          | Carrier centre frequency (F <sub>C</sub> ) [MHz] | Parameters          | Region A |      | Region B |      | Region C |      | Region D |      |
| 3MHz   | 1428.5 MHz ≤ F <sub>C</sub> ≤ 1430.5 MHz         | RB <sub>start</sub> | 0        |      | 1-2      |      | 3-6      |      |          |      |
|  |  | LCRB [RBs]          | 1        | ≥2   | 2        | ≥3   | 5-6      | ≥8   |          |      |
|  |  | A-MPR [dB]          | ≤ 11     | ≤ 16 | ≤ 9      | ≤ 15 | ≤ 12     | ≤ 14 |          |      |
| 5MHz   | 1429.5 MHz ≤ F <sub>C</sub> ≤ 1432 MHz           | RB <sub>start</sub> | 0 - 1    |      | 2 - 4    |      | 5 - 7    |      | 8 - 10   |      |
|  |  | LCRB [RBs]          | 2        | ≥3   | 4-6      | ≥7   | 8-10     | ≥11  | 12       | ≥15  |
|  |  | A-MPR [dB]          | ≤ 12     | ≤ 16 | ≤ 13     | ≤ 16 | ≤ 12     | ≤ 15 | ≤ 10     | ≤ 12 |

Table 6.2.4-30b: A-MPR for "NS\_40"

| Channel bandwidth confined to 1429-1432MHz (B51) |  |                     |          |
|--|--|---------------------|----------|
| Channel bandwidth [MHz]                          | Carrier centre frequency (F <sub>C</sub> ) [MHz] | Parameters          | Region A |
| 3MHz   | 1430.5 MHz < F <sub>C</sub> ≤ 1432 MHz           | RB <sub>start</sub> | 0        |
|  |  | LCRB [RBs]          | 12       |
|  |  | A-MPR [dB]          | ≤ 9      |

Table 6.2.4-31: A-MPR for "NS\_41"

| Channel bandwidth confined to 1432-1452MHz (B50) |                     |          |          |          |          |          |          |          |          |
|--|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Channel bandwidth [MHz]                          | Parameters          | Region A | Region B | Region C | Region D | Region E | Region F | Region G | Region H |
| 3MHz   | RB <sub>start</sub> |          |          |          |          |          |          |          |          |
|  | LCRB [RBs]          |          |          |          |          |          |          |          |          |
|  | A-MPR [dB]          |          |          |          |          |          |          |          |          |
| 5MHz   | RB <sub>start</sub> |          |          |          |          |          |          |          |          |
|  | LCRB [RBs]          |          |          |          |          |          |          |          |          |
|  | A-MPR [dB]          |          |          |          |          |          |          |          |          |
| 10MHz  | RB <sub>start</sub> | 0 - 4    | 5 - 6    |          |          |          |          |          |          |
|  | LCRB [RBs]          | ≥ 36     | ≥ 40     |          |          |          |          |          |          |

|        |                        |      |       |      |       |       |         |         |         |         |
|--------|------------------------|------|-------|------|-------|-------|---------|---------|---------|---------|
|        | A-MPR [dB]             | ≤ 11 | ≤ 10  |      |       |       |         |         |         |         |
| 15MHz  | RB <sub>start</sub>    | 0-1  | 02-06 |      | 07-11 | 12-13 | 14-15   |         |         |         |
|        | L <sub>CRB</sub> [RBs] | ≥ 36 | ≥ 40  |      | ≥ 48  | 26-40 |         | ≥ 54    |         |         |
|        | A-MPR [dB]             | ≤ 12 | ≤ 12  |      | ≤ 11  | ≤ 10  | ≤ 10    |         |         |         |
| 20 MHz | RB <sub>start</sub>    | 0    | 1 – 4 |      | 5-6   | 7-9   | 10 – 11 | 12 – 16 | 17 – 20 | 21 – 26 |
|        | L <sub>CRB</sub> [RBs] | ≥ 36 | 45-53 | ≥ 54 | ≥ 33  | ≥ 48  | ≥ 50    | ≥ 60    | ≥ 64    | ≥ 64    |
|        | A-MPR [dB]             | ≤ 12 | ≤ 11  | ≤ 12 | ≤ 12  | ≤ 12  | ≤ 12    | ≤ 12    | ≤ 11    | ≤ 10    |

Table 6.2.4-32: A-MPR for “NS\_42”

| Channel bandwidth [MHz] | Carrier centre frequency (F <sub>c</sub> ) [MHz] | Parameters             | Region A |      | Region B |      | Region C |      | Region D |      | Region E |      |
|-------------------------|--|------------------------|----------|------|----------|------|----------|------|----------|------|----------|------|
| 3MHz                    | 1512.5 MHz ≤ F <sub>c</sub> ≤ 1515.5 MHz         | RB <sub>start</sub>    | 0 – 3    |      | 4 – 7    |      | 8-10     |      | 11-14    |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 8-11     | ≥ 12 | ≥ 8      |      | ≥ 3      | ≥ 1  |          |      |          |      |
|                         |  | A-MPR [dB]             | ≤ 3      | ≤ 5  | ≤ 6      |      | ≤ 3      | ≤ 3  |          |      |          |      |
| 3MHz                    | 1511 MHz ≤ F <sub>c</sub> < 1512.5 MHz           | RB <sub>start</sub>    | 0        |      |          |      |          |      |          |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 12       |      |          |      |          |      |          |      |          |      |
|                         |  | A-MPR [dB]             | ≤ 1      |      |          |      |          |      |          |      |          |      |
| 5MHz                    | 1507 MHz ≤ F <sub>c</sub> ≤ 1514.5 MHz           | RB <sub>start</sub>    | 0 – 5    |      | 6 – 11   |      | 12-16    |      | 17-24    |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 12-16    | ≥ 17 | 9-12     | ≥ 13 | 5-8      | ≥ 9  | 1-6      | ≥ 7  |          |      |
|                         |  | A-MPR [dB]             | ≤ 5      | ≤ 9  | ≤ 6      | ≤ 10 | ≤ 4      | ≤ 9  | ≤ 4      | ≤ 6  |          |      |
| 10MHz                   | 1502 MHz ≤ F <sub>c</sub> ≤ 1512 MHz             | RB <sub>start</sub>    | 0 – 22   |      | 23 – 27  |      | 28-35    |      | 36-49    |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | ≥ 20     |      | 15-19    | ≥ 20 | 3-14     | ≥ 15 | 1-9      | ≥ 10 |          |      |
|                         |  | A-MPR [dB]             | ≤ 4      |      | ≤ 4      | ≤ 9  | ≤ 4      | ≤ 10 | ≤ 3      | ≤ 8  |          |      |
| 10MHz                   | 1497 MHz ≤ F <sub>c</sub> < 1502 MHz             | RB <sub>start</sub>    | 0 – 5    |      |          |      |          |      |          |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | 40       |      |          |      |          |      |          |      |          |      |
|                         |  | A-MPR [dB]             | ≤ 1      |      |          |      |          |      |          |      |          |      |
| 15MHz                   | 1497 MHz ≤ F <sub>c</sub> ≤ 1509.5 MHz           | RB <sub>start</sub>    | 0 – 22   |      | 23 – 48  |      | 49-60    |      | 61-74    |      |          |      |
|                         |  | L <sub>CRB</sub> [RBs] | ≥ 36     |      | 9-23     | ≥ 24 | 1-14     | ≥ 15 | ≥ 1      |      |          |      |
|                         |  | A-MPR [dB]             | ≤ 4      |      | ≤ 3      | ≤ 5  | ≤ 3      | ≤ 9  | ≤ 4      |      |          |      |
| 20 MHz                  | 1492 MHz ≤ F <sub>c</sub> ≤ 1507 MHz             | RB <sub>start</sub>    | 0 – 20   |      | 21 – 40  |      | 41 – 60  |      | 61 – 80  |      | 81 – 99  |      |
|                         |  | L <sub>CRB</sub> [RBs] | 24-47    | ≥ 48 | ≥ 40     |      | 15-29    | ≥ 30 | 1-17     | ≥ 18 | 1-14     | ≥ 15 |
|                         |  | A-MPR [dB]             | ≤ 2      | ≤ 4  | ≤ 3      |      | ≤ 2      | ≤ 4  | ≤ 3      | ≤ 4  | ≤ 3      | ≤ 6  |

Table 6.2.4-32a: Void

Table 6.2.4-32b: Void

Table 6.2.4-33: A-MPR for “NS\_43”

| Parameters  |  |                            |            |
|---|--|----------------------------|------------|
| Channel bandwidth (MHz)   | Carrier centre frequency (F <sub>c</sub> ) (MHz) | Uplink resource allocation | A-MPR (dB) |
| 20  | $3580 \leq F_c \leq 3670$                        | L = 10 (RIV = 19)          | [1]        |
|   |  | Any other RIV              | [2]        |
|   | $3560 \leq F_c < 3580$<br>$3670 < F_c \leq 3690$ | L = 10 (RIV = 19)          | [4]        |
|   |  | Any other RIV              | [4]        |
| NOTE 1: The uplink resource allocation is defined in Clause 8.1.4 of TS 36.213 [6]. |  |                            |            |

Table 6.2.4-34: A-MPR requirements for “NS\_44” for Power Class 2 UE

| Channel bandwidth [MHz] | Parameters           |                     |                        |            |
|-------------------------|----------------------|---------------------|------------------------|------------|
|                         | F <sub>c</sub> [MHz] | RB <sub>start</sub> | L <sub>CRB</sub> [RBs] | A-MPR [dB] |
| 10                      | $\geq 2605$          | 0 – 5               | $\geq 45$              | $\leq 1$   |
|                         | $< 2605$             | 38-49               | $< 13$                 | $\leq 1$   |
|                         |                      | 0 - 49              | $> 0$                  | 0          |
|                         |                      | N/A                 | NA                     | N/A        |
|                         |                      | N/A                 | NA                     | N/A        |
| 15                      | $\geq 2597.5$        | 0 – 18              | $\geq 45 \& < 56$      | $\leq 1$   |
|                         | $< 2597.5$           | 19-30               | $< 17$                 | $\leq 1$   |
|                         |                      | 54-74               | $> 0$                  | $\leq 1$   |
|                         |                      | $\geq 63$           | N/A                    | NA         |
|                         |                      | N/A                 | NA                     | N/A        |
| 20                      | $\geq 2590$          | 0 – 31              | $\geq 45 \& < 68$      | $\leq 1$   |
|                         | $< 2590$             | 32-55               | $< 19$                 | $\leq 1$   |
|                         |                      | 70-99               | $> 0$                  | $\leq 1$   |
|                         |                      | $\geq 76$           | N/A                    | NA         |
|                         |                      | N/A                 | NA                     | N/A        |

Table 6.2.4-34a: A-MPR for "NS\_56"

| Channel bandwidth confined to 1627.5- 1637.5MHz |  |                        |          |          |          |           |          |          |           |           |
|---|--|------------------------|----------|----------|----------|-----------|----------|----------|-----------|-----------|
| Channel bandwidth                               | Carrier centre frequency (F <sub>c</sub> ) (MHz) | Parameter s            | Region A | Region B | Region C | Region D  | Region E | Region F | Region G  |           |
| 5 MHz   | 1630.0, 1630.3                                   | RB <sub>start</sub>    | $\leq 8$ | $\leq 8$ | N/A      | N/A       | N/A      | N/A      | N/A       |           |
|   |  | L <sub>CRB</sub> [RBs] | $\leq 8$ | $> 8$    | N/A      | N/A       | N/A      | N/A      | N/A       |           |
|   |  | A-MPR [dB]             | 8        | 2        | N/A      | N/A       | N/A      | N/A      | N/A       |           |
|   | 1635.0   | No A-MPR needed        |          |          |          |           |          |          |           |           |
|   | 1649.0   |                        |          |          |          |           |          |          |           |           |
| 1654.0  |  |                        |          |          |          |           |          |          |           |           |
| 10 MHz  | 1632.5   | RB <sub>start</sub>    | $\leq 5$ | $\leq 5$ | 6 to 18  | $\leq 18$ | 35 to 39 | 35 to 39 | $\geq 40$ | $\geq 40$ |

|        |                 |          |               |           |        |          |       |          |       |
|--------|-----------------|----------|---------------|-----------|--------|----------|-------|----------|-------|
|        | LCRB [RBs]      | $\leq 5$ | 6<br>to<br>12 | $\leq 12$ | $> 12$ | $\leq 7$ | $> 7$ | $\leq 7$ | $> 7$ |
|        | A-MPR [dB]      | 7        | 5             | 7         | 4      | 2        | 5     | 3        |       |
| 1651.5 | No A-MPR needed |          |               |           |        |          |       |          |       |

For PRACH, PUCCH and SRS transmissions, the allowed A-MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For each TTI pattern, the A-MPR shall be evaluated per  $T_{\text{eval}}$  period as specified in table 6.2.4-35 and given by the maximum value taken over the transmission(s) within that period; the maximum A-MPR over the  $T_{\text{REF}}$  is then applied for  $T_{\text{REF}}$ .

**Table 6.2.4-35: A-MPR evaluation period**

| TTI pattern | $T_{\text{REF}}$ | $T_{\text{eval}}$   |
|-------------|------------------|---|
| Subframe    | 1 subframe       | 1 slot  |
| Slot        | 7 OS             | $\text{Min}(T_{\text{no\_hopping}}, 7\text{OS})$            |
| Sublot      | 2 OS, 3OS        | $\text{Min}(T_{\text{no\_hopping}}, 2\text{OS}/3\text{OS})$ |

For the UE maximum output power modified by A-MPR, the power limits specified in subclause 6.2.5 apply.

## 6.2.4A UE maximum output power with additional requirements for CA

Additional ACLR, spectrum emission and spurious emission requirements for carrier aggregation can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the CA Power Class as specified in Table 6.2.2A-1.

If for intra-band carrier aggregation the UE is configured for transmissions on a single serving cell, then subclauses 6.2.3 and 6.2.4 apply with the Network Signaling value indicated by the field *additionalSpectrumEmission*.

For intra-band contiguous aggregation with the UE configured for transmissions on two serving cells, the maximum output power reduction specified in Table 6.2.4A-1 is allowed for all serving cells of the applicable uplink CA configurations according to the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10*. Then clause 6.2.3A does not apply, i.e. the carrier aggregation MPR = 0dB, unless the value indicated is CA\_NS\_09 or CA\_NS\_31. For uplink 64 QAM and 256 QAM, the applied maximum output power reduction is obtained by taking the maximum value of MPR requirements specified in Table 6.2.3A-1 and A-MPR requirements specified in Table 6.2.4A-1.

**Table 6.2.4A-1: Additional Maximum Power Reduction (A-MPR) for intra-band contiguous CA**

| CA Network Signalling value | Requirements (subclause)  | Uplink CA Configuration | A-MPR [dB] (subclause) |
|-----------------------------|---------------------------|-------------------------|------------------------|
| CA_NS_01                    | 6.6.3.3A.1                | CA_1C                   | 6.2.4A.1               |
| CA_NS_02                    | 6.6.3.3A.2                | CA_1C                   | 6.2.4A.2               |
| CA_NS_03                    | 6.6.3.3A.3                | CA_1C                   | 6.2.4A.3               |
| CA_NS_04                    | 6.6.2.2A.1, 6.6.3.3A.8    | CA_41C, CA_41D          | 6.2.4A.4               |
| CA_NS_05                    | 6.6.3.3A.4                | CA_38C                  | 6.2.4A.5               |
| CA_NS_06                    | 6.6.3.3A.5                | CA_7C                   | 6.2.4A.6               |
| CA_NS_07                    | 6.6.3.3A.6                | CA_39C                  | 6.2.4A.7               |
| CA_NS_08                    | 6.6.3.3A.7                | CA_42C                  | 6.2.4A.8               |
| CA_NS_09                    | 6.6.2.2A.2                | CA_66B                  | N/A                    |
|                             | 6.6.2.2A.3                | CA_66C                  | N/A                    |
| CA_NS_10                    | 6.6.2.2A.4<br>6.6.3.3A.10 | CA_48B, CA_48C          | 6.2.4A.10              |

|  |          |                         |     |
|--|----------|-------------------------|-----|
| ...  |          |                         |     |
| CA_NS_31   | NOTE 1   | Table 5.6A.1-1 (NOTE 1) | N/A |
| CA_NS_32   | Reserved |                         |     |
| NOTE 1: Applicable for uplink CA configurations listed in Table 5.6A.1-1 for which none of the additional requirements in subclauses 6.6.2.2A or 6.6.3.3A apply. |          |                         |     |
| NOTE 2: The index of the sequence CA_NS corresponds to the value of <i>additionalSpectrumEmissionSCell-r10</i> .   |          |                         |     |

If for intra-band non-contiguous carrier aggregation the UE is configured for transmissions on a single serving cell, then subclauses 6.2.3 and 6.2.4 apply with the Network Signaling value indicated by the field *additionalSpectrumEmission*.

For intra-band non-contiguous carrier aggregation with the UE configured for transmissions on two serving cells, the maximum output power reduction specified in Table 6.2.4A-2 is allowed for all serving cells of the applicable uplink CA configurations according to the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10*. MPR as specified in subclause 6.2.3A is not allowed in addition, unless A-MPR is N/A.

**Table 6.2.4A-2: Additional Maximum Power Reduction (A-MPR) for intra-band non-contiguous CA**

| CA Network Signalling value   | Additional requirements for sub-blocks in order of increasing uplink carrier frequency |                          | Uplink CA Configuration | A-MPR for sub-blocks in order of increasing uplink carrier frequency |
|---|--|--------------------------|-------------------------|--|
|   | Requirements (subclause)   | Requirements (subclause) |                         | A-MPR [dB] (subclause)   |
| CA_NC_NS_01   | 6.6.2.2.1 (NS_03)  | 6.6.2.2.1 (NS_03)        | CA_4A-4A                | N/A  |
| ...   |  |                          |                         |  |
| CA_NC_NS_31   | NOTE 1   | NOTE 1                   | Table 5.6A.1-3 (NOTE 1) | N/A  |
| CA_NC_NS_32   | Reserved   |                          |                         |  |
| NOTE 1: Applicable for uplink CA configurations listed in Table 5.6A.1-3 for which the additional requirements in subclause 6.6.2.1.1 (indicated by NS_01) applies in each sub-block. |  |                          |                         |  |
| NOTE 2: The index of the sequence CA_NC_NS corresponds to the value of <i>additionalSpectrumEmissionSCell-r10</i> .   |  |                          |                         |  |

If for inter-band carrier aggregation the UE is configured for transmissions on a single serving cell, then subclauses 6.2.3 and 6.2.4 apply with the Network Signaling value indicated by the field *additionalSpectrumEmission*.

For inter-band carrier aggregation with the UE configured for transmissions on two serving cells the maximum output power reduction specified in Table 6.2.4-1 is allowed for each serving cell of the applicable uplink CA configuration according to the Network Signaling value indicated by the field *additionalSpectrumEmission* for the PCC and the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10* for the SCC. The value of *additionalSpectrumEmissionSCell-r10* is equal to that of *additionalSpectrumEmission* configured on the SCC. MPR as specified in subclause 6.2.3A is allowed in addition.

For PUCCH and SRS transmissions, the allowed A-MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For intra-band carrier aggregation, the A-MPR shall be evaluated per  $T_{eval}$  period as specified in table 6.2.4A-3 and given by the maximum value taken over the transmission(s) on all component carriers within that period; the maximum A-MPR over  $T_{REF}$  is then applied for the entire  $T_{REF}$ .

**Table 6.2.4A-3: A-MPR evaluation  $T_{eval}$  period**

| TTI pattern | $T_{REF}$  | $T_{eval}$   |
|-------------|------------|--|
| Subframe    | 1 subframe | 1 slot   |
| Slot        | 7 OS       | $\text{Min}(T_{no\_hopping}, 7\text{OS})$            |
| Subslot     | 2 OS, 3OS  | $\text{Min}(T_{no\_hopping}, 2\text{OS}/3\text{OS})$ |

For combinations of intra-band and inter-band carrier aggregation with the UE configured for transmission on three serving cells (up to two contiguously aggregated carriers per band), the maximum output power reduction is specified as follows. For the band supporting one serving cell the maximum output power reduction specified in Table 6.2.4-1 is allowed according to the Network Signaling value indicated by the field *additionalSpectrumEmission* for the PCC and

the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10* for the SCC. The value of *additionalSpectrumEmissionSCell-r10* is equal to that of *additionalSpectrumEmission* configured on the SCC. MPR as specified in subclause 6.2.3A is allowed in addition. For the band supporting intra-band contiguous aggregation with the UE configured for transmissions on two serving cells, the maximum output power reduction specified in Table 6.2.4A-1 is allowed for all serving cells of the applicable uplink CA configurations according to the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10*. Then clause 6.2.3A does not apply, i.e. the carrier aggregation MPR = 0dB, unless the value indicated is CA\_NS\_31. For uplink 64 QAM and 256 QAM, the applied maximum output power reduction is obtained by taking the maximum value of MPR requirements specified in Table 6.2.3A-1 and A-MPR requirements specified in Table 6.2.4A-1.

For the UE maximum output power modified by A-MPR specified in table 6.2.4A-1, the power limits specified in subclause 6.2.5A apply.

### 6.2.4A.1 A-MPR for CA\_NS\_01 for CA\_1C

If the UE is configured to CA\_1C and it receives IE CA\_NS\_01 the allowed maximum output power reduction applied to transmissions on the PCC and the SCC for contiguously aggregated signals is specified in table 6.2.4A.1-1.

**Table 6.2.4A.1-1: Contiguous allocation A-MPR for CA\_NS\_01**

| CA_1C: CA_NS_01 | RB <sub>start</sub>     | L <sub>CRB</sub> [RBs]    | RB <sub>start</sub> + L <sub>CRB</sub> [RBs] | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|-----------------|-------------------------|---------------------------|--|---|
| 100 RB / 100 RB | 0 – 23 and<br>176 – 199 | > 0                       | N/A  | ≤ 12.0  |
|                 | 24 – 105                | > 64                      | N/A  | ≤ 6.0   |
|                 | 106 – 175               | N/A                       | > 175  | ≤ 5.0   |
| 75 RB / 75 RB   | 0 – 6 and 143<br>– 149  | 0 < L <sub>CRB</sub> ≤ 10 | N/A  | ≤ 11.0  |
|                 |                         | > 10                      | N/A  | ≤ 6.0   |
|                 | 7 – 90                  | > 44                      | N/A  | ≤ 5.0   |
|                 | 91 – 142                | N/A                       | > 142  | ≤ 2.0   |

NOTE 1: RB<sub>start</sub> indicates the lowest RB index of transmitted resource blocks  
NOTE 2: L<sub>CRB</sub> is the length of a contiguous resource block allocation  
NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per T<sub>no\_hopping</sub> basis.  
NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot.

If the UE is configured to CA\_1C and it receives IE CA\_NS\_01 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

$$\text{A-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$\begin{aligned} M_A &= -22.5 A + 17 && ; 0 \leq A < 0.20 \\ &= -11.0 A + 14.7 && ; 0.20 \leq A < 0.70 \\ &= -1.7 A + 8.2 && ; 0.70 \leq A \leq 1 \end{aligned}$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

### 6.2.4A.2 A-MPR for CA\_NS\_02 for CA\_1C

If the UE is configured to CA\_1C and it receives IE CA\_NS\_02 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.2-1.

**Table 6.2.4A.2-1: Contiguous allocation A-MPR for CA\_NS\_02**

| CA_1C: CA_NS_02 | RB <sub>end</sub> | L <sub>CRB</sub> [RBs]   | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|-----------------|-------------------|--------------------------|---|
| 100 RB / 100 RB | 0 – 20            | > 0                      | ≤ 4 dB  |
|                 | 21 – 46           | > 0                      | ≤ 3 dB  |
|                 | 47 – 99           | > RB <sub>end</sub> - 20 | ≤ 3 dB  |
|                 | 100 – 184         | > 75                     | ≤ 6 dB  |
|                 | 185 – 199         | > 0                      | ≤ 10 dB   |
| 75 RB / 75 RB   | 0 – 48            | > 0                      | ≤ 2 dB  |
|                 | 49 – 80           | > RB <sub>end</sub> - 20 | ≤ 3 dB  |
|                 | 81 – 129          | > 60                     | ≤ 5 dB  |
|                 | 130 – 149         | > 84                     | ≤ 6 dB  |
|                 | 130 – 149         | 1 – 84                   | ≤ 2 dB  |

If the UE is configured to CA\_1C and it receives IE CA\_NS\_02 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$\text{A-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = \begin{cases} -22.5 A + 17 & ; 0 \leq A < 0.20 \\ -11.0 A + 14.7 & ; 0.20 \leq A < 0.70 \\ -1.7 A + 8.2 & ; 0.70 \leq A \leq 1 \end{cases}$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

### 6.2.4A.3 A-MPR for CA\_NS\_03 for CA\_1C

If the UE is configured to CA\_1C and it receives IE CA\_NS\_03 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.3-1.

**Table 6.2.4A.3-1: Contiguous allocation A-MPR for CA\_NS\_03**

| CA_1C: CA_NS_03 | RB <sub>end</sub> | L <sub>CRB</sub> [RBs]   | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|-----------------|-------------------|--------------------------|---|
| 100 RB / 100 RB | 0 – 26            | > 0                      | ≤ 10 dB   |
|                 | 27 – 63           | ≥ RB <sub>end</sub> - 27 | ≤ 6 dB  |
|                 | 27 – 63           | < RB <sub>end</sub> - 27 | ≤ 1 dB  |
|                 | 64 – 100          | > RB <sub>end</sub> - 20 | ≤ 4 dB  |
|                 | 101 – 171         | > 68                     | ≤ 7 dB  |
|                 | 172 – 199         | > 0                      | ≤ 10 dB   |
| 75 RB / 75 RB   | 0 – 20            | > 0                      | ≤ 10 dB   |
|                 | 21 – 45           | > 0                      | ≤ 4 dB  |
|                 | 46 – 75           | > RB <sub>end</sub> - 13 | ≤ 2 dB  |
|                 | 76 – 95           | > 45                     | ≤ 5 dB  |
|                 | 96 – 149          | > 43                     | ≤ 8 dB  |
|                 | 120 – 149         | 1 - 43                   | ≤ 6 dB  |



If the UE is configured to CA\_1C and it receives IE CA\_NS\_03 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = -23.33A + 17.5 \quad ; 0 \leq A < 0.15$$

$$-7.65A + 15.15 \quad ; 0.15 \leq A \leq 1$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

#### 6.2.4A.4 A-MPR for CA\_NS\_04

If the UE is configured to CA\_41C or any uplink inter-band CA configuration containing CA\_41C and it receives IE CA\_NS\_04 the allowed maximum output power reduction applied to transmission on two component carriers for contiguously aggregated signals is specified in Table 6.2.4A.4-1 and Table 6.2.4A.4-1A for UE power class 3 and in Table 6.2.4A.4-2 for UE power class 2.

**Table 6.2.4A.4-1: Contiguous Allocation A-MPR for CA\_NS\_04 (power class 3), Bandwidth Class C**

| CA Bandwidth Class C | RB <sub>start</sub>  | LCRB [RBs] | RB <sub>start</sub> + LCRB [RBs] | A-MPR for QPSK [dB] | A-MPR for 16 QAM, 64 QAM and 256 QAM [dB] |
|----------------------|----------------------|------------|----------------------------------|---------------------|---|
| 25 RB / 100 RB       | 0 – 34 and 90 – 124  | >0         | N/A                              | ≤3dB                | ≤3.5dB                                    |
|                      | 35 – 89              | N/A        | >90                              | ≤1dB                | ≤2.5dB                                    |
| 50RB / 100 RB        | 0 – 44 and 105 – 149 | >0         | N/A                              | ≤4dB                | ≤4dB                                      |
|                      | 45 – 104             | N/A        | >105                             | ≤3dB                | ≤4dB                                      |
| 75 RB / 75 RB        | 0 – 44 and 105 – 149 | >0         | N/A                              | ≤4dB                | ≤4dB                                      |
|                      | 45 – 104             | N/A        | >105                             | ≤4dB                | ≤4dB                                      |
| 100 RB / 75 RB       | 0 – 49 and 125 – 174 | >0         | N/A                              | ≤4dB                | ≤4dB                                      |
|                      | 50 - 124             | N/A        | >125                             | ≤3dB                | ≤4dB                                      |
| 100 RB / 100 RB      | 0 – 59 and 140 – 199 | >0         | N/A                              | ≤3dB                | ≤4dB                                      |
|                      | 60– 139              | N/A        | >140                             | ≤4dB                | ≤4dB                                      |

NOTE 1: RB<sub>start</sub> indicates the lowest RB index of transmitted resource blocks  
NOTE 2: LCRB is the length of a contiguous resource block allocation  
NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per T<sub>no\_hopping</sub> basis..  
NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot.

**Table 6.2.4A.4-1A: Contiguous Allocation A-MPR for CA\_NS\_04 (power class 3), Bandwidth Class D**

| CA Bandwidth Class D     | RB <sub>start</sub>  | LCRB [RBs] | RB <sub>start</sub> + LCRB [RBs] | A-MPR for QPSK [dB] | A-MPR for 16 QAM, 64 QAM and 256 QAM [dB] |
|--------------------------|----------------------|------------|----------------------------------|---------------------|---|
| 50 RB / 75 RB / 100 RB   | 0 – 64 and 161 – 224 | >0         | N/A                              | ≤4dB                | ≤4.5dB                                    |
|                          | 65 – 160             | N/A        | >161                             | ≤3dB                | ≤3.5dB                                    |
| 50 RB / 100 RB / 100 RB  | 0 – 72 and 178 – 249 | >0         | N/A                              | ≤4dB                | ≤4.5dB                                    |
|                          | 73 – 177             | N/A        | >178                             | ≤3dB                | ≤3.5dB                                    |
| 75 RB / 75 RB / 100 RB   | 0 – 72 and 178 – 249 | >0         | N/A                              | ≤4dB                | ≤4.5dB                                    |
|                          | 73 – 177             | N/A        | >178                             | ≤3dB                | ≤3.5dB                                    |
| 75 RB / 100 RB / 100 RB  | 0 – 78 and 197 – 274 | >0         | N/A                              | ≤3.5dB              | ≤4dB                                      |
|                          | 79 - 196             | N/A        | >197                             | ≤2.5dB              | ≤3dB                                      |
| 100 RB / 100 RB / 100 RB | 0 – 96 and 204 – 300 | >0         | N/A                              | ≤4dB                | ≤4dB                                      |
|                          | 97– 203              | N/A        | >204                             | ≤2.5dB              | ≤3dB                                      |

NOTE 1:  $RB_{start}$  indicates the lowest RB index of transmitted resource blocks  
 NOTE 2:  $L_{CRB}$  is the length of a contiguous resource block allocation  
 NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per  $T_{no\_hopping}$  basis..  
 NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot.

**Table 6.2.4A.4-2: Contiguous Allocation A-MPR for CA\_NS\_04 (power class 2)**

| CA Bandwidth Class C | Lower edge cutoff frequency [MHz] <sup>5</sup> | $RB_{start}$ | $L_{CRB}$ [RBs] | $RB_{start} + L_{CRB}$ [RBs] | A-MPR per modulation [dB] |       |       |        |
|----------------------|--|--------------|-----------------|------------------------------|---------------------------|-------|-------|--------|
|                      |  |              |                 |                              | QPSK                      | 16QAM | 64QAM | 256QAM |
| 25 RB / 100 RB       | 2513.5   | 0 – 42       | >0              | N/A                          | ≤5                        | ≤5    | ≤5    | 6.5    |
|                      |  | 43 – 81      | N/A             | >82                          | ≤1                        | ≤1.5  | ≤1.5  | 3      |
|                      |  | 82 – 124     | >0              | N/A                          | ≤1                        | ≤1.5  | ≤1.5  | 2.5    |
| 50 RB / 100 RB       | 2518.4   | 0 – 52       | >0              | N/A                          | ≤5                        | ≤5    | ≤5    | 6.5    |
|                      |  | 53 – 94      | N/A             | >95                          | ≤1                        | ≤1.5  | ≤1.5  | 3      |
|                      |  | 95 – 149     | >0              | N/A                          | ≤1                        | ≤1.5  | ≤1.5  | 2.5    |
| 75 RB / 75 RB        | 2519.0   | 0 – 54       | >0              | N/A                          | ≤5                        | ≤5    | ≤5    | 6.5    |
|                      |  | 55 – 94      | N/A             | >95                          | ≤2                        | ≤2.5  | ≤2.5  | 3.5    |
|                      |  | 95 – 149     | >0              | N/A                          | ≤1.5                      | ≤2    | ≤2    | 3      |
| 75 RB / 100 RB       | 2523.4   | 0 – 64       | >0              | N/A                          | ≤5                        | ≤5    | ≤5    | 6.5    |
|                      |  | 65 – 114     | N/A             | >115                         | ≤2                        | ≤2.5  | ≤2.5  | 3.5    |
|                      |  | 115 – 174    | >0              | N/A                          | ≤1                        | ≤1.5  | ≤2    | 3      |
| 100 RB / 100 RB      | 2528.3   | 0 – 69       | >0              | N/A                          | ≤5                        | ≤5    | ≤5    | 6.5    |
|                      |  | 70 – 129     | N/A             | >130                         | ≤2                        | ≤2.5  | ≤2.5  | 3.5    |
|                      |  | 130 – 199    | >0              | N/A                          | ≤1.5                      | ≤1.5  | ≤2    | 3      |

NOTE 1:  $RB_{start}$  indicates the lowest RB index of transmitted resource blocks  
 NOTE 2:  $L_{CRB}$  is the length of a contiguous resource block allocation  
 NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis  
 NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe  
 NOTE 5: The A-MPR values in this table shall apply when the lower edge of the aggregated channel bandwidth (Figure 5.6A-1) is less than or equal to the lower edge cutoff frequency specified in this table for the corresponding CA bandwidth combination. When the lower edge of the aggregated channel bandwidth exceeds the lower edge cutoff frequency, then the A-MPR shall be equal to the MPR specified in Table 6.2.3A-1a.

If the UE is configured to CA\_41C or any uplink inter-band CA configuration containing CA\_41C and it receives IE CA\_NS\_04 the allowed maximum output power reduction applied to transmissions on two serving cells assigned to Band 41 with non-contiguous resource allocation is defined as follows for UE power class 3

$$A-MPR = CEIL \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$\begin{aligned}
 M_A &= 11, & 0 \leq A < 0.05 \\
 &= -55.0A + 13.75, & 0.05 \leq A < 0.15 \\
 &= -4.0A + 6.10, & 0.15 \leq A < 0.40 \\
 &= -0.83A + 4.83, & 0.40 \leq A \leq 1
 \end{aligned}$$

Where  $A = N_{RB\_alloc} / N_{RB\_agg}$ .

If the UE is configured to CA\_41C or any uplink inter-band CA configuration containing CA\_41C and it receives IE CA\_NS\_04 the allowed maximum output power reduction applied to transmissions on two serving cells assigned to Band 41 with non-contiguous resource allocation is defined as follows for UE power class 2

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

If the UE is configured to CA\_41D or any uplink inter-band CA configuration containing CA\_41D and it receives IE CA\_NS\_04 the allowed maximum output power reduction applied to transmissions on two serving cells assigned to Band 41 with non-contiguous resource allocation is defined as follows for UE power class 3

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$\begin{aligned} M_A &= 11.5, & 0 \leq A < 0.05 \\ &= -55.0A + 14.25, & 0.05 \leq A < 0.15 \\ &= -4.0A + 6.60, & 0.15 \leq A < 0.40 \\ &= -0.833A + 5.333, & 0.40 \leq A \leq 1 \end{aligned}$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

Where  $M_A$  is defined as follows when the lower edge of the aggregated channel bandwidth (Table 5.6A-1) is less than or equal to the lower edge cutoff frequency specified in Table 6.2.4A.4-2 for the corresponding CA bandwidth combination

$$\begin{aligned} M_A &= 13.0, & 0 \leq A < 0.05 \\ &= 15.33 - 46.67A, & 0.05 \leq A < 0.20 \\ &= -7.0 - 5.0A, & 0.20 \leq A < 0.50 \\ &= 4.5, & 0.50 \leq A \leq 1 \end{aligned}$$

And  $M_A$  is defined as follows when the lower edge of the aggregated channel bandwidth exceeds the lower edge cutoff frequency specified in Table 6.2.4A.4-2 for the corresponding CA bandwidth combination

$$\begin{aligned} M_A &= 8.2, & 0 \leq A < 0.04 \\ &= 9.8 - 40.0A, & 0.04 \leq A < 0.075 \\ &= 8.0 - 16.0A, & 0.075 \leq A < 0.25 \\ &= 4.83 - 3.33A, & 0.25 \leq A < 0.40 \\ &= 3.83 - 0.83A, & 0.40 \leq A \leq 1 \end{aligned}$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

#### 6.2.4A.5 A-MPR for CA\_NS\_05 for CA\_38C

If the UE is configured to CA\_38C and it receives IE CA\_NS\_05 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.5-1.

**Table 6.2.4A.5-1: Contiguous Allocation A-MPR for CA\_NS\_05**

| CA_38C      | RB <sub>end</sub> | L <sub>CRB</sub> [RBs]   | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|-------------|-------------------|--------------------------|---|
| 100RB/100RB | 0 – 12            | >0                       | ≤ 5 dB  |
|             | 13 – 79           | > RB <sub>end</sub> – 13 | ≤ 2 dB  |
|             | 80 – 180          | >60                      | ≤ 6 dB  |
|             | 181 – 199         | > 0                      | ≤ 11 dB   |

|  |           |                                   |             |
|--|-----------|-----------------------------------|-------------|
| 75RB/75RB  | 0 – 70    | $> \max(0, RB_{\text{end}} - 10)$ | $\leq 2$ dB |
|  | 71- 108   | $> 60$                            | $\leq 5$ dB |
|  | 109 – 139 | $> 0$                             | $\leq 5$ dB |
|  | 140 – 149 | $\leq 70$                         | $\leq 2$ dB |
|  | 140 – 149 | $> 70$                            | $\leq 6$ dB |
| NOTE 1: $RB_{\text{end}}$ indicates the highest RB index of transmitted resource blocks  |           |                                   |             |
| NOTE 2: $L_{\text{CRB}}$ is the length of a contiguous resource block allocation   |           |                                   |             |
| NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per $T_{\text{no\_hopping}}$ basis.   |           |                                   |             |
| NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot. |           |                                   |             |

If the UE is configured to CA\_38C and it receives IE CA\_NS\_05 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = -14.17 A + 16.50 \quad ; 0 \leq A < 0.60$$

$$-2.50 A + 9.50 \quad ; 0.60 \leq A \leq 1$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

#### 6.2.4A.6 A-MPR for CA\_NS\_06

If the UE is configured to CA\_7C and it receives IE CA\_NS\_06 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.6-1.

**Table 6.2.4A.6-1: Contiguous Allocation A-MPR for CA\_NS\_06**

| CA Bandwidth Class C      | $RB_{\text{end}}$ | $L_{\text{CRB}}$ [RBs]            | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|---------------------------|-------------------|-----------------------------------|---|
| 100RB/100RB               | 0 – 22            | $> 0$                             | $\leq 4$ dB                                     |
|                           | 23 – 99           | $> \max(0, RB_{\text{end}} - 25)$ | $\leq 2$ dB                                     |
|                           | 100 – 142         | $> 75$                            | $\leq 3$ dB                                     |
|                           | 143 – 177         | $> 70$                            | $\leq 5$ dB                                     |
|                           | 178 – 199         | $> 0$                             | $\leq 10$ dB                                    |
| 75RB/75RB                 | 0 – 7             | $> 0$                             | $\leq 5$ dB                                     |
|                           | 8- 74             | $> \max(0, RB_{\text{end}} - 10)$ | $\leq 2$ dB                                     |
|                           | 75 – 109          | $> 64$                            | $\leq 2$ dB                                     |
|                           | 110 – 144         | $> 35$                            | $\leq 6$ dB                                     |
|                           | 145 – 149         | $> 0$                             | $\leq 10$ dB                                    |
| 50RB/100RB and 100RB/50RB | 0 – 10            | $> 0$                             | $\leq 5$ dB                                     |
|                           | 11 – 75           | $> \max(0, RB_{\text{end}} - 25)$ | $\leq 2$ dB                                     |
|                           | 76 – 103          | $> 50$                            | $\leq 3$ dB                                     |
|                           | 104 – 144         | $> 25$                            | $\leq 6$ dB                                     |
| 75RB/100RB                | 145 – 149         | $> 0$                             | $\leq 10$ dB                                    |
|                           | 0 – 15            | $> 0$                             | $\leq 5$ dB                                     |

|                   |           |                       |         |
|-------------------|-----------|-----------------------|---------|
| and<br>100RB/75RB | 16 – 75   | > max(0, RB_End – 15) | ≤ 2 dB  |
|                   | 76 – 120  | > 50                  | ≤ 3 dB  |
|                   | 121 – 160 | > 50                  | ≤ 6 dB  |
|                   | 161 – 174 | > 0                   | ≤ 10 dB |

If the UE is configured to CA\_7C and it receives IE CA\_NS\_06 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = -13.33A + 17.5 \quad ; 0 \leq A < 0.15$$

$$-6.47A + 16.47 \quad ; 0.15 \leq A \leq 1$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$ .

#### 6.2.4A.7 A-MPR for CA\_NS\_07

If the UE is configured to CA\_39C or any uplink inter-band CA configuration containing CA\_39C and it receives IE CA\_NS\_07 the allowed maximum output power reduction applied to transmission on two component carriers for contiguously aggregated signals is specified in Table 6.2.4A.7-1.

**Table 6.2.4A.7-1: Contiguous Allocation A-MPR for CA\_NS\_07**

| CA_39C: CA_NS_07                        | RB <sub>Start</sub> | L <sub>CRB</sub> [RBs]               | A-MPR for QPSK, 16 QAM, 64 QAM and 256 QAM [dB] |
|---|---------------------|--------------------------------------|---|
| 75 RB / 100 RB<br>and<br>100 RB / 75 RB | 0 – 13              | > 0                                  | ≤ 11  |
|   | 14 – 50             | ≤ 60                                 | ≤ 3   |
|   | 14 – 100            | > 60                                 | ≤ 7   |
|   | 101 – 155           | > max(155 - RB <sub>start</sub> , 0) | ≤ 2   |
|   | 156 – 174           | > 0                                  | ≤ 5   |
| 50 RB / 100 RB<br>and<br>100 RB / 50 RB | 0 – 5               | > 0                                  | ≤ 11  |
|   | 6 – 42              | ≤ 25                                 | ≤ 3   |
|   |                     | > 25                                 | ≤ 6   |
|   | 43 – 80             | > 50                                 | ≤ 5   |
|   | 81 – 138            | > 20                                 | ≤ 2   |
|   | 139 – 149           | > 0                                  | ≤ 5   |
| 25 RB / 100 RB<br>and<br>100 RB / 25 RB | 0 – 32              | ≥ 84                                 | ≤ 6   |
|   |                     | < 84                                 | ≤ 4   |
|   | 33 – 60             | > 50                                 | ≤ 3   |
|   | 61 – 124            | > 20                                 | ≤ 3   |

If the UE is configured to CA\_39C or any uplink inter-band CA configuration containing CA\_39C and it receives IE CA\_NS\_07 the allowed maximum output power reduction applied to transmissions on two serving cells assigned to Band 39 with non-contiguous resource allocation is defined as follows

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = -16.25A + 21 \quad ; 0 \leq A < 0.80$$

$$-2.50A + 10.00 \quad ; 0.80 \leq A \leq 1$$

Where  $A = N_{\text{RB\_alloc}} / N_{\text{RB\_agg}}$

## 6.2.4A.8 A-MPR for CA\_NS\_08

If the UE is configured to CA\_42C and it receives IE CA\_NS\_08 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.8-1.

Table 6.2.4A.8-1: Contiguous Allocation A-MPR for CA\_NS\_08

| CA_42C:<br>CA_NS_08                 | RBstart       | Condition       | RBend           | L <sub>CRB</sub> [RBs] | A-MPR for<br>QPSK, 16 QAM,<br>64 QAM and 256<br>QAM [dB] |
|-------------------------------------|---------------|-----------------|-----------------|------------------------|--|
| 100RB / 100RB                       | ≤ 21          | Or              | ≥ 178           | ≤ 25                   | ≤ 12   |
|                                     |               |                 |                 | > 25 and ≤ 80          | ≤ 6  |
|                                     | ≥ 0           | N/A             | N/A             | > 80 and ≤ 172         | ≤ 8  |
|                                     |               |                 |                 | > 172                  | ≤ 9  |
| > 21 and ≤ 58                       | Or            | ≥ 141 and < 178 | < 48            | ≤ 3                    |  |
| > 21                                | And           | < 178           | ≥ 48 and ≤ 80   | ≤ 4                    |  |
| 100RB / 75RB<br>And<br>75RB / 100RB | ≤ 12          | Or              | ≥ 162           | ≤ 25                   | ≤ 12   |
|                                     |               |                 |                 | > 25 and ≤ 75          | ≤ 6  |
|                                     | ≥ 0           | N/A             | N/A             | > 75 and < 172         | ≤ 8  |
|                                     |               |                 |                 | ≥ 172                  | 9  |
|                                     | > 12 and ≤ 49 | Or              | ≥ 125 and < 162 | < 54                   | ≤ 3  |
| > 12                                | And           | < 162           | ≥ 54 and ≤ 75   | ≤ 5                    |  |
| > 49                                | And           | < 125           | ≥ 36 and < 54   | ≤ 2                    |  |
| 100RB / 50RB<br>And<br>50RB / 100RB | ≤ 5           | Or              | ≥ 144           | ≤ 16                   | ≤ 12   |
|                                     |               |                 |                 | > 16 and ≤ 61          | ≤ 6  |
|                                     | ≥ 0           | N/A             | N/A             | > 61                   | ≤ 8  |
|                                     |               |                 |                 | ≥ 36 and ≤ 61          | ≤ 5  |
| > 5 and ≤ 41                        | Or            | ≥ 108 and < 144 | < 36            | ≤ 3                    |  |
| 100RB / 25RB<br>And<br>25RB / 100RB | ≤ 31          | Or              | ≥ 92            | ≤ 34                   | ≤ 4  |
|                                     |               |                 |                 | > 34 and ≤ 44          | ≤ 5  |
|                                     | ≥ 0           | N/A             | N/A             | > 44                   | ≤ 8  |

NOTE 1: RB<sub>start</sub> indicates the lowest RB index of transmitted resource blocks  
NOTE 2: L<sub>CRB</sub> is the length of a contiguous resource block allocation  
NOTE 3: RB<sub>end</sub> indicates the highest RB index of transmitted resource blocks  
NOTE 4: If condition is "and" both RB<sub>start</sub> and RB<sub>end</sub> constraints need to be met. If condition is "or" either RB<sub>start</sub> or RB<sub>end</sub> constraints need to be met  
NOTE 5: For intra-subframe frequency hopping which intersects regions, notes 1, 2, 3 and 4 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1,2,3 and 4 apply on a per T<sub>no\_hopping</sub> basis.  
NOTE 6: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot.

If the UE is configured to CA\_42C and it receives IE CA\_NS\_08 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where M<sub>A</sub> is defined as follows

$$M_A = \begin{cases} 20 & ; 0 \leq A < 0.025 \\ 23 - 120A & ; 0.025 \leq A < 0.05 \\ 17.53 - 10.59A & ; 0.05 \leq A \leq 0.9 \\ 8 & ; 0.9 \leq A \leq 1 \end{cases}$$

Where A = N<sub>RB\_alloc</sub> / N<sub>RB\_agg</sub>.

6.2.4A.9 Void

6.2.4A.10 A-MPR for CA\_NS\_10

If the UE is configured to CA\_48C and it receives IE CA\_NS\_10 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.10-2 or Table 6.2.4A.10-3. Which table is determined by the position of the carrier centre frequency in Table 6.2.4A.10-1.

**Table 6.2.4A.10-1: A-MPR regions for CA\_48C**

| Channel Bandwidth, MHz   | Carrier Centre Frequency, F <sub>c</sub> , MHz  | A-MPR             |
|--|---|-------------------|
| 20+5 / 5 + 20  | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Table 6.2.4A.10-2 |
|  | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq F_C < F_H -$<br>$3*BW_{CA}/2 + 10 \text{ MHz}$   | Table 6.2.4A.10-3 |
| 20+10 / 10 + 20  | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Table 6.2.4A.10-2 |
|  | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq$<br>$F_C < F_H - 3*BW_{CA}/2 + 10 \text{ MHz}$   | Table 6.2.4A.10-3 |
| 20+15 / 15 + 20  | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Table 6.2.4A.10-2 |
|  | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq$<br>$F_C < F_H - 3*BW_{CA}/2 + 10 \text{ MHz}$   | Table 6.2.4A.10-3 |
| 20+20  | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Table 6.2.4A.10-2 |
|  | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq$<br>$F_C < F_H - 3*BW_{CA}/2 + 10 \text{ MHz}$   | Table 6.2.4A.10-3 |
| NOTE: F <sub>L</sub> = 3550 MHz, F <sub>H</sub> = 3700 MHz and BW <sub>CA</sub> is the combined bandwidth of the contiguous CCs in the CA combination indicated. |   |                   |

**Table 6.2.4A.10-2: A-MPR regions for CA\_48C at the band edge**

| BWs [MHz]       | RB_start             | L_CRB | A-MPR [dB] |
|-----------------|----------------------|-------|------------|
| 20+5 / 5 + 20   | 0 – 7 and 117 - 124  |       | ≤ 12       |
|                 | 8 - 25               | <85   | ≤ 5.5      |
|                 |                      | ≥ 85  | ≤ 6.5      |
|                 | 26 - 116             |       | ≤ 5        |
| 20+10 / 10 + 20 | 0 - 13 and 135 - 149 |       | ≤ 11       |
|                 | 14 - 33              | <85   | ≤ 5        |
|                 |                      | ≥85   | ≤ 7        |
|                 | 34 - 134             |       | ≤ 6        |
| 20+15 / 15 + 20 | 0 - 22 and 152 - 174 |       | ≤ 11       |
|                 | 23 - 42              | <95   | ≤ 5.5      |
|                 |                      | ≥95   | ≤ 7        |
|                 | 43 - 151             |       | ≤ 6        |
| 20+20           | 0 - 31 and 165 - 199 |       | ≤ 11       |

|  |          |      |       |
|--|----------|------|-------|
|  | 32 - 51  | <100 | ≤ 5.5 |
|  |          | ≥100 | ≤ 7   |
|  | 52 - 164 | <100 | ≤ 4.5 |
|  |          | ≥100 | ≤ 6   |

**Table 6.2.4A.10-3: A-MPR regions for CA\_48C at the band center (“range for lower A-MPR”)**

| BWs [MHz]       | RB_start             | L_CRB | A-MPR [dB] |
|-----------------|----------------------|-------|------------|
| 20+5 / 5 + 20   | 0 – 7 and 117 - 124  |       | ≤ 4        |
|                 | 8 - 25               | <85   | ≤ 2        |
|                 |                      | ≥85   | ≤ 2.5      |
|                 | 26 - 116             |       | ≤ 2        |
| 20+10 / 10 + 20 | 0 - 13 and 135 - 149 |       | ≤ 4.5      |
|                 | 14 - 33              | <85   | ≤4.5       |
|                 |                      | ≥85   | ≤ 2.5      |
|                 | 34 - 134             |       | ≤ 1.5      |
| 20+15 / 15 + 20 | 0 - 22 and 152 -174  |       | ≤ 4.5      |
|                 | 23 - 42              | <95   | ≤ 1        |
|                 |                      | ≥95   | ≤ 2.5      |
|                 | 43 - 151             |       | ≤ 1        |
| 20+20           | 0 - 31 and 165 - 199 |       | ≤ 4.5      |
|                 | 32 - 51              | <100  | ≤ 1        |
|                 |                      | ≥100  | ≤ 1.5      |
|                 | 52 - 164             | <100  | ≤ 1        |
| ≥100            |                      | ≤ 1   |            |

If the UE is configured to CA\_48C and it receives IE CA\_NS\_10 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined with both an edge and a center scenario and is determined in Table 6.2.4A.10-4.

**Table 6.2.4A.10-4: A-MPR regions for CA\_48C**

| Channel Bandwidth, MHz | Carrier Centre Frequency, F <sub>c</sub> , MHz  | A-MPR  |
|------------------------|---|--------|
| 20+5 / 5 + 20          | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Edge   |
|                        | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq F_C < F_H -$<br>$3*BW_{CA}/2 + 10 \text{ MHz}$   | Center |
| 20+10 / 10 + 20        | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Edge   |
|                        | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq$<br>$F_C < F_H - 3*BW_{CA}/2 + 10 \text{ MHz}$   | Center |
| 20+15 / 15 + 20        | $F_L + BW_{CA}/2 \leq F_C <$<br>$F_L + 3*BW_{CA}/2 - 10 \text{ MHz}$<br>$F_H - 3*BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$<br>$F_H - BW_{CA}/2$ | Edge   |
|                        | $F_L + 3*BW_{CA}/2 - 10 \text{ MHz} \leq$<br>$F_C < F_H - 3*BW_{CA}/2 + 10 \text{ MHz}$   | Center |



|  |  |        |
|--|--|--------|
| 20+20  | $F_L + BW_{CA}/2 \leq F_C <$ $F_L + 3 \cdot BW_{CA}/2 - 10 \text{ MHz}$ $F_H - 3 \cdot BW_{CA}/2 + 10 \text{ MHz} \leq F_C \leq$ $F_H - BW_{CA}/2$ | Edge   |
|  | $F_L + 3 \cdot BW_{CA}/2 - 10 \text{ MHz} \leq$ $F_C < F_H - 3 \cdot BW_{CA}/2 + 10 \text{ MHz}$   | Center |
| NOTE: $F_L = 3550 \text{ MHz}$ , $F_H = 3700 \text{ MHz}$ and $BW_{CA}$ is the combined bandwidth of the contiguous CCs in the CA combination indicated. |  |        |

The Edge scenario is defined as follows

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

where  $M_A$  is defined as follows

$$M_A = \begin{array}{ll} 18.00 - 10.00 \text{ A}; & 0 \leq A < 0.05 \\ 18.50 - 20.00 \text{ A}; & 0.05 \leq A < 0.2 \\ 15.50 - 5.00 \text{ A}; & 0.2 \leq A < 1 \end{array}$$

where  $A = N_{RB\_alloc} / N_{RB\_agg}$ .

The Center scenario is defined as follows

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

where  $M_A$  is defined as follows

$$M_A = \begin{array}{ll} 11.50 - 10.00 \text{ A}; & 0 \leq A < 0.15 \\ 10.88 - 5.88 \text{ A}; & 0.15 \leq A < 1 \end{array}$$

where  $A = N_{RB\_alloc} / N_{RB\_agg}$

For CA\_48B contiguous resource allocation when  $3560 \text{ MHz} \leq F_{agg\_alloc\_low}$  and  $F_{agg\_alloc\_high} \leq 3690 \text{ MHz}$

if allocation is inner 1 then  $A\text{-MPR} = 0 \text{ dB}$  where inner 1 is defined as

$$RB_{Start,Low} = \max(1, \text{floor}(L_{CRB}/2))$$

where  $\max()$  indicates the largest value of all arguments and  $\text{floor}(x)$  is the greatest integer less than or equal to  $x$ .

$$RB_{Start,High} = N_{RB\_agg} - RB_{Start,Low} - L_{CRB}$$

with following conditions

$$RB_{Start,Low} \leq RB_{Start} \leq RB_{Start,High}, \text{ and}$$

$$L_{CRB} \leq \text{ceil}(N_{RB\_agg}/2)$$

Inner 1 region exceptions thresholds are

$$RB_{start} < 12 \text{ or } RB_{end} \geq 92 \text{ for } BW_{Channel\_CA} = 20\text{MHz}$$

For which  $A\text{MPR} = 4 \text{ dB}$ .

else  $A\text{-MPR} = 4 \text{ dB}$

For CA\_48B contiguous resource allocation when  $F_{agg\_alloc\_low} < 3560 \text{ MHz}$

if allocation is inner 3 then  $A\text{-MPR} = 0 \text{ dB}$

Inner 3 region exceptions thresholds are

$$RB_{start} < 30 \text{ for } BW_{Channel\_CA} = 20\text{MHz}$$

For which AMPR = 7dB.

where inner 3 is defined as

$$N_{RB\_agg} / 4 < RB_{Start} < N_{RB\_agg} 3/4 - L_{CRB} \quad \text{AND} \quad L_{CRB} < N_{RB\_agg}/4$$

else A-MPR = 7 dB.

For CA\_48B contiguous resource allocation when  $F_{agg\_alloc\_high} > 3690$  MHz

if allocation is inner 3 then A-MPR = 0 dB

Inner 3 region exceptions thresholds are

$$RB_{start} > 70 \text{ for } BW_{Channel\_CA} = 20\text{MHz}$$

For which AMPR = 7dB.

where inner 3 is defined as

$$N_{RB\_agg} / 4 < RB_{Start} < N_{RB\_agg} 3/4 - L_{CRB} \quad \text{AND} \quad L_{CRB} < N_{RB\_agg}/4$$

else A-MPR = 7 dB.

For CA\_48B non-contiguous resource allocation when  $3560 \text{ MHz} \leq F_{agg\_alloc\_low}$  and  $F_{agg\_alloc\_high} \leq 3690 \text{ MHz}$

$$A = N_{RB\_alloc} / N_{RB\_agg}$$

$$\begin{array}{ll} \text{A-MPR=} & 13.00; & 0.00 \leq A \leq 0.08 \\ & 13.78 - 9.78 A; & 0.08 < A \leq 1.00 \end{array}$$

For CA\_48B non-contiguous resource allocation when  $F_{agg\_alloc\_low} < 3560 \text{ MHz}$  or  $F_{agg\_alloc\_high} > 3690 \text{ MHz}$

$$\begin{array}{ll} \text{A-MPR=} & 13.00; & 0.00 \leq A \leq 0.08 \\ & 14.13 - 14.06 A; & 0.08 < A \leq 0.40 \\ & 9.17 - 1.67 A; & 0.40 < A \leq 1.00 \end{array}$$

## 6.2.4B UE maximum output power with additional requirements for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in subclause 6.2.4 shall apply to the maximum output power specified in Table 6.2.2B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For the UE maximum output power modified by A-MPR, the power limits specified in subclause 6.2.5B apply.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.4 apply.

## 6.2.4D UE maximum output power with additional requirements for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the allowed A-MPR for the maximum output power for ProSe physical channels PSDCH, PSCCH, PSSCH, and PSBCH shall be as specified in subclause 6.2.4 for PUSCH for the corresponding modulation and transmission bandwidth.

The allowed A-MPR for the maximum output power for ProSe physical signal PSSS and SSSS shall be as specified in subclause 6.2.4 for PUSCH QPSK modulation for the corresponding transmission bandwidth.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.2.4D apply for ProSe transmission and the requirements in subclause 6.2.4 apply for uplink transmission.

## 6.2.4E UE maximum output power with additional requirements for category M1 and M2 UE

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the output power as specified in Table 6.2.2E-1 and Table 6.2.4E-2. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For UE Power Class 3 and 5 the specific requirements and identified subclauses are specified in Table 6.2.4E-1 and Table 6.2.4E-2 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2.4E-1 and Table 6.2.4E-2 and from 6.2.4-2 to 6.2.4-15 are in addition to the allowed MPR requirements specified in subclause 6.2.3E.

**Table 6.2.4E-1: Additional Maximum Power Reduction (A-MPR) for category M1 UE**

| Network Signalling value | Requirements (subclause) | E-UTRA Band    | Resources Blocks ( $N_{RB}$ ) | A-MPR (dB) |
|--------------------------|--------------------------|----------------|-------------------------------|------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1    | Table 5.6-1                   | N/A        |
| NS_03                    | 6.6.2.2.1                | 2, 4           | Table 5.6-1                   | N/A        |
| NS_04                    | 6.6.2.2.2                | 41             | Table 6.2.4E-3                |            |
| NS_05                    | 6.6.3.3.1                | 1              | Table 5.6-1                   | N/A        |
| NS_06                    | 6.6.2.2.3                | 12, 13, 14, 85 | Table 5.6-1                   | N/A        |
| NS_07                    | 6.6.2.2.3<br>6.6.3.3.2   | 13             | Table 6.2.4E-4                |            |
| NS_08                    | 6.6.3.3.3                | 19             | Table 5.6-1                   | N/A        |
| NS_09                    | 6.6.3.3.4                | 21, 74         | Table 5.6-1                   | N/A        |
| NS_10                    |                          | 20             | Table 5.6-1                   | N/A        |
| NS_12                    | 6.6.3.3.5                | 26             | Table 6.2.4E-5                |            |
| NS_13                    | 6.6.3.3.6                | 26             | Table 5.6-1                   | N/A        |
| NS_14                    | 6.6.3.3.7                | 26             | Table 5.6-1                   | N/A        |
| NS_15                    | 6.6.3.3.8                | 26             | Table 6.2.4-9                 |            |
| NS_16                    | 6.6.3.3.9                | 27             | Table 5.6-1                   | N/A        |
| NS_17                    | 6.6.3.3.10               | 28             | Table 5.6-1                   | N/A        |
| NS_18                    | 6.6.3.3.11               | 28             | Table 5.6-1                   | N/A        |
| NS_22                    | 6.6.3.3.16               | 42, 43         | Table 5.6-1                   | N/A        |
| NS_23                    | 6.6.3.3.17               | 42, 43         | Table 5.6-1                   | N/A        |
| NS_32                    | -                        | -              | -                             | -          |
| NS_35                    | 6.6.2.2.7                | 71             | Table 5.6-1                   | N/A        |
| NS_38                    | 6.6.3.3.29               | 74             | Table 5.6-1                   | N/A        |
| NS_39                    | 6.6.3.3.30               | 74             | Table 5.6-1                   | N/A        |

**Table 6.2.4E-2: Additional Maximum Power Reduction (A-MPR) for category M2 UE**

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Narrowband bandwidth | Resources Blocks ( $N_{RB}$ ) | A-MPR (dB) |
|--------------------------|--------------------------|-------------|----------------------|-------------------------------|------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1 | 1.4, 3, 5            | Table 5.6-1                   | N/A        |

|       |                        |                |           |                 |     |
|-------|------------------------|----------------|-----------|-----------------|-----|
| NS_03 | 6.6.2.2.1              | 2, 4           | 3,5       | Table 6.2.4-1   |     |
| NS_04 | 6.6.2.2.2              | 41             | 5         | Table 6.2.4-1   |     |
| NS_05 | 6.6.3.3.1              | 1              | 1.4, 3, 5 | Table 6.2.4-18E |     |
| NS_06 | 6.6.2.2.3              | 12, 13, 14, 85 | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_07 | 6.6.2.2.3<br>6.6.3.3.2 | 13             |           | [TBD]           |     |
| NS_08 | 6.6.3.3.3              | 19             | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_09 | 6.6.3.3.4              | 21             | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_10 |                        | 20             | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_12 | 6.6.3.3.5              | 26             | 1.4, 3, 5 | Table 6.2.4-1   |     |
| NS_13 | 6.6.3.3.6              | 26             | 5         | Table 6.2.4-1   |     |
| NS_14 | 6.6.3.3.7              | 26             | N/A       | Table 5.6-1     | N/A |
| NS_15 | 6.6.3.3.8              | 26             | 1.4, 3, 5 | Table 5.6-1     |     |
| NS_16 | 6.6.3.3.9              | 27             | 3,5       | Table 6.2.4-1   |     |
| NS_17 | 6.6.3.3.10             | 28             | 5         | Table 6.2.4-1   |     |
| NS_18 | 6.6.3.3.11             | 28             | 5         | Table 6.2.4-1   |     |
| NS_22 | 6.6.3.3.16             | 42, 43         | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_23 | 6.6.3.3.17             | 42, 43         | 1.4, 3, 5 | Table 5.6-1     | N/A |
| NS_32 | -                      | -              |           | -               | -   |
| NS_35 | 6.6.2.2.7              | 71             | 1.4, 3, 5 | Table 5.6-1     | N/A |

Table 6.2.4E-3: A-MPR for "NS\_04" for Cat-M1

| Channel bandwidth [Hz]  | Parameters                                   | Region   |          |          |          |
|---|--|----------|----------|----------|----------|
| 5   | Fc [MHz]                                     | ≤ 2500.5 |          |          |          |
|   | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5) | (1, 0-1) |          |          |
|   | LCRB [RBs]                                   | > 0      |          |          |          |
|   | A-MPR [dB]                                   | ≤ 2      |          |          |          |
| 10  | Fc [MHz]                                     | ≤ 2504   |          |          |          |
|   | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5) | (1, 0-1) |          |          |
|   | LCRB [RBs]                                   | >0       |          |          |          |
|   | A-MPR [dB]                                   | ≤ 3      |          |          |          |
| 15  | Fc [MHz]                                     | ≤ 2510.8 |          |          |          |
|   | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5) | (1, 0-5) |          |          |
|   | LCRB [RBs]                                   | >0       |          |          |          |
|   | A-MPR [dB]                                   | ≤ 3      |          |          |          |
| 20  | Fc [MHz]                                     | ≤ 2517.5 |          |          |          |
|   | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5) | (1, 0-5) | (2, 0-5) | (3, 0-2) |
|   | LCRB [RBs]                                   | >0       |          |          |          |
|   | A-MPR [dB]                                   | ≤ 3      |          |          |          |
| NOTE 1: RBstart indicates the lowest RB index of transmitted resource blocks  |  |          |          |          |          |
| NOTE 2: LCRB is the length of a contiguous resource block allocation  |  |          |          |          |          |
| NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis  |  |          |          |          |          |
| NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe           |  |          |          |          |          |
| NOTE 5: For CAT-M1 device, the NB index is the starting index allocated from DCI[6], the RBstart is indexed within the NB allocated to cat-M1 device. |  |          |          |          |          |

Table 6.2.4E-4: A-MPR for "NS\_07" for Cat-M1

| BW [MHz]  | 5         |           |           |           | 10       |          |
|---|-----------|-----------|-----------|-----------|----------|----------|
| (NB <sub>index</sub> , RB <sub>start</sub> )  | (0,<6)    | (0,<6)    | (3,<6)    | (3,<6)    | (0,<6)   | (7,<6)   |
| LCRB  | >4 and <7 | >1 and ≤4 | >4 and <7 | >1 and ≤4 | >2and <7 | >2and <7 |
| AMPR [dB]   | 2         | 1         | 2         | 1         | 1        | 1        |
| NOTE 1: NB <sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5]. |           |           |           |           |          |          |

Table 6.2.4E-5: A-MPR for "NS\_12" for Cat-M1

| Channel bandwidth [MHz] | Parameters                                   | Region    |          |         |
|-------------------------|--|-----------|----------|---------|
|                         |  | (0,0)     | (0,1-2)  |         |
| 1.4                     | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0,0)     | (0,1-2)  |         |
|                         | LCRB [RBs]                                   | ≤3        | ≥4       | ≥4      |
|                         | A-MPR [dB]                                   | ≤3        | ≤6       | ≤3      |
| 3                       | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0,0-2)   |          |         |
|                         | LCRB [RBs]                                   | >0        |          |         |
|                         | A-MPR [dB]                                   | ≤4        |          |         |
| 5                       | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5)  |          |         |
|                         | LCRB [RBs]                                   | >0        |          |         |
|                         | A-MPR [dB]                                   | ≤5        |          |         |
| 10                      | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0, 0-5)  | (1, 0-5) | (2,0-2) |
|                         | LCRB [RBs]                                   | >0        |          |         |
|                         | A-MPR [dB]                                   | ≤4        |          |         |
| 15                      | (NB <sub>index</sub> , RB <sub>start</sub> ) | (0-5,0-5) |          |         |
|                         | LCRB [RBs]                                   | >0        |          |         |
|                         | A-MPR [dB]                                   | ≤4        |          |         |

For subPRB allocation, the allowed A-MPR values specified below in Table 6.2.4E-6 and Table 6.2.4E-7 for category M1 UE and category M2 UE respectively in addition to the allowed MPR requirements specified in subclause 6.2.3E.

Table 6.2.4E-6: Additional Maximum Power Reduction (A-MPR) for category M1 UE for subPRB allocation

| Network Signalling value | Requirements (subclause) | E-UTRA Band | A-MPR (dB)      |
|--------------------------|--------------------------|-------------|-----------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1 | N/A             |
| NS_03                    | 6.6.2.2.1                | 2, 4        | Table 6.2.4E-8  |
| NS_04                    | 6.6.2.2.2                | 41          | Table 6.2.4E-9  |
| NS_05                    | 6.6.3.3.1                | 1           | [N/A]           |
| NS_06                    | 6.6.2.2.3                | 12, 13, 14  | Table 6.2.4E-13 |
| NS_07                    | 6.6.2.2.3                | 13          | Table 6.2.4E-23 |
|                          | 6.6.3.3.2                |             |                 |
| NS_08                    | 6.6.3.3.3                | 19          | [N/A]           |
| NS_09                    | 6.6.3.3.4                | 21, 74      | [N/A]           |
| NS_10                    |                          | 20          | [N/A]           |
| NS_12                    | 6.6.3.3.5                | 26          | Table 6.2.4E-14 |
| NS_13                    | 6.6.3.3.6                | 26          | [N/A]           |
| NS_14                    | 6.6.3.3.7                | 26          | [N/A]           |
| NS_15                    | 6.6.3.3.8                | 26          | [N/A]           |
| NS_16                    | 6.6.3.3.9                | 27          | [N/A]           |
| NS_17                    | 6.6.3.3.10               | 28          | [N/A]           |
| NS_18                    | 6.6.3.3.11               | 28          | [N/A]           |
| NS_22                    | 6.6.3.3.16               | 42, 43      | [N/A]           |
| NS_23                    | 6.6.3.3.17               | 42, 43      | [N/A]           |
| NS_32                    | -                        | -           | -               |
| NS_35                    | 6.6.2.2.7                | 71          | Table 6.2.4E-15 |
| NS_38                    | 6.6.3.3.29               | 74          | Table 6.2.4E-16 |
| NS_39                    | 6.6.3.3.30               | 74          | [N/A]           |

Table 6.2.4E-7: Additional Maximum Power Reduction (A-MPR) for category M2 UE for subPRB allocation

| Network Signalling value | Requirements (subclause) | E-UTRA Band | A-MPR (dB)      |
|--------------------------|--------------------------|-------------|-----------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1 | N/A             |
| NS_03                    | 6.6.2.2.1                | 2, 4        | Table 6.2.4E-10 |

|       |                        |           |                 |
|-------|------------------------|-----------|-----------------|
| NS_04 | 6.6.2.2.2              | 41        | Table 6.2.4E-11 |
| NS_05 | 6.6.3.3.1              | 1         | Table 6.2.4E-17 |
| NS_06 | 6.6.2.2.3              | 12, 13,14 | Table 6.2.4E-18 |
| NS_07 | 6.6.2.2.3<br>6.6.3.3.2 | 13        | Table 6.2.4E-12 |
| NS_08 | 6.6.3.3.3              | 19        | N/A             |
| NS_09 | 6.6.3.3.4              | 21        | N/A             |
| NS_10 |                        | 20        | N/A             |
| NS_12 | 6.6.3.3.5              | 26        | Table 6.2.4E-19 |
| NS_13 | 6.6.3.3.6              | 26        | Table 6.2.4E-20 |
| NS_14 | 6.6.3.3.7              | 26        | N/A             |
| NS_15 | 6.6.3.3.8              | 26        | Table 6.2.4E-21 |
| NS_16 | 6.6.3.3.9              | 27        | Table 6.2.4E-22 |
| NS_17 | 6.6.3.3.10             | 28        | N/A             |
| NS_18 | 6.6.3.3.11             | 28        | N/A             |
| NS_22 | 6.6.3.3.16             | 42, 43    | [N/A]           |
| NS_23 | 6.6.3.3.17             | 42, 43    | [N/A]           |
| NS_32 | -                      | -         | -               |
| NS_35 | 6.6.2.2.7              | 71        | N/A             |
| NS_38 | 6.6.3.3.29             | 74        | Table 6.2.4E-24 |
| NS_39 | 6.6.3.3.30             | 74        | N/A             |

**Table 6.2.4E-8: A-MPR for "NS\_03" for Cat-M1 with sub-PRB allocation**

| BW [MHz]  | 5 MHz  |         |          |         |          |
|-----------|--|---------|----------|---------|----------|
|           | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤9) | (0, ≥63) | (0, ≤9) | (0, ≥63) |
| Lcsc      |  | 2       | 2        | 3,6     | 3,6      |
| AMPR [dB] |  | ≤[0.5]  | ≤[0.5]   | ≤[1]    | ≤[1]     |

NOTE 1: NB<sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].

NOTE 2: Lcsc is the length of the continuous subcarrier, SC<sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with NB<sub>index</sub>.

**Table 6.2.4E-9: A-MPR for "NS\_04" for Cat-M1 with sub-PRB allocation**

| BW [MHz]  | 5 MHz  |         |         |
|-----------|--|---------|---------|
|           | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤9) | (0, ≤9) |
| Lcsc      |  | 2       | 3,6     |
| AMPR [dB] |  | ≤[1]    | ≤[1.5]  |

NOTE 1: NB<sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].

NOTE 2: Lcsc is the length of the continuous subcarrier, SC<sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with NB<sub>index</sub>.

**Table 6.2.4E-10: A-MPR for "NS\_03" for Cat-M2 with sub-PRB allocation**

| BW [MHz]  | 5 MHz  |          |           |           |           |  |
|-----------|--|----------|-----------|-----------|-----------|--|
|           | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤72) | (0, ≥216) |           |           |  |
| Lcsc      |  | 3,6      | 3,6       |           |           |  |
| AMPR [dB] |  | ≤[1]     | ≤[1]      |           |           |  |
| BW [MHz]  | 10 MHz                                       |          |           |           |           |  |
|           | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤60) | (1, ≤24)  | (3, ≥264) | (4, ≥228) |  |
| Lcsc      |  | 3,6      | 3,6       | 3,6       | 3,6       |  |
| AMPR [dB] |  | ≤[1]     | ≤[1]      | ≤[1]      | ≤[1]      |  |

NOTE 1:  $NB_{index}$  is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].

NOTE 2:  $Lcsc$  is the length of the continuous subcarrier,  $SC_{start}$  is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with  $NB_{index}$ .

Table 6.2.4E-11: A-MPR for "NS\_04" for Cat-M2 with sub-PRB allocation

| BW [MHz]                   | 5MHz           |                 |
|----------------------------|----------------|-----------------|
| $(NB_{index}, SC_{start})$ | $(0, \leq 72)$ | $(0, \geq 216)$ |
| Lcsc                       | $\geq 2$       |                 |
| AMPR [dB]                  | $\leq [2]$     |                 |

Table 6.2.4E-12: A-MPR for "NS\_07" for Cat-M2 with sub-PRB allocation

| BW [MHz]                   | 10 MHz      |              |                 |
|----------------------------|-------------|--------------|-----------------|
|                            | $(0, < 48)$ | $(0, 48-84)$ | $(0, \geq 240)$ |
| $(NB_{index}, SC_{start})$ |             |              |                 |
| Lcsc                       | $\geq 2$    | $\geq 2$     | $\geq 2$        |
| AMPR [dB]                  | $\leq [12]$ | $\leq [6]$   | $\leq [14.5]$   |
| $(NB_{index}, SC_{start})$ | $(1, < 24)$ | $(1, 24-72)$ | $(1, \geq 264)$ |
| Lcsc                       | $\geq 2$    | $\geq 2$     | $\geq 2$        |
| AMPR [dB]                  | $\leq [12]$ | $\leq [6]$   | $\leq [14.5]$   |
| $(NB_{index}, SC_{start})$ | $(2, < 60)$ |              | $(2, \geq 252)$ |
| Lcsc                       | $\geq 2$    |              | $\geq 2$        |
| AMPR [dB]                  | $\leq [6]$  |              | $\leq [1.5]$    |
| $(NB_{index}, SC_{start})$ | $(3, < 48)$ |              | $(3, \geq 216)$ |
| Lcsc                       | $\geq 2$    |              | $\geq 2$        |
| AMPR [dB]                  | $\leq [6]$  |              | $\leq [1.5]$    |
| $(NB_{index}, SC_{start})$ | $(4, < 36)$ |              | $(4, \geq 192)$ |
| Lcsc                       | $\geq 2$    |              | $\geq 2$        |
| AMPR [dB]                  | $\leq [3]$  |              | $\leq [1.5]$    |

Table 6.2.4E-13: A-MPR for "NS\_06" for Cat-M1 with sub-PRB allocation

| BW [MHz]                   | 1.4                         | 3             | 5             |
|----------------------------|-----------------------------|---------------|---------------|
| $(NB_{index}, SC_{start})$ | $(0, < 15)$ and $(0, > 54)$ | $([0], < 15)$ | $([0], < 15)$ |
| Lcsc                       | $[2]$                       | $[2]$         | $[2]$         |
| AMPR [dB]                  | $\leq [0.5]$                | $\leq [0.5]$  | $\leq [0.5]$  |

NOTE 1:  $NB_{index}$  is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].

NOTE2:  $Lcsc$  is the length of the continuous subcarrier,  $SC_{start}$  is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with  $NB_{index}$ .

Table 6.2.4E-14: A-MPR for "NS\_12" for Cat-M1 with sub-PRB allocation

| Channel bandwidth [MHz] | Parameters                 | Region            |                   |                   |
|-------------------------|----------------------------|-------------------|-------------------|-------------------|
| 1.4                     | $(NB_{index}, SC_{start})$ | $([0], \leq [3])$ | $([0], \leq [3])$ | $([0], \leq [3])$ |
|                         | Lcsc                       | $[2]$             | $[3]$             | $[6]$             |
|                         | A-MPR [dB]                 | $\leq [5]$        | $\leq [5]$        | $\leq [5]$        |
| 3                       | $(NB_{index}, SC_{start})$ | $([0], \leq [3])$ | $([0], \leq [3])$ | $([0], \leq [3])$ |
|                         | Lcsc                       | $[2]$             | $[3]$             | $[6]$             |
|                         | A-MPR [dB]                 | $\leq [5]$        | $\leq [5]$        | $\leq [5]$        |

|   |  |              |              |              |
|---|--|--------------|--------------|--------------|
| 5 | (NB <sub>index</sub> , SC <sub>start</sub> ) | ([0], ≤ [3]) | ([0], ≤ [3]) | ([0], ≤ [3]) |
|   | Lcsc   | [2]          | [3]          | [6]          |
|   | A-MPR [dB]                                   | ≤ [5]        | ≤ [5]        | ≤ [5]        |

**Table 6.2.4E-15: A-MPR for "NS\_35" for Cat-M1 with sub-PRB allocation**

|   |                   |
|---|-------------------|
| <b>BW [MHz]</b>   | <b>5</b>          |
| <b>(NB<sub>index</sub>, SC<sub>start</sub>)</b>   | <b>([0], [0])</b> |
| Lcsc  | [2]               |
| AMPR [dB]   | ≤ [0.5]           |
| NOTE 1: NB <sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5]. |                   |
| NOTE2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with NB <sub>index</sub> .   |                   |

**Table 6.2.4E-16: A-MPR for "NS\_38" for Cat-M1 with sub-PRB allocation for E-UTRA lowest channel edge > 1427 MHz and ≤ 1447 MHz**

| Channel bandwidth [MHz] | Parameters                                   | Region      |             |  |  |  |  |
|-------------------------|--|-------------|-------------|--|--|--|--|
| 1.4                     | (NB <sub>index</sub> , SC <sub>start</sub> ) | ([0], < 27) | ([0], > 51) |  |  |  |  |
|                         | Lcsc   | 2,3,6       | [3]         |  |  |  |  |
|                         | A-MPR [dB]                                   | ≤ [7]       | ≤ [1]       |  |  |  |  |
| 3                       | (NB <sub>index</sub> , SC <sub>start</sub> ) | ([0], < 21) | ([0], > 60) |  |  |  |  |
|                         | Lcsc   | 2,3,6       | 2,3,6       |  |  |  |  |
|                         | A-MPR [dB]                                   | ≤ [7]       | ≤ [1]       |  |  |  |  |
| 5                       | (NB <sub>index</sub> , SC <sub>start</sub> ) | ([0], < 21) | ([0], > 60) |  |  |  |  |
|                         | Lcsc   | [2]         | [2]         |  |  |  |  |
|                         | A-MPR [dB]                                   | ≤ [7]       | ≤ [1]       |  |  |  |  |
| 10                      | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, < 15)   |             |  |  |  |  |
|                         | Lcsc   | 2,3,6       |             |  |  |  |  |
|                         | A-MPR [dB]                                   | ≤ [7]       |             |  |  |  |  |
| 15                      | (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, < 12)   |             |  |  |  |  |
|                         | Lcsc   | 2,3,6       |             |  |  |  |  |
|                         | A-MPR [dB]                                   | ≤ [7]       |             |  |  |  |  |

**Table 6.2.4E-17: A-MPR for "NS\_05" for Cat-M2 with sub-PRB allocation**

| BW [MHz]  | 5        |         | 10       |          | 15       |          | 20     |        |
|---|----------|---------|----------|----------|----------|----------|--------|--------|
| (WB <sub>index</sub> , SC <sub>start</sub> )  | (0, ≤36) | (0, ≤6) | (0, ≤30) | (0, ≤12) | (0, ≤24) | (0, ≤12) | (0,0)  | (0,0)  |
| Lcsc  | 2        | 6       | 2        | 6        | 2        | 6        | 2      | 3      |
| AMPR [dB]   | ≤[1.5]   | ≤ [0.5] | ≤[1.5]   | ≤[0.5]   | ≤[1.5]   | ≤[0.5]   | ≤[1.5] | ≤[0.5] |
| NOTE 1: WB <sub>index</sub> is the wideband index that is defined in [4].   |          |         |          |          |          |          |        |        |
| NOTE2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB indicated with WB <sub>index</sub> . |          |         |          |          |          |          |        |        |

**Table 6.2.4E-18: A-MPR for "NS\_06" for Cat-M2 with sub-PRB allocation**

| BW [MHz]                                     | 5 MHz    |           |           |           |  |  |
|--|----------|-----------|-----------|-----------|--|--|
| (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤72) | (0, ≥216) |           |           |  |  |
| Lcsc   | 3,6      | 3,6       |           |           |  |  |
| AMPR [dB]                                    | ≤[1]     | ≤[1]      |           |           |  |  |
|  | 10 MHz   |           |           |           |  |  |
| (NB <sub>index</sub> , SC <sub>start</sub> ) | (0, ≤60) | (1, ≤24)  | (3, ≥264) | (4, ≥228) |  |  |



|   |      |      |      |      |  |  |
|---|------|------|------|------|--|--|
| Lcsc  | 3,6  | 3,6  | 3,6  | 3,6  |  |  |
| AMPR [dB]   | ≤[1] | ≤[1] | ≤[1] | ≤[1] |  |  |
| NOTE 1: NB <sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5]. |      |      |      |      |  |  |
| NOTE 2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with NB <sub>index</sub> .  |      |      |      |      |  |  |

**Table 6.2.4E-19: A-MPR for "NS\_12" for Cat-M2 with sub-PRB allocation for E-UTRA lower channel edge ≥ 814.2 MHz and ≤ 829.2 MHz**

|   |                    |
|---|--------------------|
| <b>BW [MHz]</b>   | <b>5 MHz</b>       |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>  | <b>(0, &lt;84)</b> |
| Lcsc  | ≥2                 |
| AMPR [dB]   | ≤[5]               |
| <b>BW [MHz]</b>   | <b>10 MHz</b>      |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>  | <b>(0, &lt;72)</b> |
| Lcsc  | ≥2                 |
| AMPR [dB]   | ≤[5]               |
| <b>BW [MHz]</b>   | <b>15 MHz</b>      |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>  | <b>(0, &lt;66)</b> |
| Lcsc  | ≥2                 |
| AMPR [dB]   | ≤[5]               |
| NOTE 1: NB <sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5].                 |                    |
| NOTE 2: WB <sub>index</sub> is the wideband index that is defined in [4].   |                    |
| NOTE 3: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB indicated with NB <sub>index</sub> or WB <sub>index</sub> . |                    |

**Table 6.2.4E-20: A-MPR for "NS\_13" for Cat-M2 with sub-PRB allocation for E-UTRA lower channel edge ≥ 819 MHz and ≤ 824 MHz**

|  |                    |                    |
|--|--------------------|--------------------|
| <b>BW [MHz]</b>  | <b>5</b>           |                    |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>   | <b>(0, &lt;30)</b> | <b>(0, &lt;30)</b> |
| Lcsc   | 2                  | 3,6                |
| AMPR [dB]  | ≤[3]               | ≤[5]               |
| NOTE 1: WB <sub>index</sub> is the wideband index that is defined in [4].  |                    |                    |
| NOTE 2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB indicated with WB <sub>index</sub> . |                    |                    |

**Table 6.2.4E-21: A-MPR for "NS\_15" for Cat-M2 with sub-PRB allocation for E-UTRA highest channel edge > 834 MHz and ≤ 849 MHz**

|  |                    |                    |                    |                     |                     |                     |
|--|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
| <b>BW [MHz]</b>                                | <b>5 MHz</b>       |                    |                    |                     |                     |                     |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b> | <b>(0, &lt;54)</b> | <b>(0, &lt;54)</b> | <b>(0, &lt;54)</b> | <b>(0, 200-234)</b> | <b>(0, &gt;234)</b> | <b>(0, &gt;234)</b> |
| Lcsc   | 2                  | 3                  | 6                  | ≥2                  | 2,3                 | 6                   |
| AMPR [dB]                                      | ≤[10.5]            | ≤[8.5]             | ≤[5.5]             | ≤[3.5]              | ≤[10]               | ≤[9]                |
| <b>BW [MHz]</b>                                | <b>10 MHz</b>      |                    |                    |                     |                     |                     |

|  |                    |                    |                    |                     |                     |                     |
|--|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>   | <b>(1, &lt;48)</b> | <b>(1, &lt;48)</b> | <b>(1, &lt;48)</b> | <b>(1, 200-234)</b> | <b>(1, &gt;234)</b> | <b>(1, &gt;234)</b> |
| Lcsc   | 2                  | 3                  | 6                  | ≥2                  | 2,3                 | 6                   |
| AMPR [dB]  | ≤[10.5]            | ≤[8.5]             | ≤[5.5]             | ≤[3.5]              | ≤[10]               | ≤[9]                |
| <b>BW [MHz]</b>  | <b>15 MHz</b>      |                    |                    |                     |                     |                     |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>   | <b>(2, &lt;48)</b> | <b>(2, &lt;48)</b> | <b>(2, &lt;48)</b> | <b>(2, 200-234)</b> | <b>(2, &gt;234)</b> | <b>(2, &gt;234)</b> |
| Lcsc   | 2                  | 3                  | 6                  | ≥2                  | 2,3                 | 6                   |
| AMPR [dB]  | ≤[10.5]            | ≤[8.5]             | ≤[5.5]             | ≤[3.5]              | ≤[10]               | ≤[9]                |
| NOTE 1: WB <sub>index</sub> is the wideband index that is defined in [4].  |                    |                    |                    |                     |                     |                     |
| NOTE 2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB indicated with WB <sub>index</sub> |                    |                    |                    |                     |                     |                     |

**Table 6.2.4E-22: A-MPR for "NS\_16" for Cat-M2 with sub-PRB allocation for E-UTRA lowest channel edge > 807 MHz and ≤ 812 MHz**

|  |                   |
|--|-------------------|
| <b>BW [MHz]</b>  | <b>5 MHz</b>      |
| <b>(WB<sub>index</sub>,SC<sub>start</sub>)</b>   | <b>(0, &lt;6)</b> |
| Lcsc   | 2                 |
| AMPR [dB]  | ≤[7]              |
| NOTE 1: WB <sub>index</sub> is the wideband index that is defined in [4].  |                   |
| NOTE 2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB indicated with WB <sub>index</sub> |                   |

**Table 6.2.4E-23: A-MPR for "NS\_07" for Cat-M1 with sub-PRB allocation**

|   |                    |
|---|--------------------|
| <b>BW [MHz]</b>   | <b>10</b>          |
| <b>(NB<sub>index</sub>,SC<sub>start</sub>)</b>  | <b>(0, &lt; 9)</b> |
| Lcsc  | 2                  |
| AMPR [dB]   | ≤ 0.5              |
| NOTE 1: NB <sub>index</sub> is the narrowband index that is defined in 6.2.7 in [4]. The resource block assignment is defined within the narrowband as defined in 5.3.3.1.12 and 5.3.3.1.13 in [5]. |                    |
| NOTE 2: Lcsc is the length of the continuous subcarrier, SC <sub>start</sub> is the subcarrier offset relative to the first subcarrier of the first PRB of NB indicated with NB <sub>index</sub> .  |                    |

**Table 6.2.4E-24: A-MPR for "NS\_38" for Cat-M2 with sub-PRB allocation for E-UTRA lowest channel edge > 1427 MHz and ≤ 1447 MHz**

| Channel bandwidth [MHz] | Parameters                                  | Region    |            |            |             |              |
|-------------------------|---|-----------|------------|------------|-------------|--------------|
|                         |   | (0, 0-27) | (0, 30-42) | (0, 45-51) | (0, 96-120) | (0, 123-168) |
| 3                       | (NB <sub>index</sub> ,SC <sub>start</sub> ) | (0, 0-27) | (0, 30-42) | (0, 45-51) | (0, 96-120) | (0, 123-168) |
|                         | Lcsc  | 2,3,6     | 2,3,6      | 2,3,6      | 2,3,6       | 2,3,6        |
|                         | A-MPR [dB]                                  | ≤ [16]    | ≤ [13]     | ≤ [10]     | ≤ [7]       | ≤ [3]        |
| 5                       | (WB <sub>index</sub> ,SC <sub>start</sub> ) | (0, < 96) | (0, > 219) |            |             |              |
|                         | Lcsc  | 2,3,6     | 2,3,6      |            |             |              |
|                         | A-MPR [dB]                                  | ≤ [7]     | ≤ [1]      |            |             |              |
| 10                      | (WB <sub>index</sub> ,SC <sub>start</sub> ) | (0, < 93) | (0, > 219) |            |             |              |
|                         | Lcsc  | 2,3,6     | 2,3,6      |            |             |              |
|                         | A-MPR [dB]                                  | ≤ [7]     | ≤ [1]      |            |             |              |
| 15                      | (WB <sub>index</sub> ,SC <sub>start</sub> ) | (0, < 87) | (0, > 234) |            |             |              |
|                         | Lcsc  | 2,3,6     | 2,3,6      |            |             |              |
|                         | A-MPR [dB]                                  | ≤ [7]     | ≤ [1]      |            |             |              |
| 20                      | (WB <sub>index</sub> ,SC <sub>start</sub> ) | (0, < 81) | (0, > 234) |            |             |              |
|                         | Lcsc  | 2,3,6     | 2,3,6      |            |             |              |
|                         | A-MPR [dB]                                  | ≤ [7]     | ≤ [1]      |            |             |              |

No other A-MPR requirement than those specified in table 6.2.4E-1, table 6.2.4E-2, table 6.2.4E-6 and table 6.2.4E-7 applies to category M1 and M2 UE.

## 6.2.4F UE maximum output power with additional requirements for category NB1 and NB2 UE

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the output power are specified. For the agreed E-UTRA bands for category NB1 and NB2 UE an A-MPR of 0 dB shall be allowed unless specified otherwise.

For UE Power Class 3 and 5 the specific requirements and identified subclauses are specified in Table 6.2.4F-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2.4F-1 are in addition to the allowed MPR requirements specified in subclause 6.2.3F-1.

**Table 6.2.4F-1: Additional Maximum Power Reduction (A-MPR) for category NB1 and NB2 UE**

| Network Signalling value | Requirements (subclause) | E-UTRA Band  | A-MPR (dB) |
|--------------------------|--------------------------|--|------------|
| NS_01                    | 6.6.2F.1                 | Operating bands defined in 5.5F  | N/A        |
| NS_02                    | 6.6.2F.2.1               | [1, 2, 3, 5, 8, 11, 12, 13, 17, 18, 19, 20, 21, 25, 26, 28, 66, 70 and 85] | [N/A]      |
| NS_03                    | 6.6.2F.2.2               | [1, 2, 3, 5, 8, 11, 12, 13, 17, 18, 19, 20, 21, 25, 26, 28, 66, 70 and 85] | [N/A]      |
| NS_04                    | 5.5F                     | 2, 4, 5, 12, 13, 17, 25, 26, 66, 71, 85                                    | N/A        |

## 6.2.4G UE maximum output power with additional requirements for V2X Communication

For QPSK the MPR requirements specified in subclause 6.2.3G does not apply, i.e. MPR = 0dB. For 16QAM and 64 QAM, the applied maximum output power reduction is obtained by taking the maximum value of MPR requirements specified in subclause 6.2.3G and A-MPR requirements specified in subclause 6.2.4G.

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the maximum output power reduction specified as

$$A\text{-MPR} = \text{CEIL} \{M_A, 0.5\}$$

Where  $M_A$  is defined as follows

$$M_A = A\text{-MPR}_{\text{Base}} + G_{\text{post connector}} * A\text{-MPR}_{\text{Step}}$$

$\text{CEIL}\{M_A, 0.5\}$  means rounding upwards to closest 0.5dB.

$A\text{-MPR}_{\text{Base}}$  and  $A\text{-MPR}_{\text{Step}}$  are specified in Tables 6.2.4G-1, 6.2.4G-2, 6.2.4G-3 is allowed when network signalling value is provided. The supported post antenna connector gain  $G_{\text{post connector}}$  is declared by the UE following the principle described in annex I.

NOTE: the  $A\text{-MPR}_{\text{Step}}$  is the increase in A-MPR allowance to allow UE to meet tighter conducted A-SE and A-SEM requirements with higher value of declared  $G_{\text{post connector}}$ .  $A\text{-MPR}_{\text{Base}}$  is the default A-MPR value when no  $G_{\text{post connector}}$  is declared.  $A\text{-MPR}_{\text{Base}}$  and  $A\text{-MPR}_{\text{Step}}$  vary depending on channel frequency and RB allocation. For channel

frequencies and RB allocations that are close to the frequency range 5815-5855MHz, those value are much higher due to stringent emission requirement in this range.

**Table 6.2.4G-1: Additional Maximum Power Reduction (A-MPR) for power class 3 V2X UE**

| Network Signalling value | Requirements (subclause)                      | E-UTRA Band | Channel bandwidth (MHz) | A-MPR (dB)     |
|--------------------------|---|-------------|-------------------------|----------------|
| NS_33                    | 6.6.2.2.4 (A-SEM)<br>6.6.3.2 (A-SE)<br>6.6.2G | 47          | 10                      | Table 6.2.4G-2 |

**Table 6.2.4G-2: A-MPR for NS\_33**

| Resource pool | Carrier frequency(MHz) | Resources Blocks ( $N_{RB}$ ) | Start Resource Block    | A-MPR <sub>Base</sub> | A-MPR <sub>Step</sub> |      |
|---------------|------------------------|-------------------------------|-------------------------|-----------------------|-----------------------|------|
| Adjacent      | 5860                   | $\leq 6$                      | 0                       | 20                    | 0.86                  |      |
|               |                        |                               | 5,6                     | 8                     | 0.64                  |      |
|               |                        |                               | 10,12                   | 6                     | 0.50                  |      |
|               |                        |                               | $\geq 15$               | 5                     | 0.93                  |      |
|               |                        | >6 and $\leq 10$              | 0                       | 15.5                  | 0.86                  |      |
|               |                        |                               | 5, 6                    | 8                     | 0.64                  |      |
|               |                        |                               | 10, 12                  | 6                     | 0.50                  |      |
|               |                        |                               | $\geq 15$               | 5                     | 0.93                  |      |
|               |                        | >10 and $\leq 22$             | 0                       | 15                    | 0.71                  |      |
|               |                        |                               | 5, 6                    | 11.5                  | 0.64                  |      |
|               |                        |                               | 10, 12                  | 10                    | 0.57                  |      |
|               |                        |                               | 15, 18                  | 6                     | 0.57                  |      |
|               |                        |                               | 20, 24, 25              | 5                     | 0.57                  |      |
|               |                        |                               | $\geq 30$               | 4.5                   | 0.64                  |      |
|               |                        | >22                           | 0, 5, 6                 | 12.5                  | 0.71                  |      |
|               |                        |                               | 10, 12                  | 10.5                  | 0.57                  |      |
|               | 15, 18                 |                               | 9.5                     | 0.64                  |                       |      |
|               | 20, 24, 25             |                               | 6.5                     | 0.71                  |                       |      |
|               | 5870, 5910, 5920       | <20                           | $\geq 0$                | 3                     | 0.64                  |      |
|               |                        |                               |                         | 1.5                   | 0.43                  |      |
|               |                        | $\geq 20$ and $\leq 45$       | 2.5                     | 0.36                  |                       |      |
|               |                        |                               | >45                     |                       |                       |      |
|               |                        | 5880, 5890, 5900              | <10                     | $\geq 0$              | 3                     | 0.43 |
|               |                        |                               | $\geq 10$ and $\leq 38$ | $\geq 0$              | 1.5                   | 0.50 |
| >38           |                        |                               | 2                       | 0.43                  |                       |      |
| Non-Adjacent  | 5860                   | $\leq 5$                      | $\geq 0$                | 13.5                  | 1                     |      |
|               |                        | >5                            |                         | 11.5                  | 1                     |      |
|               | 5870, 5910, 5920       | $\leq 5$                      | $\geq 0$                | 5                     | 1                     |      |
|               |                        | >5 and $\leq 42$              | $\geq 0$                | 3                     | 1                     |      |
|               |                        | >42                           |                         | 4.5                   | 1                     |      |
|               | 5880, 5890, 5900       | $\leq 18$                     | $\geq 0$                | 3.5                   | 1                     |      |
|               |                        | >18 and $\leq 42$             | $\geq 0$                | 2.5                   | 1                     |      |
|               |                        | >42                           |                         | 3                     | 1                     |      |

The allowed A-MPR for the maximum output power for V2X physical signal PSBCH and PSSS/SSSS shall be as be as specified in subclause 6.2.4 for the corresponding modulation and transmission bandwidth.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.2.4G apply for V2X PSSCH and PSCCH transmission. The allowed A-MPR requirements in subclause 6.2.4D apply for other V2X sidelink transmission (PSBCH/PSSS/SSSS). The A-MPR requirements in subclause 6.2.4 apply for uplink transmission.

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the allowed A-MPR for the maximum output power for V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2.4G-3 and 6.2.4G-4 for V2X UE power class 2.

**Table 6.2.4G-3: Additional Maximum Power Reduction (A-MPR) for power class 2 V2X UE**

| Network Signalling value | Requirements (subclause)                      | E-UTRA Band | Channel bandwidth (MHz) | A-MPR (dB)     |
|--------------------------|---|-------------|-------------------------|----------------|
| NS_34                    | 6.6.2.2.4 (A-SEM)<br>6.6.3.2 (A-SE)<br>6.6.2G | 47          | 10                      | Table 6.2.4G-4 |

| Table 6.2.4G-4: A-MPR for NS_34 Resource pool | Carrier frequency(MHz)       | Resources Blocks ( $N_{RB}$ ) | A-MPR (dB) |
|---|------------------------------|-------------------------------|------------|
| Adjacent                                      | 5860                         | <20                           | 15         |
|   |                              | >20 and <30                   | 13         |
|   |                              | >30                           | 12         |
|   | 5870, 5900, 5880, 5890, 5900 | <15 or >40                    | 1          |
| Non-Adjacent                                  | 5860                         | -                             | 12.5       |
|   | 5910, 5920                   | <10                           | 5.5        |
|   |                              | >10 and <20                   | 3          |
|   | 5870, 5880, 5890, 5900       | <10                           | 5.5        |

## 6.2.5 Configured transmitted power

The UE is allowed to set its configured maximum output power  $P_{C_{MAX,c}}$  for serving cell  $c$ . The configured maximum output power  $P_{C_{MAX,c}}$  is set within the following bounds:

$$P_{C_{MAX,L,c}} \leq P_{C_{MAX,c}} \leq P_{C_{MAX,H,c}} \text{ with}$$

$$P_{C_{MAX,L,c}} = \text{MIN} \{ P_{E_{MAX,c}} - \Delta T_{C,c}, (P_{\text{PowerClass}} - \Delta P_{\text{PowerClass}}) - \text{MAX}(M_{PR,c} + A\text{-}M_{PR,c} + \Delta T_{IB,c} + \Delta T_{C,c} + \Delta T_{\text{ProSe}}, P\text{-}M_{PR,c} \}$$

$$P_{C_{MAX,H,c}} = \text{MIN} \{ P_{E_{MAX,c}}, P_{\text{PowerClass}} - \Delta P_{\text{PowerClass}} \}$$

where

- $P_{E_{MAX,c}}$  is the value given by IE *P-Max* for serving cell  $c$ , defined in [7];
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2-1 without taking into account the tolerance specified in the Table 6.2.2-1;
- $\Delta P_{\text{PowerClass}} = 3$  dB for a power class 2 capable UE operating in Band 41, when *P-max* of 23 dBm or lower is indicated or if the uplink/downlink configuration is 0 or 6 in the cell; otherwise,  $\Delta P_{\text{PowerClass}} = 0$  dB

- $\Delta P_{PowerClass} = P_{PowerClass} - P_{PowerClass\_Default}$  dB for UE operating in Band 14, when  $P_{max}$  of 23 dBm or lower is indicated in the cell; otherwise,  $\Delta P_{PowerClass} = 0$  dB.
- $MPR_c$  and  $A-MPR_c$  for serving cell  $c$  are specified in subclause 6.2.3 and subclause 6.2.4, respectively;
- $\Delta T_{IB,c}$  is the additional tolerance for serving cell  $c$  as specified in Table 6.2.5-2;  $\Delta T_{IB,c} = 0$  dB otherwise;
- $\Delta T_{C,c} = 1.5$  dB when NOTE 2 in Table 6.2.2-1 applies;
- $\Delta T_{C,c} = 0$  dB when NOTE 2 in Table 6.2.2-1 does not apply;
- $\Delta T_{ProSe} = 0.1$  dB when the UE supports ProSe Direct Discovery and/or ProSe Direct Communication on the corresponding E-UTRA ProSe band;  $\Delta T_{ProSe} = 0$  dB otherwise.
- For a power class higher than default UE power class capable UE except for operating in Band 14 and Band 41,  $\Delta P_{PowerClass} = P_{PowerClass} - P_{PowerClass\_Default}$  dB, when the band is a TDD band whose frame configuration is 0 or 6; or  $P_{max}$  is not indicated in the cell; or  $P_{Max}$  is provided and set to the maximum output power of the default power class or lower, otherwise,  $\Delta P_{PowerClass} = 0$  dB.

$P-MPR_c$  is the allowed maximum output power reduction for

- a) ensuring compliance with applicable electromagnetic energy absorption requirements and addressing unwanted emissions / self desense requirements in case of simultaneous transmissions on multiple RAT(s) for scenarios not in scope of 3GPP RAN specifications;
- b) ensuring compliance with applicable electromagnetic energy absorption requirements in case of proximity detection is used to address such requirements that require a lower maximum output power.

The UE shall apply  $P-MPR_c$  for serving cell  $c$  only for the above cases. For UE conducted conformance testing  $P-MPR$  shall be 0 dB

NOTE 1:  $P-MPR_c$  was introduced in the  $P_{CMAX,c}$  equation such that the UE can report to the eNB the available maximum output transmit power. This information can be used by the eNB for scheduling decisions.

NOTE 2:  $P-MPR_c$  may impact the maximum uplink performance for the selected UL transmission path.

$T_{REF}$  and  $T_{eval}$  are specified in Table 6.2.5-0 for different TTI patterns. For each  $T_{REF}$ , the  $P_{CMAX_{L,c}}$  for serving cell  $c$  is evaluated per  $T_{eval}$  and given by the minimum value taken over the transmission(s) within the  $T_{eval}$ ; the minimum  $P_{CMAX_{L,c}}$  over the one or more  $T_{eval}$  is then applied for the entire  $T_{REF}$ .  $P_{PowerClass}$  shall not be exceeded by the UE during any period of time.

**Table 6.2.5-0:  $P_{CMAX}$  evaluation window for different TTI patterns**

| TTI pattern | $T_{REF}$  | $T_{eval}$ | $T_{eval}$ with frequency hopping  |
|-------------|------------|------------|------------------------------------|
| Subframe    | 1 subframe | 1 slot     | 1 slot                             |
| Subslot     | 2 OS       | 2 OS       | $\text{Min}(T_{no\_hopping}, 2OS)$ |
| Slot        | 7 OS       | 7 OS       | $\text{Min}(T_{no\_hopping}, 7OS)$ |

The measured configured maximum output power  $P_{UMAX,c}$  shall be within the following bounds:

$$P_{CMAX_{L,c}} - \text{MAX}\{T_{L,c}, T(P_{CMAX_{L,c}})\} \leq P_{UMAX,c} \leq P_{CMAX_{H,c}} + T(P_{CMAX_{H,c}}).$$

where the tolerance  $T(P_{CMAX,c})$  for applicable values of  $P_{CMAX,c}$  is specified in Table 6.2.5-1, and Table 6.2.5-1A. The tolerance  $T_{L,c}$  is the absolute value of the lower tolerance for the applicable operating band as specified in Table 6.2.2-1.

**Table 6.2.5-1:  $P_{CMAX}$  tolerance**

| $P_{CMAX,c}$ (dBm)           | Tolerance $T(P_{CMAX,c})$ (dB) |
|------------------------------|--------------------------------|
| $23 < P_{CMAX,c} \leq 33$    | 2.0                            |
| $21 \leq P_{CMAX,c} \leq 23$ | 2.0                            |
| $20 \leq P_{CMAX,c} < 21$    | 2.5                            |

|                                  |     |
|----------------------------------|-----|
| $19 \leq P_{\text{CMAX},c} < 20$ | 3.5 |
| $18 \leq P_{\text{CMAX},c} < 19$ | 4.0 |
| $13 \leq P_{\text{CMAX},c} < 18$ | 5.0 |
| $8 \leq P_{\text{CMAX},c} < 13$  | 6.0 |
| $-40 \leq P_{\text{CMAX},c} < 8$ | 7.0 |

**Table 6.2.5-1A:  $P_{\text{CMAX}}$  tolerance for power class 5**

| $P_{\text{CMAX},c}$<br>(dBm)     | Tolerance T( $P_{\text{CMAX},c}$ )<br>(dB) |
|----------------------------------|--|
| $P_{\text{CMAX},c} = 20$         | 2.0  |
| $19 \leq P_{\text{CMAX},c} < 20$ | 3.5  |
| $18 \leq P_{\text{CMAX},c} < 19$ | 4.0  |
| $13 \leq P_{\text{CMAX},c} < 18$ | 5.0  |
| $8 \leq P_{\text{CMAX},c} < 13$  | 6.0  |
| $-40 \leq P_{\text{CMAX},c} < 8$ | 7.0  |

**Table 6.2.5-1B:  $P_{\text{CMAX}}$  tolerance for power class 6 for category M1 and M2 UE**

| $P_{\text{CMAX},c}$<br>(dBm)        | Tolerance T( $P_{\text{CMAX},c}$ )<br>(dB) |
|-------------------------------------|--|
| $13 \leq P_{\text{CMAX},c} \leq 14$ | 2.5  |
| $12 \leq P_{\text{CMAX},c} < 13$    | 3.5  |
| $11 \leq P_{\text{CMAX},c} < 12$    | 4  |
| $8 \leq P_{\text{CMAX},c} < 11$     | 5  |
| $5 \leq P_{\text{CMAX},c} < 8$      | 6.0  |
| $-40 \leq P_{\text{CMAX},c} < 5$    | 7.0  |

For the UE which supports inter-band carrier aggregation configurations with the uplink assigned to one or two E-UTRA bands the  $\Delta T_{\text{IB},c}$  is defined for applicable bands in Table 6.2.5-2, Table 6.2.5-3 and Table 6.2.5-4 where unless otherwise stated, the same  $\Delta T_{\text{IB},c}$  is applicable to E-UTRA band(s) part for CA configurations which have the same E-UTRA operating band combination.

**Table 6.2.5-2:  $\Delta T_{\text{IB},c}$  (two bands)**

| E-UTRA operating band combination      | E-UTRA Band | $\Delta T_{\text{IB},c}$ [dB] |
|--|-------------|-------------------------------|
| CA_1-3, CA_1-1-3, CA_1-1-3-3, CA_1-3-3 | 1           | 0.3                           |
|  | 3           | 0.3                           |
| CA_1-5                                 | 1           | 0.3                           |
|  | 5           | 0.3                           |
| CA_1-7, CA_1-1-7, CA_1-7-7             | 1           | 0.5                           |
|  | 7           | 0.6                           |
| CA_1-8                                 | 1           | 0.3                           |
|  | 8           | 0.3                           |
| CA_1-11                                | 1           | 0.3                           |
|  | 11          | 0.3                           |
| CA_1-18                                | 1           | 0.3                           |
|  | 18          | 0.3                           |
| CA_1-19                                | 1           | 0.3                           |
|  | 19          | 0.3                           |
| CA_1-20                                | 1           | 0.3                           |
|  | 20          | 0.3                           |
| CA_1-21                                | 1           | 0.3                           |
|  | 21          | 0.3                           |
| CA_1-26                                | 1           | 0.3                           |
|  | 26          | 0.3                           |
|  | 1           | 0.3                           |

|   |    |     |
|---|----|-----|
| CA_1-28,<br>CA_1-1-28   | 28 | 0.6 |
| CA_1-32   | 1  | 0.5 |
|   | 32 | N/A |
| CA_1-38   | 1  | 0.5 |
|   | 38 | 0.5 |
| CA_1-40   | 1  | 0.5 |
|   | 40 | 0.5 |
| CA_1-41 <sup>8</sup>  | 1  | 0.5 |
|   | 41 | 0.5 |
| CA_1-42,<br>CA_1-42-42  | 1  | 0.3 |
|   | 42 | 0.8 |
| CA_1-43   | 1  | 0.3 |
|   | 43 | 0.8 |
| CA_1-46   | 1  | 0   |
| CA_2-4, CA_2-<br>2-4, CA_2-4-4,<br>CA_2-2-4-4                           | 2  | 0.5 |
|   | 4  | 0.5 |
| CA_2-5, CA_2-<br>2-5  | 2  | 0.3 |
|   | 5  | 0.3 |
| CA_2-7, CA_2-<br>2-7, CA_2-7-7  | 2  | 0.5 |
|   | 7  | 0.5 |
| CA_2-12,<br>CA_2-2-12,<br>CA_2-12-12,<br>CA_2-2-12-12                   | 2  | 0.3 |
|   | 12 | 0.3 |
| CA_2-13,<br>CA_2-2-13   | 2  | 0.3 |
|   | 13 | 0.3 |
| CA_2-14,<br>CA_2-2-14   | 2  | 0.3 |
|   | 14 | 0.3 |
| CA_2-17   | 2  | 0.3 |
|   | 17 | 0.8 |
| CA_2-26   | 2  | 0.3 |
|   | 26 | 0.3 |
| CA_2-28   | 2  | 0.3 |
|   | 28 | 0.3 |
| CA_2-29,<br>CA_2-2-29   | 2  | 0.3 |
| CA_2-30,<br>CA_2-2-30   | 2  | 0.5 |
|   | 30 | 0.3 |
| CA_2-46,<br>CA_2-2-46,<br>CA_2-46-46                                    | 2  | 0   |
| CA_2-48,<br>CA_2-48-48  | 2  | 0.6 |
|   | 48 | 0.8 |
| CA_2-49   | 2  | 0.6 |
| CA_2-66,<br>CA_2-2-66,<br>CA_2-66-66,<br>CA_2-2-66-66,<br>CA_2-66-66-66 | 2  | 0.5 |
|   | 66 | 0.5 |
| CA_2-71,<br>CA_2-2-71   | 2  | 0.3 |
|   | 71 | 0.3 |
| CA_3-5,<br>CA_3-3-5   | 3  | 0.3 |
|   | 5  | 0.3 |
| CA_3-7, CA_3-<br>3-7, CA_3-7-7,<br>CA_3-3-7-7                           | 3  | 0.5 |
|   | 7  | 0.5 |
| CA_3-8, CA_3-<br>3-8  | 3  | 0.3 |
|   | 8  | 0.3 |
| CA_3-11   | 3  | 0.8 |
|   | 11 | 0.9 |
| CA_3-18   | 3  | 0.3 |
|   | 18 | 0.3 |
| CA_3-19,<br>CA_3-3-19   | 3  | 0.3 |
|   | 19 | 0.3 |



|                            |    |                   |
|----------------------------|----|-------------------|
| CA_3-20,                   | 3  | 0.3               |
| CA_3-3-20                  | 20 | 0.3               |
| CA_3-21,                   | 3  | 0.8               |
| CA_3-3-21                  | 21 | 0.9               |
| CA_3-26                    | 3  | 0.3               |
|                            | 26 | 0.3               |
| CA_3-27                    | 3  | 0.3               |
|                            | 27 | 0.3               |
| CA_3-28                    | 3  | 0.3               |
|                            | 28 | 0.3               |
| CA_3-31                    | 3  | 0.3               |
|                            | 31 | 0.6               |
| CA_3-32                    | 3  | 0.5               |
| CA_3-38                    | 3  | 0,5               |
|                            | 38 | 0,5               |
| CA_3-40,                   | 3  | 0.5               |
| CA_3-40-40                 | 40 | 0.5               |
| CA_3-41,                   | 3  | 0.5               |
| CA_3-3-41                  | 41 | 0.3 <sup>10</sup> |
|                            |    | 0.8 <sup>11</sup> |
| CA_3-42,                   | 3  | 0.6               |
| CA_3-3-42,                 |    |                   |
| CA_3-42-42                 | 42 | 0.8               |
| CA_3-43                    | 3  | 0.3               |
|                            | 43 | 0.8               |
| CA_3-46,                   | 3  | 0                 |
| CA_3-3-46                  |    |                   |
| CA_3-69                    | 3  | 0.5               |
| CA_4-5, CA_4-4-5           | 4  | 0.3               |
|                            | 5  | 0.3               |
| CA_4-7, CA_4-4-7, CA_4-7-7 | 4  | 0.5               |
|                            | 7  | 0.5               |
| CA_4-12,                   | 4  | 0.3               |
| CA_4-4-12,                 |    |                   |
| CA_4-12-12,                | 12 | 0.8               |
| CA_4-4-12-12               |    |                   |
| CA_4-13,                   | 4  | 0.3               |
| CA_4-4-13                  | 13 | 0.3               |
| CA_4-17                    | 4  | 0.3               |
|                            | 17 | 0.8               |
| CA_4-27                    | 4  | 0.3               |
|                            | 27 | 0.3               |
| CA_4-28                    | 4  | 0.3               |
|                            | 28 | 0.6               |
| CA_4-29,                   | 4  | 0.3               |
| CA_4-4-29                  |    |                   |
| CA_4-30,                   | 4  | 0.5               |
| CA_4-4-30                  | 30 | 0.3               |
| CA_4-46,                   | 4  | 0                 |
| CA_4-46-46                 |    |                   |
| CA_4-48                    | 4  | 0.3               |
|                            | 48 | 0.8               |
| CA_4-71,                   | 4  | 0.3               |
| CA_4-4-71                  | 71 | 0.3               |
| CA_5-7, CA_5-7-7           | 5  | 0.3               |
|                            | 7  | 0.3               |
| CA_5-12,                   | 5  | 0.8               |
| CA_5-12-12                 | 12 | 0.4               |
| CA_5-13                    | 5  | 0.5               |
|                            | 13 | 0.5               |
| CA_5-17                    | 5  | 0.8               |
|                            | 17 | 0.4               |
| CA_5-25                    | 5  | 0.3               |
|                            | 25 | 0.3               |
| CA_5-28                    | 5  | 0.5               |
|                            | 28 | 0.5               |

|   |    |       |
|---|----|-------|
| CA_5-29   | 5  | 0.5   |
| CA_5-30   | 5  | 0.3   |
|   | 30 | 0.3   |
| CA_5-38   | 5  | 0.3   |
|   | 38 | 0.3   |
| CA_5-40,<br>CA_5-5-40,<br>CA_5-40-40                  | 5  | 0.3   |
|   | 40 | 0.3   |
| CA_5-41   | 5  | 0.3   |
|   | 41 | 0.3   |
| CA_5-46   | 5  | 0     |
| CA_5-48   | 5  | 0.3   |
|   | 48 | 0.3   |
| CA_5-66,<br>CA_5-5-66,<br>CA_5-66-66,<br>CA_5-5-66-66 | 5  | 0.3   |
|   | 66 | 0.3   |
| CA_7-8, CA_7-<br>7-8                                  | 7  | 0.3   |
|   | 8  | 0.6   |
| CA_7-12   | 7  | 0.3   |
|   | 12 | 0.3   |
| CA_7-13   | 7  | 0.3   |
|   | 13 | 0.3   |
| CA_7-20,<br>CA_7-7-20                                 | 7  | 0.3   |
|   | 20 | 0.3   |
| CA_7-22   | 7  | 0.5   |
|   | 22 | 0.8   |
| CA_7-26,<br>CA_7-7-26                                 | 7  | 0.3   |
|   | 26 | 0.3   |
| CA_7-28,<br>CA_7-7-28                                 | 7  | 0.3   |
|   | 28 | 0.3   |
| CA_7-29<br>CA_7-7-29                                  | 7  | 0.3   |
| CA_7-30   | 7  | 0.5   |
|   | 30 | 0.5   |
| CA_7-32   | 7  | 0.7   |
| CA_7-40   | 7  | 0.5   |
|   | 40 | [0.6] |
| CA_7-42,<br>CA_7-42-42                                | 7  | 0.5   |
|   | 42 | 0.8   |
| CA_7-46,<br>CA_7-7-46                                 | 7  | 0     |
| CA_7-66,<br>CA_7-7-66,<br>CA_7-66-66,<br>CA_7-7-66-66 | 7  | 0.5   |
|   | 66 | 0.5   |
| CA_8-11   | 8  | 0.3   |
|   | 11 | 0.4   |
| CA_8-20   | 8  | 0.4   |
|   | 20 | 0.4   |
| CA_8-27   | 8  | 0.8   |
|   | 27 | 0.8   |
| CA_8-28 <sup>14</sup>                                 | 8  | 0.6   |
|   | 28 | 0.5   |
| CA_8-32   | 8  | 0.3   |
| CA_8-38   | 8  | 0.3   |
|   | 38 | 0.3   |
| CA_8-39   | 8  | 0.3   |
|   | 39 | 0.3   |
| CA_8-40   | 8  | 0.3   |
|   | 40 | 0.3   |
| CA_8-41   | 8  | 0.3   |
|   | 41 | 0.3   |
| CA_8-42   | 8  | 0.6   |
|   | 42 | 0.8   |
| CA_8-46   | 8  | 0     |

|   |    |     |
|---|----|-----|
| CA_11-18  | 11 | 0.3 |
|   | 18 | 0.3 |
| CA_11-26  | 11 | 0.3 |
|   | 26 | 0.3 |
| CA_11-28  | 11 | 0.4 |
|   | 28 | 0.6 |
| CA_11-41  | 11 | 0.3 |
|   | 41 | 0.3 |
| CA_11-42  | 11 | 0.4 |
|   | 42 | 0.8 |
| CA_11-46  | 11 | 0   |
| CA_12-25  | 12 | 0.3 |
|   | 25 | 0.3 |
| CA_12-30  | 12 | 0.3 |
|   | 30 | 0.3 |
| CA_12-46  | 12 | 0   |
|   | 46 | 0   |
| CA_12-48  | 12 | 0.3 |
|   | 48 | 0.3 |
| CA_12-66,<br>CA_12-66-66                        | 12 | 0.8 |
|   | 66 | 0.3 |
| CA_13-46,<br>CA_13-46-46                        | 13 | 0   |
| CA_13-48,<br>CA_13-48-48                        | 13 | 0.3 |
|   | 48 | 0.3 |
| CA_13-66,<br>CA_13-66-66                        | 13 | 0.3 |
|   | 66 | 0.3 |
| CA_14-30  | 14 | 0.3 |
|   | 30 | 0.3 |
| CA_14-66,<br>CA_14-66-66,<br>CA_14-66-66-<br>66 | 14 | 0.3 |
|   | 66 | 0.3 |
| CA_18-28 <sup>9</sup>                           | 18 | 0.5 |
|   | 28 | 0.5 |
| CA_18-41  | 18 | 0.3 |
|   | 41 | 0.3 |
| CA_19-21  | 19 | 0.3 |
|   | 21 | 0.4 |
| CA_19-28 <sup>9</sup>                           | 19 | 0.5 |
|   | 28 | 0.5 |
| CA_18-42  | 18 | 0.3 |
|   | 42 | 0.8 |
| CA_19-42  | 19 | 0.3 |
|   | 42 | 0.8 |
| CA_19-46  | 19 | 0   |
| CA_20-28  | 20 | 0.5 |
|   | 28 | 0.5 |
| CA_20-31  | 20 | 0.5 |
|   | 31 | 0.5 |
| CA_20-32  | 20 | 0.3 |
| CA_20-38  | 20 | 0.3 |
|   | 38 | 0.3 |
| CA_20-40,<br>CA_20-40-40                        | 20 | 0.3 |
|   | 40 | 0.3 |
| CA_20-41  | 20 | 0.3 |
|   | 41 | 0.3 |
| CA_20-42,<br>CA_20-42-42                        | 20 | 0.6 |
|   | 42 | 0.8 |
| CA_20-43  | 20 | 0.3 |
|   | 43 | 0.8 |
| CA_20-67  | 20 | 0.5 |
| CA_20-75  | 20 | 0.3 |
| CA_20-76  | 20 | 0.3 |
| CA_21-28  | 21 | 0.4 |
|   | 28 | 0.3 |

|                          |    |                   |
|--------------------------|----|-------------------|
| CA_21-42                 | 21 | 0.4               |
|                          | 42 | 0.8               |
| CA_21-46                 | 21 | 0                 |
| CA_23-29                 | 23 | 0.3               |
| CA_25-26,<br>CA_25-25-26 | 25 | 0.3               |
|                          | 26 | 0.3               |
| CA_25-41,<br>CA_25-25-41 | 25 | 0.5               |
|                          | 41 | 0.4 <sup>10</sup> |
|                          |    | 0.9 <sup>11</sup> |
| CA_25-46                 | 25 | 0                 |
|                          | 46 | 0                 |
| CA_26-41                 | 26 | 0.3               |
|                          | 41 | 0.3               |
| CA_26-46                 | 26 | 0                 |
| CA_26-48,<br>CA_26-48-48 | 26 | 0.3               |
|                          | 48 | 0.3               |
| A_26-66                  | 26 | 0.3               |
|                          | 66 | 0.3               |
| CA_28-32                 | 28 | 0.3               |
| CA_28-38                 | 28 | 0.3               |
|                          | 38 | 0.3               |
| CA_28-40                 | 28 | 0.3               |
|                          | 40 | 0.3               |
| CA_28-41                 | 28 | 0.3               |
|                          | 41 | 0.3               |
| CA_28-42,<br>CA_28-42-42 | 28 | 0.5               |
|                          | 42 | 0.8               |
| CA_28-46                 | 28 | 0                 |
| CA_28-66                 | 28 | 0.6               |
|                          | 66 | 0.3               |
| CA_29-30                 | 30 | 0.3               |
| CA_29-66,<br>CA_29-66-66 | 66 | 0.3               |
| CA_29-70                 | 70 | 0.3               |
| CA_30-66,<br>CA_30-66-66 | 30 | 0.3               |
|                          | 66 | 0.5               |
| CA_32-42                 | 42 | 0.8               |
| CA_32-43                 | 43 | 0.8               |
| CA_34-39                 | 34 | 0 <sup>1</sup>    |
|                          | 39 | 0 <sup>1</sup>    |
| CA_34-41                 | 34 | 0 <sup>1</sup>    |
|                          | 41 | 0 <sup>1</sup>    |
| CA_38-40,<br>CA_38-40-40 | 38 | 0 <sup>4</sup>    |
|                          | 40 | 0 <sup>4</sup>    |
| CA_39-40                 | 39 | 0 <sup>4</sup>    |
|                          | 40 | 0 <sup>4</sup>    |
| CA_39-41                 | 39 | 0 <sup>4</sup>    |
|                          | 41 | 0 <sup>4</sup>    |
| CA_39-41                 | 39 | 0.5 <sup>7</sup>  |
|                          | 41 | 0.5 <sup>7</sup>  |
| CA_39-42                 | 39 | 0 <sup>4</sup>    |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_39-46                 | 39 | 0                 |
| CA_40-41                 | 40 | 0.5 <sup>4</sup>  |
|                          | 41 | 0.5 <sup>4</sup>  |
| CA_40-42                 | 40 | 0 <sup>4</sup>    |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_40-43                 | 40 | 0 <sup>4</sup>    |
|                          | 43 | 0.5 <sup>4</sup>  |
| CA_40-46                 | 40 | 0                 |
| CA_41-42,<br>CA_41-42-42 | 41 | 0 <sup>4</sup>    |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_41-42,<br>CA_41-42-42 | 41 | 0.3 <sup>7</sup>  |
|                          | 42 | 0.8 <sup>7</sup>  |
| CA_41-46                 | 41 | 0                 |

|  |    |                  |
|--|----|------------------|
| CA_41-48   | 41 | 0 <sup>4</sup>   |
|  | 48 | 0.5 <sup>4</sup> |
| CA_42-43   | 42 | 0 <sup>4</sup>   |
|  | 43 | 0 <sup>4</sup>   |
| CA_42-46   | 42 | [0.5]            |
| CA_46-48,<br>CA_46-48-48   | 48 | 0.8              |
| CA_46-66,<br>CA_46-46-66,<br>CA_46-66-66   | 66 | 0                |
| CA_46-70   | 70 | 0                |
| CA_46-71   | 71 | 0                |
| CA_48-66,<br>CA_48-48-66,<br>CA_48-66-66,<br>CA_48-48-66-<br>66  | 48 | 0.8              |
|  | 66 | 0.6              |
| CA_48-71,<br>CA_48-48-71   | 48 | 0.3              |
|  | 71 | 0.3              |
| CA_66-70,<br>CA_66-66-70   | 66 | 0.5              |
|  | 70 | 0.5              |
| CA_66-71,<br>CA_66-66-71   | 66 | 0.3              |
|  | 71 | 0.3              |
| CA_70-71   | 70 | 0.3              |
|  | 71 | 0.6              |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations</p> <p>NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations</p> <p>NOTE 3: In case the UE supports more than one of the above 2DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 2DL inter-band carrier aggregation configurations then:</p> <ul style="list-style-type: none"> <li>- When the E-UTRA operating band frequency range is <math>\leq 1</math>GHz, the applicable additional tolerance shall be the average of the 2DL tolerances above, truncated to one decimal place for that operating band among the supported 2DL CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 2DL carrier aggregation configurations involving such band shall be applied</li> <li>- When the E-UTRA operating band frequency range is <math>&gt;1</math>GHz, the applicable additional 2DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 2DL CA configurations</li> </ul> <p>NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx.</p> <p>NOTE 5: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:</p> <ul style="list-style-type: none"> <li>- When the E-UTRA operating band frequency range is <math>\leq 1</math>GHz and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied</li> <li>- When the E-UTRA operating band frequency range is <math>&gt;1</math>GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations.</li> </ul> <p>NOTE 6: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> <p>NOTE 7: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx.</p> |    |                  |

|          |  |
|----------|--|
| NOTE 8:  | Only applicable for UE supporting inter-band carrier aggregation with the uplink active in the FDD band.   |
| NOTE 9:  | For Band 28, the requirements only apply for the restricted frequency range specified for this CA configuration (Table 5.5A-2).  |
| NOTE 10: | The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.   |
| NOTE 11: | The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz.   |
| NOTE 12: | For UE supporting E-UTRA band 65 and CA configurations including Band 1, the Band 65 $\Delta T_{IB,c}$ is the max(Band 65 $\Delta T_{IB,c}$ , Band 1 $\Delta T_{IB,c}$ )   |
| NOTE 13: | For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable $\Delta T_{IB,c}$ in Band 42, 43, or 48 is the max(Band 42 $\Delta T_{IB,c}$ , Band 43 $\Delta T_{IB,c}$ , Band 48 $\Delta T_{IB,c}$ ). |
| NOTE 14: | Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8.   |

NOTE: The above additional tolerances do not apply to supported UTRA operating bands with frequency range below 1 GHz that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations when such bands are belonging only to band combination(s) where one band is <1GHz and another band is >1.7GHz and there is no harmonic relationship between the low band UL and high band DL. Otherwise the above additional tolerances also apply to supported UTRA operating bands that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.

NOTE: To meet the  $\Delta T_{IB,c}$  requirements for CA\_3A-7A with state-of-the-art technology, an increase in power consumption of the UE may be required. It is also expected that as the state-of-the-art technology evolves in the future, this possible power consumption increase can be reduced or eliminated.

**Table 6.2.5-3:  $\Delta T_{IB,c}$  (three bands)**

| E-UTRA operating band combination  | E-UTRA Band | $\Delta T_{IB,c}$ [dB] |
|--|-------------|------------------------|
| CA_1-3-5, CA_1-1-3-5, CA_1-3-3-5   | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 5           | 0.3                    |
| CA_1-3-7, CA_1-1-3-7, CA_1-1-3-3-7, CA_1-3-3-7, CA_1-3-3-7-7, CA_1-3-7-7 | 1           | 0.6                    |
|  | 3           | 0.6                    |
|  | 7           | 0.6                    |
| CA_1-3-8, CA_1-3-3-8   | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 8           | 0.3                    |
| CA_1-3-11  | 1           | 0.3                    |
|  | 3           | 0.8                    |
|  | 11          | 0.9                    |
| CA_1-3-18  | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 18          | 0.3                    |
| CA_1-3-19, CA_1-3-3-19   | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 19          | 0.3                    |
| CA_1-3-20, CA_1-3-3-20   | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 20          | 0.3                    |
| CA_1-3-21, CA_1-3-3-21   | 1           | 0.3                    |
|  | 3           | 0.8                    |
|  | 21          | 0.9                    |
| CA_1-3-26  | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 26          | 0.3                    |
| CA_1-3-28, CA_1-1-3-28, CA_1-3-3-28, CA_1-1-3-28                         | 1           | 0.3                    |
|  | 3           | 0.3                    |
|  | 28          | 0.6                    |
| CA_1-3-32  | 1           | 0.5                    |
|  | 3           | 0.5                    |

|                         |    |               |
|-------------------------|----|---------------|
| CA_1-3-38               | 1  | 0.5           |
|                         | 3  | 0.5           |
|                         | 38 | 0.5           |
| CA_1-3-40               | 1  | 0.5           |
|                         | 3  | 0.5           |
|                         | 40 | 0.5           |
| CA_1-3-41               | 1  | 0.5           |
|                         | 3  | 0.5           |
|                         | 41 | $0.3^5/0.8^6$ |
| CA_1-3-42, CA_1-3-3-42  | 1  | 0.6           |
|                         | 3  | 0.6           |
|                         | 42 | 0.8           |
| CA_1-3-43               | 1  | 0.3           |
|                         | 3  | 0.3           |
|                         | 43 | 0.8           |
| CA_1-3-46               | 1  | 0.3           |
|                         | 3  | 0.3           |
| CA_1-5-7, CA_1-5-7-7    | 1  | 0.5           |
|                         | 5  | 0.3           |
|                         | 7  | 0.6           |
| CA_1-5-28               | 1  | 0.3           |
|                         | 5  | 0.5           |
|                         | 28 | 0.6           |
| CA_1-5-40               | 1  | 0.5           |
|                         | 5  | 0.3           |
|                         | 40 | 0.5           |
| CA_1-5-41               | 1  | 0.5           |
|                         | 5  | 0.3           |
|                         | 41 | 0.5           |
| CA_1-5-46               | 1  | 0.3           |
|                         | 5  | 0.3           |
| CA_1-7-8, CA_1-7-7-8    | 1  | 0.5           |
|                         | 7  | 0.6           |
|                         | 8  | 0.6           |
| CA_1-7-20, CA_1-7-7-20  | 1  | 0.5           |
|                         | 7  | 0.6           |
|                         | 20 | 0.3           |
| CA_1-7-26, CA_1-7-7-26  | 1  | 0.5           |
|                         | 7  | 0.6           |
|                         | 26 | 0.3           |
| CA_1-7-28               | 1  | 0.5           |
|                         | 7  | 0.6           |
|                         | 28 | 0.6           |
| CA_1-7-32               | 1  | 0.7           |
|                         | 7  | 0.7           |
| CA_1-7-38               | 1  | 0.5           |
| CA_1-7-40               | 1  | 0.6           |
|                         | 7  | 0.8           |
|                         | 40 | 0.9           |
| CA_1-7-42               | 1  | 0.6           |
|                         | 7  | 0.6           |
|                         | 42 | 0.8           |
| CA_1-7-46               | 1  | 0.5           |
|                         | 7  | 0.6           |
| CA_1-8-11               | 1  | 0.3           |
|                         | 8  | 0.3           |
|                         | 11 | 0.4           |
| CA_1-8-20               | 1  | 0.3           |
|                         | 8  | 0.4           |
|                         | 20 | 0.4           |
| CA_1-8-28 <sup>11</sup> | 1  | 0.3           |
|                         | 8  | 0.6           |
|                         | 28 | 0.6           |
| CA_1-8-38               | 1  | 0.5           |
|                         | 8  | 0.3           |

|                             |    |     |
|-----------------------------|----|-----|
|                             | 38 | 0.5 |
| CA_1-8-40                   | 1  | 0.5 |
|                             | 8  | 0.3 |
|                             | 40 | 0.5 |
| CA_1-8-42                   | 1  | 0.3 |
|                             | 8  | 0.6 |
|                             | 42 | 0.8 |
| CA_1-11-18                  | 1  | 0.3 |
|                             | 11 | 0.4 |
|                             | 18 | 0.3 |
| CA_1-11-28                  | 1  | 0.3 |
|                             | 11 | 0.4 |
|                             | 28 | 0.6 |
| CA_1-11-42                  | 1  | 0.3 |
|                             | 11 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-18-28                  | 1  | 0.3 |
|                             | 18 | 0.5 |
|                             | 28 | 0.5 |
| CA_1-18-41                  | 1  | 0.5 |
|                             | 18 | 0.3 |
|                             | 41 | 0.5 |
| CA_1-18-42                  | 1  | 0.3 |
|                             | 18 | 0.3 |
|                             | 42 | 0.8 |
| CA_1-19-21                  | 1  | 0.3 |
|                             | 19 | 0.3 |
|                             | 21 | 0.4 |
| CA_1-19-28                  | 1  | 0.3 |
|                             | 19 | 0.5 |
|                             | 28 | 0.5 |
| CA_1-19-42                  | 1  | 0.3 |
|                             | 19 | 0.3 |
|                             | 42 | 0.8 |
| CA_1-20-28                  | 1  | 0.3 |
|                             | 20 | 0.6 |
|                             | 28 | 0.6 |
| CA_1-20-32                  | 1  | 0.5 |
|                             | 20 | 0.3 |
| CA_1-20-38                  | 1  | 0.5 |
|                             | 20 | 0.3 |
|                             | 38 | 0.5 |
| CA_1-20-42                  | 1  | 0.3 |
|                             | 20 | 0.3 |
|                             | 42 | 0.8 |
| CA_1-20-43                  | 1  | 0.3 |
|                             | 20 | 0.3 |
|                             | 43 | 0.8 |
| CA_1-21-28                  | 1  | 0.3 |
|                             | 21 | 0.4 |
|                             | 28 | 0.6 |
| CA_1-21-42                  | 1  | 0.3 |
|                             | 21 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-28-40                  | 1  | 0.6 |
|                             | 28 | 0.3 |
|                             | 40 | 0.5 |
| CA_1-28-42                  | 1  | 0.3 |
|                             | 28 | 0.6 |
|                             | 42 | 0.8 |
| CA_1-32-42                  | 1  | 0.5 |
|                             | 42 | 0.8 |
| CA_1-32-43                  | 1  | 0.5 |
|                             | 43 | 0.8 |
| CA_1-41-42 <sup>8, 13</sup> | 1  | 0.5 |



|   |    |       |
|---|----|-------|
|   | 41 | 0.5   |
|   | 42 | 0.8   |
| CA_1-42-43 <sup>13</sup>                          | 1  | 0.3   |
|   | 42 | 0.8   |
|   | 43 | 0.8   |
| CA_2-4-5, CA_2-2-4-5, CA_2-4-4-5                  | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 5  | 0.3   |
| CA_2-4-7, CA_2-4-7-7                              | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 7  | 0.5   |
| CA_2-4-12, CA_2-2-4-12, CA_2-4-4-12, CA_2-4-12-12 | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 12 | 0.8   |
| CA_2-4-13   | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 13 | 0.3   |
| CA_2-4-28   | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 28 | 0.8   |
| CA_2-4-29   | 2  | [0.5] |
|   | 4  | 0.5   |
| CA_2-4-30   | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 30 | 0.3   |
| CA_2-4-71, CA_2-2-4-71                            | 2  | 0.5   |
|   | 4  | 0.5   |
|   | 71 | 0.3   |
| CA_2-5-12, CA_2-2-5-12, CA_2-5-12-12              | 2  | 0.3   |
|   | 5  | 0.8   |
|   | 12 | 0.4   |
| CA_2-5-7  | 2  | 0.5   |
|   | 5  | 0.3   |
|   | 7  | 0.5   |
| CA_2-5-13   | 2  | 0.3   |
|   | 5  | 0.5   |
|   | 13 | 0.5   |
| CA_2-5-28   | 2  | 0.3   |
|   | 5  | 0.8   |
|   | 28 | 0.4   |
| CA_2-5-29   | 2  | 0.3   |
|   | 5  | 0.5   |
| CA_2-5-30, CA_2-2-5-30                            | 2  | 0.5   |
|   | 5  | 0.3   |
|   | 30 | 0.3   |
| CA_2-5-46   | 2  | 0.3   |
|   | 5  | 0.3   |
| CA_2-5-66, CA_2-2-5-66, CA_2-5-66-66              | 2  | 0.5   |
|   | 5  | 0.3   |
|   | 66 | 0.5   |
| CA_2-7-12, CA_2-2-7-12                            | 2  | 0.5   |
|   | 7  | 0.5   |
|   | 12 | 0.3   |
| CA_2-7-13, CA_2-7-7-13                            | 2  | 0.5   |
|   | 7  | 0.5   |
|   | 13 | 0.3   |
| 2   | 2  | 0.5   |
| 7   | 7  | 0.5   |
| 28  | 26 | 0.3   |
| CA_2-7-28   | 2  | 0.5   |
|   | 7  | 0.5   |
|   | 28 | 0.3   |
| CA_2-7-29, CA_2-7-7-29                            | 2  | 0.5   |
|   | 7  | 0.5   |
| CA_2-7-30   | 2  | 0.5   |

|  |    |                   |
|--|----|-------------------|
|  | 7  | 0.5               |
|  | 30 | 0.5               |
| CA_2-7-46  | 2  | 0.5               |
|  | 7  | 0.5               |
| CA_2-7-66, CA_2-2-7-66, CA_2-7-7-66, CA_2-7-7-66-66, CA_2-7-66-66          | 2  | 0.5               |
|  | 7  | 0.5               |
|  | 66 | 0.5               |
| CA_2-12-30, CA_2-2-12-30   | 2  | 0.5               |
|  | 12 | 0.3               |
|  | 30 | 0.3               |
| CA_2-12-66, CA_2-2-12-66, CA_2-12-66-66, CA_2-2-12-66-66                   | 2  | 0.5               |
|  | 12 | 0.8               |
|  | 66 | 0.5               |
| CA_2-13-46   | 2  | 0.3               |
|  | 13 | 0.3               |
| CA_2-13-48, CA_2-13-48-48  | 2  | 0.6               |
|  | 13 | 0.3               |
|  | 48 | 0.8               |
| CA_2-13-66, CA_2-2-13-66, CA_2-13-66-66                                    | 2  | 0.5               |
|  | 13 | 0.3               |
|  | 66 | 0.5               |
| CA_2-14-30, CA_2-2-14-30   | 2  | 0.5               |
|  | 14 | 0.3               |
|  | 30 | 0.5               |
| CA_2-14-66, CA_2-2-14-66, CA_2-14-66-66, CA_2-2-14-66-66, CA_2-14-66-66-66 | 2  | 0.5               |
|  | 14 | 0.3               |
|  | 66 | 0.5               |
| CA_2-26-66   | 2  | 0.5               |
|  | 26 | 0.3               |
|  | 66 | 0.5               |
| CA_2-28-66   | 2  | 0.5               |
|  | 28 | 0.6               |
|  | 66 | 0.5               |
| CA_2-29-30, CA_2-2-29-30   | 2  | 0.5               |
|  | 30 | 0.3               |
| CA_2-29-66   | 2  | 0.5               |
|  | 66 | 0.5               |
| CA_2-30-66, CA_2-2-30-66, CA_2-30-66-66                                    | 2  | 0.5               |
|  | 30 | 0.3               |
|  | 66 | 0.5               |
| CA_2-46-48   | 2  | 0.6               |
|  | 48 | 0.8               |
| CA_2-46-66, CA_2-46-46-66, CA_2-46-66-66                                   | 2  | 0.5               |
|  | 66 | 0.5               |
| CA_2-48-66, CA_2-48-48-66  | 2  | 0.6               |
|  | 48 | 0.8               |
|  | 66 | 0.6               |
| CA_2-66-71<br>CA_2-2-66-71<br>CA_2-66-66-71                                | 2  | 0.5               |
|  | 66 | 0.5               |
|  | 71 | 0.3               |
| CA_3-5-7, CA_3-5-7-7, CA_3-3-5-7   | 3  | 0.5               |
|  | 5  | 0.3               |
|  | 7  | 0.5               |
| CA_3-5-28<br>CA_3-3-5-28   | 3  | 0.3               |
|  | 5  | 0.5               |
|  | 28 | 0.5               |
| CA_3-5-40, CA_3-5-40-40  | 3  | 0.5               |
|  | 5  | 0.3               |
|  | 40 | 0.5               |
| CA_3-5-41  | 3  | 0.5               |
|  | 5  | 0.3 <sup>18</sup> |
|  | 41 | 0.3 <sup>5</sup>  |
|  |    | 0.8 <sup>6</sup>  |

|                                     |    |     |
|-------------------------------------|----|-----|
| CA_3-7-8, CA_3-3-7-8, CA_3-3-7-7-8  | 3  | 0.5 |
|                                     | 7  | 0.5 |
|                                     | 8  | 0.6 |
| CA_3-7-20, CA_3-3-7-20, CA_3-7-7-20 | 3  | 0.5 |
|                                     | 7  | 0.5 |
|                                     | 20 | 0.3 |
| CA_3-7-26, CA_3-7-7-26              | 3  | 0.5 |
|                                     | 7  | 0.5 |
|                                     | 26 | 0.3 |
| CA_3-7-28, CA_3-3-7-28              | 3  | 0.5 |
|                                     | 7  | 0.5 |
|                                     | 28 | 0.3 |
| CA_3-7-32                           | 3  | 0.7 |
|                                     | 7  | 0.7 |
| CA_3-7-38                           | 3  | 0.5 |
|                                     | 7  | 0.5 |
|                                     | 38 | 0.5 |
| CA_3-7-40                           | 3  | 0.6 |
|                                     | 7  | 0.8 |
|                                     | 40 | 0.9 |
| CA_3-7-42                           | 3  | 0.6 |
|                                     | 7  | 0.6 |
|                                     | 42 | 0.8 |
| CA_3-7-46                           | 3  | 0.5 |
|                                     | 7  | 0.5 |
| CA_3-8-11                           | 3  | 0.8 |
|                                     | 8  | 0.3 |
|                                     | 11 | 0.9 |
| CA_3-8-20                           | 3  | 0.3 |
|                                     | 8  | 0.4 |
|                                     | 20 | 0.4 |
| CA_3-8-28 <sup>12</sup>             | 3  | 0.3 |
|                                     | 8  | 0.6 |
|                                     | 28 | 0.5 |
| CA_3-8-32                           | 3  | 0.8 |
|                                     | 8  | 0.3 |
| CA_3-8-38                           | 3  | 0.5 |
|                                     | 8  | 0.3 |
|                                     | 38 | 0.5 |
| CA_3-8-40                           | 3  | 0.5 |
|                                     | 8  | 0.3 |
|                                     | 40 | 0.5 |
| CA_3-8-42                           | 3  | 0.6 |
|                                     | 8  | 0.6 |
|                                     | 42 | 0.8 |
| CA_3-11-18                          | 3  | 0.8 |
|                                     | 11 | 0.9 |
|                                     | 18 | 0.3 |
| CA_3-11-26                          | 3  | 0.8 |
|                                     | 11 | 0.9 |
|                                     | 26 | 0.3 |
| CA_3-11-28                          | 3  | 0.8 |
|                                     | 11 | 0.9 |
|                                     | 28 | 0.6 |
| CA_3-18-42                          | 3  | 0.6 |
|                                     | 18 | 0.3 |
|                                     | 42 | 0.8 |
| CA_3-19-21, CA_3-3-19-21            | 3  | 0.8 |
|                                     | 19 | 0.3 |
|                                     | 21 | 0.9 |
| CA_3-19-42                          | 3  | 0.6 |
|                                     | 19 | 0.3 |
|                                     | 42 | 0.8 |
| CA_3-20-28, CA_3-3-20-28            | 3  | 0.3 |
|                                     | 20 | 0.5 |

|   |    |               |
|---|----|---------------|
|   | 28 | 0.5           |
| CA_3-20-32                                | 3  | 0.5           |
|   | 20 | 0.3           |
| CA_3-20-42                                | 3  | 0.6           |
|   | 20 | 0.3           |
|   | 42 | 0.8           |
| CA_3-20-43                                | 3  | 0.3           |
|   | 20 | 0.3           |
|   | 43 | 0.8           |
| CA_3-21-28                                | 3  | 0.8           |
|   | 21 | 0.9           |
|   | 28 | 0.3           |
| CA_3-21-42                                | 3  | 0.8           |
|   | 21 | 0.9           |
|   | 42 | 0.8           |
| CA_3-28-38                                | 3  | 0.5           |
|   | 28 | 0.5           |
|   | 38 | 0.5           |
| CA_3-28-40                                | 3  | 0.5           |
|   | 28 | 0.3           |
|   | 40 | 0.5           |
| CA_3-28-41                                | 3  | 0.5           |
|   | 28 | 0.3           |
|   | 41 | $0.3^5/0.8^6$ |
| CA_3-28-42, CA_3-28-42-42                 | 3  | 0.6           |
|   | 28 | 0.5           |
|   | 42 | 0.8           |
| CA_3-32-42                                | 3  | 0.6           |
|   | 42 | 0.8           |
| CA_3-32-43                                | 3  | 0.3           |
|   | 43 | 0.8           |
| CA_3-32-46                                | 3  | 0.5           |
| CA_3-41-42 <sup>14</sup><br>CA_3-41-42-42 | 3  | 1             |
|   | 41 | $0.3^5/0.8^6$ |
|   | 42 | 0.8           |
| CA_3-42-43 <sup>13</sup>                  | 3  | 0.6           |
|   | 42 | 0.8           |
|   | 43 | 0.8           |
| CA_4-5-12, CA_4-5-12-12, CA_4-4-5-12      | 4  | 0.3           |
|   | 5  | 0.8           |
|   | 12 | 0.8           |
| CA_4-5-13                                 | 4  | 0.3           |
|   | 5  | 0.5           |
|   | 13 | 0.5           |
| CA_4-5-29                                 | 4  | 0.3           |
|   | 5  | 0.5           |
| CA_4-5-30, CA_4-4-5-30                    | 4  | 0.5           |
|   | 5  | 0.3           |
|   | 30 | 0.3           |
| CA_4-7-12                                 | 4  | 0.5           |
|   | 7  | 0.5           |
|   | 12 | 0.8           |
| CA_4-7-28                                 | 4  | 0.5           |
|   | 7  | 0.5           |
|   | 28 | 0.6           |
| CA_4-12-30, CA_4-4-12-30                  | 4  | 0.5           |
|   | 12 | 0.8           |
|   | 30 | 0.3           |
| CA_4-29-30, CA_4-4-29-30                  | 4  | 0.5           |
|   | 30 | 0.3           |
| CA_5-7-28                                 | 5  | 0.5           |
|   | 7  | 0.3           |
|   | 28 | 0.5           |
| CA_5-7-46                                 | 5  | 0.3           |
|   | 7  | 0.3           |

|                           |    |       |
|---------------------------|----|-------|
| CA_5-7-66<br>CA_5-7-66-66 | 5  | 0.3   |
|                           | 7  | 0.5   |
|                           | 66 | 0.5   |
| CA_5-12-46                | 5  | 0.8   |
|                           | 12 | 0.4   |
| CA_5-12-48                | 5  | 0.8   |
|                           | 12 | 0.4   |
|                           | 48 | 0.3   |
| CA_5-12-66                | 5  | 0.3   |
|                           | 12 | 0.8   |
|                           | 66 | 0.8   |
| CA_5-30-66, CA_5-30-66-66 | 5  | 0.3   |
|                           | 30 | 0.3   |
|                           | 66 | 0.5   |
| CA_5-40-41                | 5  | 0.3   |
|                           | 40 | 0.5   |
|                           | 41 | 0.5   |
| CA_5-46-66, CA_5-46-66-66 | 5  | 0.3   |
|                           | 66 | 0.3   |
| CA_5-48-66                | 5  | 0.3   |
|                           | 48 | 0.8   |
|                           | 66 | 0.6   |
| CA_7-8-20                 | 7  | 0.3   |
|                           | 8  | 0.6   |
|                           | 20 | [0.6] |
| CA_7-8-38                 | 7  | 0.5   |
|                           | 8  | 0.5   |
|                           | 38 | 0.5   |
| CA_7-8-40                 | 7  | 0.5   |
|                           | 8  | 0.6   |
|                           | 40 | 0.6   |
| CA_7-12-66                | 7  | 0.5   |
|                           | 12 | 0.8   |
|                           | 66 | 0.5   |
| CA_7-13-66                | 7  | 0.5   |
|                           | 13 | 0.3   |
|                           | 66 | 0.5   |
| CA_7-20-28                | 7  | 0.3   |
|                           | 20 | 0.6   |
|                           | 28 | 0.6   |
| CA_7-20-32                | 7  | 0.7   |
|                           | 20 | 0.3   |
|                           | 32 | N/A   |
| CA_7-20-38                | 7  | 0.3   |
|                           | 20 | 0.3   |
|                           | 38 | 0.3   |
| CA_7-20-42                | 7  | 0.3   |
|                           | 20 | 0.3   |
|                           | 42 | 0.8   |
| CA_7-26-66                | 7  | 0.5   |
|                           | 26 | 0.3   |
|                           | 66 | 0.5   |
| CA_7-28-38                | 7  | 0.3   |
|                           | 28 | 0.3   |
|                           | 38 | 0.3   |
| CA_7-28-40                | 7  | 0.5   |
|                           | 28 | 0.3   |
|                           | 40 | 0.6   |
| CA_7-29-66                | 7  | 0.5   |
|                           | 66 | 0.5   |
| CA_7-30-66                | 7  | 0.5   |
|                           | 30 | 0.5   |
|                           | 66 | 0.5   |
| CA_7-32-46                | 7  | 0.7   |
| CA_7-46-66                | 7  | 0.5   |

|   |    |                   |
|---|----|-------------------|
|   | 66 | 0.5               |
| CA_8-11-28 <sup>17</sup>  | 8  | 0.6               |
|   | 11 | 0.4               |
|   | 28 | 0.6               |
| CA_8-11-42  | 8  | 0.6               |
|   | 11 | 0.4               |
|   | 42 | 0.8               |
| CA_8-20-28  | 8  | 0.6               |
|   | 20 | 0.5               |
|   | 28 | 0.5               |
| CA_8-28-41 <sup>15</sup>  | 8  | 0.6               |
|   | 28 | 0.5               |
|   | 41 | 0.3               |
| CA_8-39-41  | 8  | 0.3               |
|   | 39 | 0.3 <sup>19</sup> |
|   | 41 | 0.3 <sup>19</sup> |
| CA_12-30-66,<br>CA_12-30-66-66  | 12 | 0.8               |
|   | 30 | 0.3               |
|   | 66 | 0.5               |
| CA_13-46-66   | 13 | 0.3               |
|   | 66 | 0.3               |
| CA_13-48-66   | 13 | 0.3               |
|   | 48 | 0.8               |
|   | 66 | 0.6               |
| CA_14-30-66,<br>CA_14-30-66-66  | 14 | 0.3               |
|   | 30 | 0.3               |
|   | 66 | 0.5               |
| CA_19-21-42   | 19 | 0.3               |
|   | 21 | 0.4               |
|   | 42 | 0.8               |
| CA_20-32-42   | 20 | 0.5               |
|   | 42 | 0.8               |
| CA_20-32-43   | 20 | 0.3               |
|   | 43 | 0.8               |
| CA_20-38-40 <sup>20</sup> ,<br>CA_20-38-40-40 <sup>20</sup>   | 20 | 0.3               |
|   | 38 | 0.3               |
|   | 40 | 0.3               |
| CA_21-28-42   | 21 | 0.4               |
|   | 28 | 0.5               |
|   | 42 | 0.8               |
| CA_25-26-41,<br>CA_25-25-26-41  | 25 | 0.3               |
|   | 26 | 0.3               |
|   | 41 | 0.3               |
| CA_28-41-42 <sup>10</sup> ,<br>CA_28-41-42-42 <sup>10</sup>   | 28 | 0.5               |
|   | 41 | 0.3 <sup>1</sup>  |
|   | 42 | 0.8 <sup>1</sup>  |
| CA_29-30-66,<br>CA_29-30-66-66  | 30 | 0.3               |
|   | 66 | 0.5               |
| CA_29-46-66   | 66 | 0.3               |
| CA_29-66-70,<br>CA_29-66-66-70  | 66 | 0.5               |
|   | 70 | 0.5               |
| CA_32-42-43 <sup>13</sup>   | 42 | 0.8               |
|   | 43 | 0.8               |
| CA_46-48-66   | 48 | 0.8               |
|   | 66 | 0.6               |
| CA_46-48-71,<br>CA_46-48-48-71  | 46 | 0                 |
|   | 48 | 0.8               |
|   | 71 | 0.3               |
| CA_66-70-71,<br>CA_66-66-70-71  | 66 | 0.5               |
|   | 70 | 0.5               |
|   | 71 | 0.6               |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations |    |                   |

- NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations
- NOTE 3: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:
- When the E-UTRA operating band frequency range is  $\leq 1\text{GHz}$  and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied
  - When the E-UTRA operating band frequency range is  $>1\text{GHz}$ , the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations
- NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.
- NOTE 5: The requirement is specified for the frequency range of 2545-2690MHz.
- NOTE 6: The requirement is specified for the frequency range of 2496-2545MHz.
- NOTE 7: For UE supporting E-UTRA band 65 and CA configurations including Band 1, the Band 65  $\Delta T_{\text{IB,c}}$  is the  $\max(\text{Band 65 } \Delta T_{\text{IB,c}}, \text{Band 1 } \Delta T_{\text{IB,c}})$
- NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1 or Band 42.
- NOTE 9: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx on Band 41 and Band 42.
- NOTE 10: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 11: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1 or Band 8
- NOTE 12: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 3 or Band 8.
- NOTE 13: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 14: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 15: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8 or Band 41.
- NOTE 16: For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable  $\Delta T_{\text{IB,c}}$  in Band 42, 43, or 48 is the  $\max(\text{Band 42 } \Delta T_{\text{IB,c}}, \text{Band 43 } \Delta T_{\text{IB,c}}, \text{Band 48 } \Delta T_{\text{IB,c}})$ .
- NOTE 17: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8 or Band 11.
- NOTE 18: The values in the table reflect what can be achieved with the present state of the art technology. They shall be reconsidered when the state of the art technology progresses.
- NOTE 19: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRAN band and without simultaneous Rx/Tx on band 39 and band 41
- NOTE 20: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx among TDD bands

Table 6.2.5-4:  $\Delta T_{IB,c}$  (four bands)

| E-UTRA operating band combination   | E-UTRA Band | $\Delta T_{IB,c}$ [dB]               |
|---|-------------|--------------------------------------|
| CA_1-3-5-7, CA_1-3-3-5-7, CA_1-3-5-7-7                                    | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 5           | 0.3                                  |
|   | 7           | 0.6                                  |
| CA_1-3-5-28   | 1           | 0.3                                  |
|   | 3           | 0.3                                  |
|   | 5           | 0.5                                  |
|   | 28          | 0.6                                  |
| CA_1-3-5-40   | 1           | 0.5                                  |
|   | 3           | 0.5                                  |
|   | 5           | 0.3                                  |
|   | 40          | 0.5                                  |
| CA_1-3-5-41   | 1           | 0.5                                  |
|   | 3           | 0.5                                  |
|   | 5           | 0.3 <sup>9</sup>                     |
|   | 41          | 0.5 <sup>7</sup><br>0.8 <sup>8</sup> |
| CA_1-3-7-8, CA_1-3-3-7-8, CA_1-3-7-7-8, CA_1-3-3-7-7-8                    | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
|   | 8           | 0.6                                  |
| CA_1-3-7-20, CA_1-3-3-7-20, CA_1-3-7-7-20                                 | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
|   | 20          | 0.3                                  |
| CA_1-3-7-26, CA_1-3-7-7-26  | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
|   | 26          | 0.3                                  |
| CA_1-3-7-28, CA_1-1-3-7-28, CA_1-1-3-3-7-28, CA_1-3-3-7-28, CA_1-3-7-7-28 | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
|   | 28          | 0.6                                  |
| CA_1-3-7-32   | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
| CA_1-3-7-38   | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
| CA_1-3-7-40   | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.8                                  |
|   | 40          | 0.9                                  |
| CA_1-3-7-42   | 1           | 0.7                                  |
|   | 3           | 0.7                                  |
|   | 7           | 0.7                                  |
|   | 42          | 0.8                                  |
| CA_1-3-7-46   | 1           | 0.6                                  |
|   | 3           | 0.6                                  |
|   | 7           | 0.6                                  |
| CA_1-3-8-11   | 1           | 0.3                                  |
|   | 3           | 0.8                                  |
|   | 8           | 0.3                                  |
|   | 11          | 0.9                                  |
| CA_1-3-8-20   | 1           | 0.3                                  |
|   | 3           | 0.3                                  |
|   | 8           | 0.4                                  |
|   | 20          | 0.4                                  |
| CA_1-3-8-28 <sup>10</sup>   | 1           | 0.3                                  |
|   | 3           | 0.3                                  |
|   | 8           | 0.6                                  |
|   | 28          | 0.6                                  |



|                              |    |     |
|------------------------------|----|-----|
| CA_1-3-8-38                  | 1  | 0.5 |
|                              | 3  | 0.5 |
|                              | 8  | 0.3 |
|                              | 38 | 0.5 |
| CA_1-3-8-40                  | 1  | 0.5 |
|                              | 3  | 0.5 |
|                              | 8  | 0.3 |
|                              | 40 | 0.5 |
| CA_1-3-8-42                  | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 8  | 0.6 |
|                              | 42 | 0.8 |
| CA_1-3-11-28                 | 1  | 0.3 |
|                              | 3  | 0.8 |
|                              | 11 | 0.9 |
|                              | 28 | 0.6 |
| CA_1-3-18-42                 | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 18 | 0.3 |
|                              | 42 | 0.8 |
| CA_1-3-19-21                 | 1  | 0.3 |
|                              | 3  | 0.8 |
|                              | 19 | 0.3 |
|                              | 21 | 0.9 |
| CA_1-3-19-42, CA_1-3-3-19-21 | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 19 | 0.3 |
|                              | 42 | 0.8 |
| CA_1-3-20-28, CA_1-3-3-20-28 | 1  | 0.3 |
|                              | 3  | 0.3 |
|                              | 20 | 0.6 |
|                              | 28 | 0.6 |
| CA_1-3-20-32                 | 1  | 0.5 |
|                              | 3  | 0.5 |
|                              | 20 | 0.3 |
| CA_1-3-20-42                 | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 20 | 0.3 |
|                              | 42 | 0.8 |
| CA_1-3-20-43                 | 1  | 0.3 |
|                              | 3  | 0.3 |
|                              | 20 | 0.3 |
|                              | 43 | 0.8 |
| CA_1-3-21-28                 | 1  | 0.3 |
|                              | 3  | 0.8 |
|                              | 21 | 0.9 |
|                              | 28 | 0.6 |
| CA_1-3-21-42                 | 1  | 0.6 |
|                              | 3  | 0.8 |
|                              | 21 | 0.9 |
|                              | 42 | 0.8 |
| CA_1-3-28-40                 | 1  | 0.5 |
|                              | 3  | 0.5 |
|                              | 28 | 0.6 |
|                              | 40 | 0.5 |
| CA_1-3-28-42                 | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 28 | 0.6 |
|                              | 42 | 0.8 |
| CA_1-3-32-42                 | 1  | 0.6 |
|                              | 3  | 0.6 |
|                              | 42 | 0.8 |
| CA_1-3-32-43                 | 1  | 0.5 |
|                              | 3  | 0.5 |
|                              | 43 | 0.8 |

|                             |    |     |
|-----------------------------|----|-----|
| CA_1-3-41-42                | 1  | 0.6 |
|                             | 3  | 0.6 |
|                             | 41 | 0.5 |
|                             | 42 | 0.8 |
| CA_1-3-42-43 <sup>13</sup>  | 1  | 0.6 |
|                             | 3  | 0.6 |
|                             | 42 | 0.8 |
|                             | 43 | 0.8 |
| CA_1-5-7-28                 | 1  | 0.6 |
|                             | 5  | 0.5 |
|                             | 7  | 0.6 |
|                             | 28 | 0.6 |
| CA_1-5-7-46                 | 1  | 0.5 |
|                             | 5  | 0.3 |
|                             | 7  | 0.6 |
| CA_1-7-8-20                 | 1  | 0.5 |
|                             | 7  | 0.6 |
|                             | 8  | 0.6 |
|                             | 20 | 0.6 |
| CA_1-7-8-40                 | 1  | 0.6 |
|                             | 7  | 0.8 |
|                             | 8  | 0.6 |
|                             | 40 | 0.9 |
| CA_1-7-20-28                | 1  | 0.5 |
|                             | 7  | 0.6 |
|                             | 20 | 0.6 |
|                             | 28 | 0.6 |
| CA_1-7-20-32                | 1  | 0.7 |
|                             | 7  | 0.7 |
|                             | 20 | 0.3 |
| CA_1-7-20-42                | 1  | 0.6 |
|                             | 7  | 0.7 |
|                             | 20 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-7-28-40                | 1  | 0.6 |
|                             | 7  | 0.8 |
|                             | 28 | 0.6 |
|                             | 40 | 0.9 |
| CA_1-8-11-28 <sup>11</sup>  | 1  | 0.3 |
|                             | 8  | 0.6 |
|                             | 11 | 0.4 |
|                             | 28 | 0.6 |
| CA_1-8-11-42                | 1  | 0.3 |
|                             | 8  | 0.6 |
|                             | 11 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-8-20-28                | 1  | 0.3 |
|                             | 8  | 0.6 |
|                             | 20 | 0.6 |
|                             | 28 | 0.6 |
| CA_1-19-21-42               | 1  | 0.3 |
|                             | 19 | 0.3 |
|                             | 21 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-20-32-42               | 1  | 0.5 |
|                             | 20 | 0.4 |
|                             | 42 | 0.8 |
| CA_1-20-32-43               | 1  | 0.5 |
|                             | 20 | 0.3 |
|                             | 43 | 0.8 |
| CA_1-21-28-42               | 1  | 0.3 |
|                             | 21 | 0.4 |
|                             | 28 | 0.6 |
|                             | 42 | 0.8 |
| CA_1-32-42-43 <sup>13</sup> | 1  | 0.5 |

|  |    |     |
|--|----|-----|
|  | 42 | 0.8 |
|  | 43 | 0.8 |
| CA_2-4-5-12                                      | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 5  | 0.8 |
|  | 12 | 0.8 |
| CA_2-4-5-29                                      | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 5  | 0.5 |
| CA_2-4-5-30                                      | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 5  | 0.3 |
|  | 30 | 0.3 |
| CA_2-4-7-12                                      | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 7  | 0.5 |
|  | 12 | 0.8 |
| CA_2-4-12-30                                     | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 12 | 0.8 |
|  | 30 | 0.3 |
| CA_2-4-29-30                                     | 2  | 0.5 |
|  | 4  | 0.5 |
|  | 30 | 0.3 |
| CA_2-5-7-28                                      | 2  | 0.5 |
|  | 5  | 0.6 |
|  | 7  | 0.6 |
|  | 28 | 0.6 |
| CA_2-5-12-66, CA_2-2-5-12-66                     | 2  | 0.5 |
|  | 5  | 0.8 |
|  | 12 | 0.5 |
|  | 66 | 0.8 |
| CA_2-5-30-66, CA_2-2-5-30-66, CA_2-5-30-66-66    | 2  | 0.5 |
|  | 5  | 0.3 |
|  | 30 | 0.3 |
|  | 66 | 0.5 |
| CA_2-5-46-66, CA_2-5-46-66-66                    | 2  | 0.5 |
|  | 5  | 0.3 |
|  | 66 | 0.5 |
| CA_2-7-46-66                                     | 2  | 0.5 |
|  | 7  | 0.5 |
|  | 46 | 0   |
|  | 66 | 0.5 |
| CA_2-7-13-66                                     | 2  | 0.5 |
|  | 7  | 0.5 |
|  | 13 | 0.3 |
|  | 66 | 0.5 |
| CA_2-7-26-66                                     | 2  | 0.5 |
|  | 7  | 0.5 |
|  | 26 | 0.3 |
|  | 66 | 0.5 |
| CA_2-12-30-66, CA_2-2-12-30-66, CA_2-12-30-66-66 | 2  | 0.5 |
|  | 12 | 0.8 |
|  | 30 | 0.3 |
|  | 66 | 0.5 |
| CA_2-13-46-66, CA_2-13-46-66-66                  | 2  | 0.5 |
|  | 13 | 0.3 |
|  | 66 | 0.5 |
| CA_2-13-48-66, CA_2-13-48-48-66                  | 2  | 0.6 |
|  | 13 | 0.3 |
|  | 48 | 0.8 |
|  | 66 | 0.6 |
| CA_2-14-30-66, CA_2-2-14-30-66, CA_2-14-30-66-66 | 2  | 0.5 |
|  | 14 | 0.3 |
|  | 30 | 0.3 |

|                              |    |     |
|------------------------------|----|-----|
|                              | 66 | 0.5 |
| CA_2-7-12-66, CA_2-2-7-12-66 | 2  | 0.5 |
|                              | 7  | 0.5 |
|                              | 12 | 0.8 |
|                              | 66 | 0.5 |
| CA_2-7-29-66, CA_2-7-7-29-66 | 2  | 0.5 |
|                              | 7  | 0.5 |
|                              | 66 | 0.5 |
| CA_2-29-30-66                | 2  | 0.5 |
|                              | 30 | 0.3 |
|                              | 66 | 0.5 |
| CA_2-46-48-66                | 2  | 0.6 |
|                              | 48 | 0.8 |
|                              | 66 | 0.6 |
| CA_3-5-7-28, CA_3-3-5-7-28   | 3  | 0.5 |
|                              | 5  | 0.5 |
|                              | 7  | 0.5 |
|                              | 28 | 0.5 |
| CA_3-7-8-20                  | 3  | 0.5 |
|                              | 7  | 0.5 |
|                              | 8  | 0.4 |
|                              | 20 | 0.4 |
| CA_3-7-8-38                  | 3  | 0.5 |
|                              | 7  | 0.5 |
|                              | 8  | 0.5 |
|                              | 38 | 0.5 |
| CA_3-7-8-40                  | 3  | 0.6 |
|                              | 7  | 0.8 |
|                              | 8  | 0.6 |
|                              | 40 | 0.9 |
| CA_3-7-20-28                 | 3  | 0.5 |
|                              | 7  | 0.5 |
|                              | 20 | 0.6 |
|                              | 28 | 0.5 |
| CA_3-7-20-32                 | 3  | 0.7 |
|                              | 7  | 0.7 |
|                              | 20 | 0.3 |
| CA_3-7-20-42                 | 3  | 0.6 |
|                              | 7  | 0.6 |
|                              | 20 | 0.3 |
|                              | 42 | 0.8 |
| CA_3-7-28-38                 | 3  | 0.5 |
|                              | 7  | 0.5 |
|                              | 28 | 0.5 |
|                              | 38 | 0.5 |
| CA_3-7-28-40                 | 3  | 0.6 |
|                              | 7  | 0.8 |
|                              | 28 | 0.3 |
|                              | 40 | 0.9 |
| CA_3-7-32-46                 | 3  | 0.7 |
|                              | 7  | 0.7 |
| CA_3-8-11-28 <sup>12</sup>   | 3  | 0.8 |
|                              | 8  | 0.6 |
|                              | 11 | 0.9 |
|                              | 28 | 0.6 |
| CA_3-8-20-28                 | 3  | 0.3 |
|                              | 8  | 0.6 |
|                              | 20 | 0.5 |
|                              | 28 | 0.5 |
| CA_3-19-21-42                | 3  | 0.8 |
|                              | 19 | 0.3 |
|                              | 21 | 0.9 |
|                              | 42 | 0.8 |
| CA_3-20-32-42                | 3  | 0.6 |
|                              | 20 | 0.4 |

|  |    |                                    |
|--|----|------------------------------------|
|  | 42 | 0.8                                |
| CA_3-20-32-43  | 3  | 0.5                                |
|  | 20 | 0.3                                |
|  | 43 | 0.8                                |
| CA_3-21-28-42  | 3  | 0.8                                |
|  | 21 | 0.9                                |
|  | 28 | 0.5                                |
| CA_3-28-41-42  | 42 | 0.8                                |
|  | 3  | 1                                  |
|  | 28 | 0.5                                |
| CA_3-32-42-43 <sup>13</sup>  | 41 | 0.3 <sup>7</sup> /0.8 <sup>8</sup> |
|  | 42 | 0.8                                |
|  | 3  | 0.6                                |
| CA_3-32-42-43 <sup>13</sup>  | 42 | 0.8                                |
|  | 43 | 0.8                                |
|  | 43 | 0.8                                |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 3: Tolerances for a UE supporting multiple 4DL inter-band CA configurations are FFS.</p> <p>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> <p>NOTE 5: For UE supporting E-UTRA band 65 and CA configurations including Band 1, the Band 65 <math>\Delta T_{IB,c}</math> is the max(Band 65 <math>\Delta T_{IB,c}</math>, Band 1 <math>\Delta T_{IB,c}</math>).</p> <p>NOTE 6: For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable <math>\Delta T_{IB,c}</math> in Band 42, 43, or 48 is the max(Band 42 <math>\Delta T_{IB,c}</math>, Band 43 <math>\Delta T_{IB,c}</math>, Band 48 <math>\Delta T_{IB,c}</math>).</p> <p>NOTE 7: The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.</p> <p>NOTE 8: The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz.</p> <p>NOTE 9: The values in the table reflect what can be achieved with the present state of the art technology. They shall be reconsidered when the state of the art technology progresses.</p> <p>NOTE 10: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1, Band 3 or Band 8.</p> <p>NOTE 11: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1, Band 8 or Band 11.</p> <p>NOTE 12: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 3, Band 8 or Band 11.</p> <p>NOTE 13: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.</p> |    |                                    |

Table 6.2.5-5:  $\Delta T_{IB,c}$  (five bands)

| E-UTRA operating band combination | E-UTRA Band | $\Delta T_{IB,c}$ [dB] |
|-----------------------------------|-------------|------------------------|
| CA_1-3-5-7-28                     | 1           | 0.6                    |
|                                   | 3           | 0.6                    |
|                                   | 5           | 0.5                    |
|                                   | 7           | 0.6                    |
|                                   | 28          | 0.6                    |
| CA_1-3-7-8-20                     | 1           | 0.6                    |
|                                   | 3           | 0.6                    |
|                                   | 7           | 0.6                    |
|                                   | 8           | 0.6                    |
| CA_1-3-7-20-28                    | 20          | 0.6                    |
|                                   | 1           | 0.6                    |
|                                   | 3           | 0.6                    |
|                                   | 7           | 0.6                    |
| CA_1-3-7-20-28                    | 20          | 0.6                    |
|                                   | 7           | 0.6                    |
|                                   | 20          | 0.6                    |

|  |    |     |
|--|----|-----|
|  | 28 | 0.6 |
| CA_1-3-7-20-32   | 1  | 0.7 |
|  | 3  | 0.7 |
|  | 7  | 0.7 |
|  | 20 | 0.3 |
| CA_1-3-7-20-42   | 1  | 0.7 |
|  | 3  | 0.7 |
|  | 7  | 0.7 |
|  | 20 | 0.3 |
|  | 42 | 0.8 |
| CA_1-3-8-11-28   | 1  | 0.3 |
|  | 3  | 0.8 |
|  | 8  | 0.6 |
|  | 11 | 0.9 |
|  | 28 | 0.6 |
| CA_1-3-20-32-42  | 1  | 0.6 |
|  | 3  | 0.6 |
|  | 20 | 0.4 |
|  | 42 | 0.8 |
| CA_1-3-20-32-43  | 1  | 0.5 |
|  | 3  | 0.5 |
|  | 20 | 0.3 |
|  | 43 | 0.8 |
| CA_1-3-32-42-43  | 1  | 0.6 |
|  | 3  | 0.6 |
|  | 42 | 0.8 |
|  | 43 | 0.8 |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 3: Tolerances for a UE supporting multiple 5DL inter-band CA configurations are FFS.</p> <p>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> |    |     |

NOTE: The above additional tolerances do not apply to supported UTRA operating bands with frequency range below 1 GHz that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations when such bands are belonging only to band combination(s) where one band is <1GHz and other bands are >1.7GHz and there is no harmonic relationship between the low band UL and high band DL. Otherwise the above additional tolerances also apply to supported UTRA operating bands that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.

## 6.2.5A Configured transmitted power for CA

For uplink carrier aggregation the UE is allowed to set its configured maximum output power  $P_{\text{MAX},c}$  for serving cell  $c$  and its total configured maximum output power  $P_{\text{MAX}}$ .

The configured maximum output power  $P_{\text{MAX},c}$  on serving cell  $c$  shall be set as specified in subclause 6.2.5.

For uplink inter-band carrier aggregation,  $\text{MPR}_c$  and  $\text{A-MPR}_c$  apply per serving cell  $c$  and are specified in subclause 6.2.3 and subclause 6.2.4, respectively.  $\text{P-MPR}_c$  accounts for power management for serving cell  $c$ .  $P_{\text{MAX},c}$  is calculated under the assumption that the transmit power is increased independently on all component carriers.

For uplink intra-band contiguous and non-contiguous carrier aggregation,  $\text{MPR}_c = \text{MPR}$  and  $\text{A-MPR}_c = \text{A-MPR}$  with  $\text{MPR}$  and  $\text{A-MPR}$  specified in subclause 6.2.3A and subclause 6.2.4A respectively. There is one power management term for the UE, denoted  $\text{P-MPR}$ , and  $\text{P-MPR}_c = \text{P-MPR}$ .  $P_{\text{MAX},c}$  is calculated under the assumption that the transmit power is increased by the same amount in dB on all component carriers.

The total configured maximum output power  $P_{\text{CMAX}}$  shall be set within the following bounds:

$$P_{\text{CMAX\_L}} \leq P_{\text{CMAX}} \leq P_{\text{CMAX\_H}}$$

For uplink inter-band carrier aggregation with one serving cell  $c$  per operating band when same TTI pattern is used in all aggregated serving cells,

$$P_{\text{CMAX\_L}} = \text{MIN} \{ 10 \log_{10} \sum \text{MIN} [ p_{\text{EMAX},c} / (\Delta t_{\text{C},c}), p_{\text{PowerClass}} / (\text{mpr}_c \cdot a\text{-mpr}_c \cdot \Delta t_{\text{C},c} \cdot \Delta t_{\text{IB},c} \cdot \Delta t_{\text{ProSe}}), p_{\text{PowerClass}} / \text{pmpr}_c ], P_{\text{PowerClass}} \}$$

$$P_{\text{CMAX\_H}} = \text{MIN} \{ 10 \log_{10} \sum p_{\text{EMAX},c}, P_{\text{PowerClass}} \}$$

where

- $p_{\text{EMAX},c}$  is the linear value of  $P_{\text{EMAX},c}$  which is given by IE *P-Max* for serving cell  $c$  in [7];
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2A-1 without taking into account the tolerance specified in the Table 6.2.2A-1;  $p_{\text{PowerClass}}$  is the linear value of  $P_{\text{PowerClass}}$ ;
- $\text{mpr}_c$  and  $a\text{-mpr}_c$  are the linear values of  $\text{MPR}_c$  and  $\text{A-MPR}_c$  as specified in subclause 6.2.3 and subclause 6.2.4, respectively;
- $\text{pmpr}_c$  is the linear value of  $\text{P-MPR}_c$ ;
- $\Delta t_{\text{C},c}$  is the linear value of  $\Delta T_{\text{C},c}$ .  $\Delta t_{\text{C},c} = 1.41$  when NOTE 2 in Table 6.2.2-1 applies for a serving cell  $c$ , otherwise  $\Delta t_{\text{C},c} = 1$ ;
- $\Delta t_{\text{IB},c}$  is the linear value of the inter-band relaxation term  $\Delta T_{\text{IB},c}$  of the serving cell  $c$  as specified in Table 6.2.5-2; otherwise  $\Delta t_{\text{IB},c} = 1$ ;
- $\Delta t_{\text{ProSe}}$  is the linear value of  $\Delta T_{\text{ProSe}}$  and applies as specified in subclause 6.2.5.

For uplink intra-band contiguous and non-contiguous carrier aggregation when same TTI pattern is used in all aggregated serving cells,

$$P_{\text{CMAX\_L}} = \text{MIN} \{ 10 \log_{10} \sum p_{\text{EMAX},c} - \Delta T_{\text{C}}, (P_{\text{PowerClass}} - \Delta P_{\text{PowerClass}}) - \text{MAX}(\text{MPR} + \text{A-MPR} + \Delta T_{\text{IB},c} + \Delta T_{\text{C}} + \Delta T_{\text{ProSe}}, \text{P-MPR}) \}$$

$$P_{\text{CMAX\_H}} = \text{MIN} \{ 10 \log_{10} \sum p_{\text{EMAX},c}, P_{\text{PowerClass}} \}$$

where

- $p_{\text{EMAX},c}$  is the linear value of  $P_{\text{EMAX},c}$  which is given by IE *P-Max* for serving cell  $c$  in [7];
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2A-1 without taking into account the tolerance specified in the Table 6.2.2A-1;  
 $\Delta P_{\text{PowerClass}} = 3$  dB for a power class 2 capable UE operating in Band 41, when *P-max* of 23 dBm or lower is indicated or if the uplink/downlink configuration is 0 or 6 in the cell; otherwise,  $\Delta P_{\text{PowerClass}} = 0$  dB
- $\text{MPR}$  and  $\text{A-MPR}$  are specified in subclause 6.2.3A and subclause 6.2.4A respectively;
- $\Delta T_{\text{IB},c}$  is the additional tolerance for serving cell  $c$  as specified in Table 6.2.5-2;
- $\text{P-MPR}$  is the power management term for the UE;
- $\Delta T_{\text{C}}$  is the highest value  $\Delta T_{\text{C},c}$  among all serving cells  $c$  in the  $T_{\text{REF}}$  over all  $T_{\text{eval}}$  durations.  $\Delta T_{\text{C},c} = 1.5$  dB when NOTE 2 in Table 6.2.2A-1 applies to the serving cell  $c$ , otherwise  $\Delta T_{\text{C},c} = 0$  dB;
- $\Delta T_{\text{ProSe}}$  applies as specified in subclause 6.2.5.

For uplink inter-band carrier aggregation with one serving cell  $c$  per operating band when at least one different TTI patterns is used in aggregated cells, the UE is allowed to set its configured maximum output power  $P_{\text{CMAX},c(i),i}$  for serving cell  $c(i)$  of TTI length  $i$ ,  $i = 1,2,3$  and its total configured maximum output power  $P_{\text{CMAX}}$ .

The configured maximum output power  $P_{\text{CMAX},c(i),i}(p)$  in TTI  $p$  of serving cell  $c(i)$  on TTI length  $i$  shall be set within the following bounds:

$$P_{\text{CMAX\_L},c(i),i}(p) \leq P_{\text{CMAX},c(i),i}(p) \leq P_{\text{CMAX\_H},c(i),i}(p)$$

where  $P_{\text{CMAX\_L},c(i),i}(p)$  and  $P_{\text{CMAX\_H},c(i),i}(p)$  are the limits for a serving cell  $c(i)$  of TTI length  $i$  as specified in subclause 6.2.5.

The total UE configured maximum output power  $P_{\text{CMAX}}(p,q,k)$  in a TTI  $p$  of TTI length 1, a TTI  $q$  of TTI length 2 and a TTI  $k$  of TTI length 3 that overlap in time shall be set within the following bounds unless stated otherwise:

$$P_{\text{CMAX\_L}}(p,q,k) \leq P_{\text{CMAX}}(p,q,k) \leq P_{\text{CMAX\_H}}(p,q,k)$$

When  $p$ ,  $q$ ,  $k$  are of different lengths and belong to different cells:

$$P_{\text{CMAX\_L}}(p,q,k) = \text{MIN} \{ 10 \log_{10} [p_{\text{CMAX\_L},c(1),1}(p) + p_{\text{CMAX\_L},c(2),2}(q) + p_{\text{CMAX\_L},c(3),3}(k)], P_{\text{PowerClass}} \}$$

$$P_{\text{CMAX\_H}}(p,q,k) = \text{MIN} \{ 10 \log_{10} [p_{\text{CMAX\_H},c(1),1}(p) + p_{\text{CMAX\_H},c(2),2}(q) + p_{\text{CMAX\_H},c(3),3}(k)], P_{\text{PowerClass}} \}$$

where  $p_{\text{CMAX\_L},c(i),i}$  and  $p_{\text{CMAX\_H},c(i),i}$  are the respective limits  $P_{\text{CMAX\_L},c(i),i}$  and  $P_{\text{CMAX\_H},c(i),i}$  expressed in linear scale.

For combinations of intra-band and inter-band carrier aggregation with UE configured for transmission on three serving cells (up to two contiguously aggregated carriers per operating band),

For the case when  $p$  and  $q$  belong to the same band and  $k$  belongs to a different band but  $p$ ,  $q$  and  $k$  are of the same TTI pattern.

$$P_{\text{CMAX\_L}} = \text{MIN} \{ 10 \log_{10} \sum (p_{\text{CMAX\_L},Bi}), P_{\text{PowerClass}} \}$$

$$P_{\text{CMAX\_H}} = \text{MIN} \{ 10 \log_{10} \sum p_{\text{EMAX},c}, P_{\text{PowerClass}} \}$$

For the case when  $p$  and  $q$  belong to the same band and are of the same TTI pattern while  $k$  belong to a different band and is of different TTI pattern then:

$$P_{\text{CMAX\_L}}(p,q,k) = \text{MIN} \{ 10 \log_{10} [p_{\text{CMAX\_L},Bi}(p) + p_{\text{CMAX\_L},c(3),3}(k)], P_{\text{PowerClass}} \}$$

$$P_{\text{CMAX\_H}}(p,q,k) = \text{MIN} \{ 10 \log_{10} [p_{\text{CMAX\_H},Bi}(p) + p_{\text{CMAX\_H},c(3),3}(k)], P_{\text{PowerClass}} \}$$

where

- $p_{\text{EMAX},c}$  is the linear value of  $P_{\text{EMAX},c}$  which is given by IE *P-Max* for serving cell  $c$  in [7];
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2A-0 without taking into account the tolerance specified in the Table 6.2.2A-0;  $p_{\text{PowerClass}}$  is the linear value of  $P_{\text{PowerClass}}$ ;
- $p_{\text{CMAX\_L},Bi}$  is the linear values of  $P_{\text{CMAX\_L}}$  as specified in corresponding operating band.  $P_{\text{CMAX\_L},c}$  specified for single carrier in subclause 6.2.5 applies for operating band supporting one serving cell.  $P_{\text{CMAX\_L}}$  specified for uplink intra-band contiguous carrier aggregation in subclause 6.2.5A applies for operating band supporting two contiguous serving cells.
- intra-band carriers use the same TTI patterns.

$T_{\text{REF}}$  and  $T_{\text{eval}}$  are specified in Table 6.2.5A-0 when same and different TTI patterns are used in aggregated carriers. For each  $T_{\text{REF}}$ , the  $P_{\text{CMAX\_L}}$  is evaluated per  $T_{\text{eval}}$  and given by the minimum value taken over the transmission(s) within the  $T_{\text{eval}}$ ; the minimum  $P_{\text{CMAX\_L}}$  over the one or more  $T_{\text{eval}}$  is then applied for the entire  $T_{\text{REF}}$ .  $P_{\text{PowerClass}}$  shall not be exceeded by the UE during any period of time.

**Table 6.2.5A-0:  $P_{\text{CMAX}}$  evaluation window for different TTI patterns**

| TTI duration   | $T_{\text{REF}}$               | $T_{\text{eval}}$                 |
|--|--------------------------------|-----------------------------------|
| Different TTI duration in different aggregated carrier | $T_{\text{REF}}$ of longer TTI | $T_{\text{eval}}$ of shortest TTI |

If the UE is configured with multiple TAGs and transmissions of the UE on TTI  $i$  for any serving cell in one TAG overlap some portion of the first symbol of the transmission on TTI  $i + 1$  for a different serving cell in another TAG, the UE minimum of  $P_{\text{CMAX\_L}}$  for TTIs  $i$  and  $i + 1$  applies for any overlapping portion of TTIs  $i$  and  $i + 1$ .  $P_{\text{PowerClass}}$  shall not be exceeded by the UE during any period of time.

In case PC2 and uplink intra-band contiguous CA capable UE receives  $p_{\text{EMAX},c}$  in Scell then that applies both to Scell and Pcell once the Scell is activated.



The measured maximum output power  $P_{UMAX}$  over all serving cells with same TTI pattern shall be within the following range:

$$P_{CMAX\_L} - \text{MAX}\{T_L, T_{LOW}(P_{CMAX\_L})\} \leq P_{UMAX} \leq P_{CMAX\_H} + T_{HIGH}(P_{CMAX\_H})$$

$$P_{UMAX} = 10 \log_{10} \sum P_{UMAX,c}$$

where  $p_{UMAX,c}$  denotes the measured maximum output power for serving cell  $c$  expressed in linear scale. The tolerances  $T_{LOW}(P_{CMAX})$  and  $T_{HIGH}(P_{CMAX})$  for applicable values of  $P_{CMAX}$  are specified in Table 6.2.5A-1 and Table 6.2.5A-2 for inter-band carrier aggregation and intra-band carrier aggregation, respectively. The tolerance  $T_L$  is the absolute value of the lower tolerance for applicable E-UTRA CA configuration as specified in Table 6.2.2A-0, Table 6.2.2A-1 and Table 6.2.2A-2 for inter-band carrier aggregation, intra-band contiguous carrier aggregation and intra-band non-contiguous carrier aggregation, respectively.

The measured maximum output power  $P_{UMAX}$  over all serving cells, when atleast one TTI has a different TTI pattern, shall be within the following range:

$$P'_{CMAX\_L} - \text{MAX}\{T_L, T_{LOW}(P'_{CMAX\_L})\} \leq P'_{UMAX} \leq P'_{CMAX\_H} + T_{HIGH}(P'_{CMAX\_H})$$

$$P'_{UMAX} = 10 \log_{10} \sum p'_{UMAX,c}$$

where  $p'_{UMAX,c}$  denotes the average measured maximum output power for serving cell  $c$  expressed in linear scale over  $T_{REF}$ . The tolerances  $T_{LOW}(P'_{CMAX})$  and  $T_{HIGH}(P'_{CMAX})$  for applicable values of  $P'_{CMAX}$  are specified in Table 6.2.5A-1 and Table 6.2.5A-2 for inter-band carrier aggregation and intra-band carrier aggregation, respectively. The tolerance  $T_L$  is the absolute value of the lower tolerance for applicable E-UTRA CA configuration as specified in Table 6.2.2A-0, Table 6.2.2A-1 and Table 6.2.2A-2 for inter-band carrier aggregation, intra-band contiguous carrier aggregation and intra-band non-contiguous carrier aggregation, respectively.

where:

$$P'_{CMAX\_L} = \text{MIN}\{ \text{MIN}\{10 \log_{10} \sum (P_{CMAX\_L, Bi}), P_{PowerClass}\} \text{ over all overlapping TTIs in } T_{REF}\}$$

$$P'_{CMAX\_H} = \text{MAX}\{ \text{MIN}\{10 \log_{10} \sum P_{EMAX,c}, P_{PowerClass}\} \text{ over all overlapping TTIs in } T_{REF}\}$$

**Table 6.2.5A-1:  $P_{CMAX}$  tolerance for uplink inter-band CA (two bands)**

| $P_{CMAX}$<br>(dBm)      | Tolerance<br>$T_{LOW}(P_{CMAX})$<br>(dB) | Tolerance<br>$T_{HIGH}(P_{CMAX})$<br>(dB) |
|--------------------------|--|---|
| $P_{CMAX} = 23$          | 3.0                                      | 2.0                                       |
| $22 \leq P_{CMAX} < 23$  | 5.0                                      | 2.0                                       |
| $21 \leq P_{CMAX} < 22$  | 5.0                                      | 3.0                                       |
| $20 \leq P_{CMAX} < 21$  | 6.0                                      | 4.0                                       |
| $16 \leq P_{CMAX} < 20$  | 5.0                                      |   |
| $11 \leq P_{CMAX} < 16$  | 6.0                                      |   |
| $-40 \leq P_{CMAX} < 11$ | 7.0                                      |   |

**Table 6.2.5A-2:  $P_{CMAX}$  tolerance for uplink intra-band CA**

| $P_{CMAX}$<br>(dBm)        | Tolerance<br>$T_{LOW}(P_{CMAX})$<br>(dB) | Tolerance<br>$T_{HIGH}(P_{CMAX})$<br>(dB) |
|----------------------------|--|---|
| $21 \leq P_{CMAX} \leq 26$ | 2.0                                      |   |
| $20 \leq P_{CMAX} < 21$    | 2.5                                      |   |
| $19 \leq P_{CMAX} < 20$    | 3.5                                      |   |
| $18 \leq P_{CMAX} < 19$    | 4.0                                      |   |
| $13 \leq P_{CMAX} < 18$    | 5.0                                      |   |
| $8 \leq P_{CMAX} < 13$     | 6.0                                      |   |
| $-40 \leq P_{CMAX} < 8$    | 7.0                                      |   |

## 6.2.5B Configured transmitted power for UL-MIMO

For UE supporting UL-MIMO, the transmitted power is configured per each UE.

The definitions of configured maximum output power  $P_{\text{CMAX},c}$ , the lower bound  $P_{\text{CMAX}_L,c}$ , and the higher bound  $P_{\text{CMAX}_H,c}$  specified in subclause 6.2.5 shall apply to UE supporting UL-MIMO, where

- $P_{\text{PowerClass}}$ ,  $\Delta P_{\text{PowerClass}}$  and  $\Delta T_{C,c}$  are specified in subclause 6.2.2B;
- $\text{MPR}_{c}$  is specified in subclause 6.2.3B;
- $\text{A-MPR}_{c}$  is specified in subclause 6.2.4B.

The measured configured maximum output power  $P_{\text{UMAX},c}$  for serving cell  $c$  shall be within the following bounds:

$$P_{\text{CMAX}_L,c} - \text{MAX}\{T_L, T_{\text{LOW}}(P_{\text{CMAX}_L,c})\} \leq P_{\text{UMAX},c} \leq P_{\text{CMAX}_H,c} + T_{\text{HIGH}}(P_{\text{CMAX}_H,c})$$

where  $T_{\text{LOW}}(P_{\text{CMAX}_L,c})$  and  $T_{\text{HIGH}}(P_{\text{CMAX}_H,c})$  are defined as the tolerance and applies to  $P_{\text{CMAX}_L,c}$  and  $P_{\text{CMAX}_H,c}$  separately, while  $T_L$  is the absolute value of the lower tolerance in Table 6.2.2B-1 for the applicable operating band.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the tolerance is specified in Table 6.2.5B-1. The requirements shall be met with UL-MIMO configurations specified in Table 6.2.2B-2.

**Table 6.2.5B-1:  $P_{\text{CMAX},c}$  tolerance in closed-loop spatial multiplexing scheme**

| $P_{\text{CMAX},c}$<br>(dBm)      | Tolerance<br>$T_{\text{LOW}}(P_{\text{CMAX}_L,c})$ (dB) | Tolerance<br>$T_{\text{HIGH}}(P_{\text{CMAX}_H,c})$ (dB) |
|-----------------------------------|---|--|
| $P_{\text{CMAX},c} = 23$          | 3.0   | 2.0  |
| $22 \leq P_{\text{CMAX},c} < 23$  | 5.0   | 2.0  |
| $21 \leq P_{\text{CMAX},c} < 22$  | 5.0   | 3.0  |
| $20 \leq P_{\text{CMAX},c} < 21$  | 6.0   | 4.0  |
| $16 \leq P_{\text{CMAX},c} < 20$  | 5.0   |  |
| $11 \leq P_{\text{CMAX},c} < 16$  | 6.0   |  |
| $-40 \leq P_{\text{CMAX},c} < 11$ | 7.0   |  |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.5 apply.

## 6.2.5C Configured transmitted power for Dual Connectivity

For inter-band dual connectivity with one uplink serving cell per CG, the UE is allowed to set its configured maximum output power  $P_{\text{CMAX},c(i),i}$  for serving cell  $c(i)$  of CG  $i$ ,  $i = 1, 2$ , and its total configured maximum output power  $P_{\text{CMAX}}$ .

The configured maximum output power  $P_{\text{CMAX},c(i),i}(p)$  in subframe  $p$  of serving cell  $c(i)$  on CG  $i$  shall be set within the following bounds:

$$P_{\text{CMAX}_L,c(i),i}(p) \leq P_{\text{CMAX},c(i),i}(p) \leq P_{\text{CMAX}_H,c(i),i}(p)$$

where  $P_{\text{CMAX}_L,c(i),i}(p)$  and  $P_{\text{CMAX}_H,c(i),i}(p)$  are the limits for a serving cell  $c(i)$  of CG  $i$  as specified in subclause 6.2.5.

The total UE configured maximum output power  $P_{\text{CMAX}}(p,q)$  in a subframe  $p$  of CG 1 and a subframe  $q$  of CG 2 that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

$$P_{\text{CMAX}_L}(p,q) \leq P_{\text{CMAX}}(p,q) \leq P_{\text{CMAX}_H}(p,q)$$

with

$$P_{\text{CMAX}_L}(p,q) = \text{MIN} \{10 \log_{10} [p_{\text{CMAX}_L,c(1),1}(p) + p_{\text{CMAX}_L,c(2),2}(q)], P_{\text{PowerClass}}\}$$

$$P_{\text{CMAX}_H}(p,q) = \text{MIN} \{10 \log_{10} [p_{\text{CMAX}_H,c(1),1}(p) + p_{\text{CMAX}_H,c(2),2}(q)], P_{\text{PowerClass}}\}$$

where  $p_{\text{CMAX}_L,c(i),i}$  is  $p_{\text{CMAX}_H,c(i),i}$  are the respective limits  $P_{\text{CMAX}_L,c(i),i}(p)$  and  $P_{\text{CMAX}_H,c(i),i}(p)$  expressed in linear scale.

If the UE is configured in Dual Connectivity and synchronous transmissions of the UE on subframe  $p$  for a serving cell in one CG overlaps some portion of the first symbol of the transmission on subframe  $q + 1$  for a different serving cell in the other CG, the UE minimum of  $P_{\text{CMAX\_L}}$  between subframes pairs  $(p, q)$  and  $(p+1, q+1)$  respectively applies for any overlapping portion of subframes  $(p, q)$  and  $(p+1, q+1)$ .  $P_{\text{PowerClass}}$  shall not be exceeded by the UE during any period of time.

The measured total maximum output power  $P_{\text{UMAX}}$  over both CGs is

$$P_{\text{UMAX}} = 10 \log_{10} [p_{\text{UMAX},c(1),1} + p_{\text{UMAX},c(2),2}],$$

where  $p_{\text{UMAX},c(i),i}$  denotes the measured output power of serving cell  $c(i)$  of CG  $i$  expressed in linear scale.

If the UE is configured in Dual Connectivity and synchronous transmissions

$$P_{\text{CMAX\_L}}(p, q) - T_{\text{LOW}}(P_{\text{CMAX\_L}}(p, q)) \leq P_{\text{UMAX}} \leq P_{\text{CMAX\_H}}(p, q) + T_{\text{HIGH}}(P_{\text{CMAX\_H}}(p, q))$$

where  $P_{\text{CMAX\_L}}(p, q)$  and  $P_{\text{CMAX\_H}}(p, q)$  are the limits for the pair  $(p, q)$  and with the tolerances  $T_{\text{LOW}}(P_{\text{CMAX}})$  and  $T_{\text{HIGH}}(P_{\text{CMAX}})$  for applicable values of  $P_{\text{CMAX}}$  specified in Table 6.2.5C-1.  $P_{\text{CMAX\_L}}$  may be modified for any overlapping portion of subframes  $(p, q)$  and  $(p+1, q+1)$ .

If the UE is configured in Dual Connectivity and asynchronous transmissions, the subframes of the leading CG are taken as reference subframes for the measurement of the total configured output power  $P_{\text{UMAX}}$ . If subframe  $p$  of CG 1 and subframe  $q$  of CG 2 overlap in time in their respective slot 0 and

1. if  $p$  leads in time over  $q$ , then  $p$  is the reference subframe and the  $(p, q)$  and  $(p, q-1)$  pairs are considered for determining the  $P_{\text{CMAX}}$  tolerance
2. if  $q$  leads in time over  $p$ , then  $q$  is the reference subframe and the  $(p-1, q)$  and  $(p, q)$  pairs are considered for determining the  $P_{\text{CMAX}}$  tolerance;

for the reference subframe  $p$  duration (when subframe  $p$  in CG 1 leads):

$$P'_{\text{CMAX\_L}} = \text{MIN} \{P_{\text{CMAX\_L}}(p, q), P_{\text{CMAX\_L}}(p, q-1)\}$$

$$P'_{\text{CMAX\_H}} = \text{MAX} \{P_{\text{CMAX\_H}}(p, q), P_{\text{CMAX\_H}}(p, q-1)\}$$

while for the reference subframe  $q$  duration (when subframe  $q$  in CG 2 leads):

$$P'_{\text{CMAX\_L}} = \text{MIN} \{P_{\text{CMAX\_L}}(p-1, q), P_{\text{CMAX\_L}}(p, q)\}$$

$$P'_{\text{CMAX\_H}} = \text{MAX} \{P_{\text{CMAX\_H}}(p-1, q), P_{\text{CMAX\_H}}(p, q)\}$$

where  $P_{\text{CMAX\_L}}$  and  $P_{\text{CMAX\_H}}$  are the applicable limits for each overlapping subframe pairs  $(p, q)$ ,  $(p, q-1)$  and  $(p-1, q)$ . The measured total configured maximum output power  $P_{\text{UMAX}}$  shall be within the following bounds:

$$P'_{\text{CMAX\_L}} - T_{\text{LOW}}(P'_{\text{CMAX\_L}}) \leq P_{\text{UMAX}} \leq P'_{\text{CMAX\_H}} + T_{\text{HIGH}}(P'_{\text{CMAX\_H}})$$

with the tolerances  $T_{\text{LOW}}(P_{\text{CMAX}})$  and  $T_{\text{HIGH}}(P_{\text{CMAX}})$  for applicable values of  $P_{\text{CMAX}}$  specified in Table 6.2.5C-1.

**Table 6.2.5C-1:  $P_{\text{CMAX}}$  tolerance for inter-band Dual Connectivity**

| $P_{\text{CMAX}}(\text{dBm})$   | Tolerance<br>$T_{\text{LOW}}(P_{\text{CMAX\_L}})(\text{dB})$ | Tolerance<br>$T_{\text{HIGH}}(P_{\text{CMAX\_H}})(\text{dB})$ |
|---------------------------------|--|---|
| $P_{\text{CMAX}} = 23$          | 3.0  | 2.0   |
| $22 \leq P_{\text{CMAX}} < 23$  | 5.0  | 2.0   |
| $21 \leq P_{\text{CMAX}} < 22$  | 5.0  | 3.0   |
| $20 \leq P_{\text{CMAX}} < 21$  | 6.0  | 4.0   |
| $16 \leq P_{\text{CMAX}} < 20$  | 5.0  |   |
| $11 \leq P_{\text{CMAX}} < 16$  | 6.0  |   |
| $-40 \leq P_{\text{CMAX}} < 11$ | 7.0  |   |

## 6.2.5D Configured transmitted power for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the configured maximum output power  $P_{\text{CMAX},c}$  and power boundary requirement specified in subclause 6.2.5 shall apply to UE supporting ProSe, where

- $\text{MPR}_c$  is specified in subclause 6.2.3D;
- $\text{A-MPR}_c$  is specified in subclause 6.2.4D;
- $\Delta T_{\text{ProSe}} = 0.1$  dB.

For  $P_{\text{CMAX},\text{PSSCH}}$  and  $P_{\text{CMAX},\text{PSCCH}}$ ,  $P_{\text{EMAX},c}$  is the value given by IE *P-Max* for serving cell  $c$ , defined by [7], when present.  $P_{\text{EMAX},c}$  is the value given by IE *maxTxPower*, defined by [7], when the UE is not associated with a serving cell on the ProSe carrier .

For  $P_{\text{CMAX},\text{PSDCH}}$ ,  $P_{\text{EMAX},c}$  is the value given by the IE *discMaxTxPower* in [7].

For  $P_{\text{CMAX},\text{PSBCH}}$ ,  $P_{\text{EMAX},c}$  is the value given by the IE *maxTxPower* in [7] when the ProSe UE is not associated with a serving cell on the ProSe carrier. When the UE is associated with a serving cell, then  $P_{\text{EMAX},c}$  is the value given by the IE *P-Max* when PSBCH/SLSS transmissions is triggered for ProSe Direct communication as specified in [7], and is the value given by the IE *discMaxTxPower* in [7] otherwise.

For  $P_{\text{CMAX},\text{SSSS}}$ , the value is as calculated for  $P_{\text{CMAX},\text{PSBCH}}$  and applying the MPR for SSSS as specified in Section 6.2.3D.

When a UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the UE is allowed to set its configured maximum output power  $P_{\text{CMAX},c,\text{E-UTRA}}$  and  $P_{\text{CMAX},c,\text{ProSe}}$  for the configured E-UTRA uplink carrier and the configured E-UTRA ProSe carrier, respectively, and its total configured maximum output power  $P_{\text{CMAX},c}$ .

The configured maximum output power  $P_{\text{CMAX},c,\text{E-UTRA}}(p)$  in subframe  $p$  for the configured E-UTRA uplink carrier shall be set within the bounds:

$$P_{\text{CMAX}_L,c,\text{E-UTRA}}(p) \leq P_{\text{CMAX},c,\text{E-UTRA}}(p) \leq P_{\text{CMAX}_H,c,\text{E-UTRA}}(p)$$

where  $P_{\text{CMAX}_L,c,\text{E-UTRA}}$  and  $P_{\text{CMAX}_H,c,\text{E-UTRA}}$  are the limits for a serving cell  $c$  as specified in subclause 6.2.5.

The configured maximum output power  $P_{\text{CMAX},c,\text{ProSe}}(q)$  in subframe  $q$  for the configured E-UTRA ProSe carrier shall be set within the bounds:

$$P_{\text{CMAX},c,\text{ProSe}}(q) \leq P_{\text{CMAX}_H,c,\text{ProSe}}(q)$$

where  $P_{\text{CMAX}_H,c,\text{ProSe}}$  is the limit as specified in subclause 6.2.5D.

The total UE configured maximum output power  $P_{\text{CMAX}}(p,q)$  in a subframe  $p$  of an E-UTRA uplink carrier and a subframe  $q$  of an E-UTRA ProSe sidelink that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

$$P_{\text{CMAX}_L}(p,q) \leq P_{\text{CMAX}}(p,q) \leq P_{\text{CMAX}_H}(p,q)$$

with

$$P_{\text{CMAX}_L}(p,q) = P_{\text{CMAX}_L,c,\text{E-UTRA}}(p)$$

$$P_{\text{CMAX}_H}(p,q) = \text{MIN} \{ 10 \log_{10} [p_{\text{CMAX}_H,c,\text{E-UTRA}}(p) + p_{\text{CMAX}_H,c,\text{ProSe}}(q)], P_{\text{PowerClass}} \}$$

where  $p_{\text{CMAX}_H,c,\text{ProSe}}$  and  $p_{\text{CMAX}_H,c,\text{E-UTRA}}$  are the limits  $P_{\text{CMAX}_H,c,\text{ProSe}}(q)$  and  $P_{\text{CMAX}_H,c,\text{E-UTRA}}(p)$  expressed in linear scale.

The measured total maximum output power  $P_{\text{UMAX}}$  over both the E-UTRA uplink and E-UTRA ProSe carriers is

$$P_{\text{UMAX}} = 10 \log_{10} [p_{\text{UMAX},c,\text{E-UTRA}} + p_{\text{UMAX},c,\text{ProSe}}],$$

where  $P_{UMAX,c,E-UTRA}$  denotes the measured output power of serving cell  $c$  for the configured E-UTRA uplink carrier, and  $P_{UMAX,c,ProSe}$  denotes the measured output power for the configured E-UTRA ProSe carrier expressed in linear scale.

When a UE is configured for synchronous ProSe and uplink transmissions,

$$P_{CMAX\_L}(p, q) - T_{LOW}(P_{CMAX\_L}(p, q)) \leq P_{UMAX} \leq P_{CMAX\_H}(p, q) + T_{HIGH}(P_{CMAX\_H}(p, q))$$

where  $P_{CMAX\_L}(p, q)$  and  $P_{CMAX\_H}(p, q)$  are the limits for the pair  $(p, q)$  and with the tolerances  $T_{LOW}(P_{CMAX})$  and  $T_{HIGH}(P_{CMAX})$  for applicable values of  $P_{CMAX}$  specified in Table 6.2.5C-1.  $P_{CMAX\_L}$  may be modified for any overlapping portion of subframes  $(p, q)$  and  $(p + 1, q + 1)$ .

When a UE is configured for asynchronous ProSe and uplink transmissions, the carrier configured for uplink transmission is taken as the reference. If subframe  $p$  for the E-UTRA uplink carrier and subframe  $q$  for the E-UTRA ProSe carrier overlap in time and

1. if uplink carrier leads in time over  $q$ , then  $p$  is the reference subframe and, the  $(p, q)$  and  $(p, q-1)$  pairs are considered for determining the  $P_{CMAX}$  tolerance
2. if ProSe carrier leads in time over  $p$ , then  $p$  is the reference subframe and, the  $(p, q)$  and  $(p, q+1)$  pairs are considered for determining the  $P_{CMAX}$  tolerance

For the reference subframe  $p$  duration when uplink carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,cE-UTRA}(p)$$

$$P'_{CMAX\_H} = \text{MAX} \{P_{CMAX\_H}(p, q-1), P_{CMAX\_H}(p, q)\}$$

For the reference subframe  $p$  duration when ProSe carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,cE-UTRA}(p)$$

$$P'_{CMAX\_H} = \text{MAX} \{P_{CMAX\_H}(p, q), P_{CMAX\_H}(p, q+1)\}$$

where  $P_{CMAX\_L,cE-UTRA}(p)$  and  $P_{CMAX\_H}$  are the applicable limits for each overlapping subframe pairs  $(p, q)$ ,  $(p, q+1)$ ,  $(p, q-1)$ . The measured total configured maximum output power  $P_{UMAX}$  shall be within the following bounds:

$$P'_{CMAX\_L} - T_{LOW}(P'_{CMAX\_L}) \leq P_{UMAX} \leq P'_{CMAX\_H} + T_{HIGH}(P'_{CMAX\_H})$$

with the tolerances  $T_{LOW}(P_{CMAX})$  and  $T_{HIGH}(P_{CMAX})$  for applicable values of  $P_{CMAX}$  specified in Table 6.2.5C-1.

## 6.2.5F Configured transmitted Power for category NB1 and NB2

For each slot  $i$  the category NB1 and NB2 UE is allowed to set its configured maximum output power  $P_{CMAX,c}$ . The configured maximum output power  $P_{CMAX,c}$  is set within the following bounds:

$$P_{CMAX\_L,c} \leq P_{CMAX,c} \leq P_{CMAX\_H,c}$$

Where

- $P_{CMAX\_L,c} = \text{MIN} \{ P_{EMAX,c}, P_{PowerClass} - MPR_c - A-MPR_c \}$
- $P_{CMAX\_H,c} = \text{MIN} \{ P_{EMAX,c}, P_{PowerClass} \}$
- $P_{EMAX,c}$  is the value given to IE *P-Max*, defined in [7]
- $P_{PowerClass}$  is the maximum category NB1 and NB2 UE power specified in Table 6.2.2F-1 without taking into account the associated tolerance
- $MPR_c$  is specified in subclause 6.2.3F
- $A-MPR_c = 0\text{dB}$  unless otherwise stated.

The measurement period for  $P_{UMAX,c}$  is at least one sub-frame (1ms) for 15 KHz channel spacing, and at least a 2ms slot (excluding the 2304Ts gap when UE is not transmitting) respectively for the 3.75 KHz channel spacing. The measured maximum output power  $P_{UMAX,c}$  shall be within the following bounds:

$$P_{CMAX,L,c} - T(P_{CMAX,L,c}) \leq P_{UMAX,c} \leq P_{CMAX,H,c} + T(P_{CMAX,H,c})$$

Where  $T(P_{CMAX})$  is defined by the tolerance table below and applies to  $P_{CMAX,L,c}$  and  $P_{CMAX,H,c}$  separately.

**Table 6.2.5F-1:  $P_{CMAX}$  tolerance for power class 3**

| $P_{CMAX}$ (dBm)           | Tolerance $T(P_{CMAX})$ (dB) |
|----------------------------|------------------------------|
| $21 \leq P_{CMAX} \leq 23$ | 2.0                          |
| $20 \leq P_{CMAX} < 21$    | 2.5                          |
| $19 \leq P_{CMAX} < 20$    | 3.5                          |
| $18 \leq P_{CMAX} < 19$    | 4.0                          |
| $13 \leq P_{CMAX} < 18$    | 5.0                          |
| $8 \leq P_{CMAX} < 13$     | 6.0                          |
| $-40 \leq P_{CMAX} < 8$    | 7.0                          |

**Table 6.2.5F-2:  $P_{CMAX}$  tolerance for power class 5**

| $P_{CMAX,c}$ (dBm)           | Tolerance $T(P_{CMAX,c})$ (dB) |
|------------------------------|--------------------------------|
| $18 \leq P_{CMAX,c} \leq 20$ | 2.0                            |
| $17 \leq P_{CMAX,c} < 18$    | 2.5                            |
| $16 \leq P_{CMAX,c} < 17$    | 3.5                            |
| $15 \leq P_{CMAX,c} < 16$    | 4.0                            |
| $10 \leq P_{CMAX,c} < 15$    | 5.0                            |
| $5 \leq P_{CMAX,c} < 10$     | 6.0                            |
| $-40 \leq P_{CMAX,c} < 5$    | 7.0                            |

**Table 6.2.5F-3:  $P_{CMAX}$  tolerance for power class 6**

| $P_{CMAX,c}$ (dBm)           | Tolerance $T(P_{CMAX,c})$ (dB) |
|------------------------------|--------------------------------|
| $13 \leq P_{CMAX,c} \leq 14$ | 2.5                            |
| $12 \leq P_{CMAX,c} < 13$    | 3.5                            |
| $11 \leq P_{CMAX,c} < 12$    | 4                              |
| $8 \leq P_{CMAX,c} < 11$     | 5                              |
| $5 \leq P_{CMAX,c} < 8$      | 6.0                            |
| $-40 \leq P_{CMAX,c} < 5$    | 7.0                            |

## 6.2.5G Configured transmitted power for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the V2X UE is allowed to set its configured maximum output power  $P_{CMAX,c}$  for component carrier  $c$ . The configured maximum output power  $P_{CMAX,c}$  is set within the following bounds:

$$P_{CMAX,L,c} \leq P_{CMAX,c} \leq P_{CMAX,H,c} \text{ with}$$

$$P_{CMAX,L,c} = \text{MIN} \{ P_{EMAX,c} - \Delta T_{C,c}, P_{PowerClass} - \text{MAX}(MPR_c + A\text{-}MPR_c + \Delta T_{IB,c} + \Delta T_{C,c} + \Delta T_{ProSe}, P\text{-}MPR_c), P_{Regulatory,c} \}$$

$$P_{CMAX,H,c} = \text{MIN} \{ P_{EMAX,c}, P_{PowerClass}, P_{Regulatory,c} \}$$

where

- For the total transmitted power  $P_{\text{CMAX},c}$  of PSSCH and PSCCH,  $P_{\text{EMAX},c}$  is the value given by IE *maxTxPower*, defined by [7], when the UE is not associated with a serving cell on the V2X carrier.
- For  $P_{\text{CMAX,PSBCH}}$ ,  $P_{\text{EMAX},c}$  is the value given by the IE *maxTxPower* in [7] when the UE is not associated with a serving cell on the V2X carrier.
- For  $P_{\text{CMAX,SSSS}}$ , the value is as calculated for  $P_{\text{CMAX,PSBCH}}$  and applying the MPR for SSSS as specified in Section 6.2.3D.
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2-1 without taking into account the tolerance specified in the Table 6.2.2-1;
- $\text{MPR}_c$  and  $\text{A-MPR}_c$  for serving cell  $c$  are specified in subclause 6.2.3G and subclause 6.2.4G, respectively;
- $\Delta T_{\text{IB},c}$ ,  $\Delta T_{\text{C},c}$ ,  $\Delta T_{\text{ProSe}}$  and  $\text{P-MPR}_c$  are specified in subclause 6.2.5
- $P_{\text{Regulatory},c} = 10 - G_{\text{post connector}}$  dBm when the V2X UE is within the protected zone [13] of CEN DSRC tolling system and operating in Band 47;  $P_{\text{Regulatory},c} = 33 - G_{\text{post connector}}$  dBm otherwise.

The maximum output power  $P_{\text{CMAX,PSSCH}}$  and  $P_{\text{CMAX,PSCCH}}$  are derived from  $P_{\text{CMAX},c}$  based on the PSD offset following subclause 14.1.1.5 in [6]. For all cases, the PSD difference between PSCCH and PSSCH shall be the same as the PSD offset value.

For the measured configured maximum output power  $P_{\text{UMAX},c}$  for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions, the same requirement as in subclause 6.2.5 shall be applied.

When a UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the UE is allowed to set its configured maximum output power  $P_{\text{CMAX},c,E\text{-UTRA}}$  and  $P_{\text{CMAX},c,V2X}$  for the configured E-UTRA uplink carrier and the configured E-UTRA V2X carrier, respectively, and its total configured maximum output power  $P_{\text{CMAX},c}$ . The  $\Delta T_{\text{IB},c}$  of  $P_{\text{CMAX},c,E\text{-UTRA}}$  is specified in Table 6.2.5G-1.

The configured maximum output power  $P_{\text{CMAX},c,E\text{-UTRA}}(p)$  in subframe  $p$  for the configured E-UTRA uplink carrier shall be set within the bounds:

$$P_{\text{CMAX}_L,c,E\text{-UTRA}}(p) \leq P_{\text{CMAX},c,E\text{-UTRA}}(p) \leq P_{\text{CMAX}_H,c,E\text{-UTRA}}(p)$$

where  $P_{\text{CMAX}_L,c,E\text{-UTRA}}$  and  $P_{\text{CMAX}_H,c,E\text{-UTRA}}$  are the limits for a serving cell  $c$  as specified in subclause 6.2.5.

The configured maximum output power  $P_{\text{CMAX},c,V2X}(q)$  in subframe  $q$  for the configured E-UTRA V2X carrier shall be set within the bounds:

$$P_{\text{CMAX},c,V2X}(q) \leq P_{\text{CMAX}_H,c,V2X}(q)$$

where  $P_{\text{CMAX}_H,c,V2X}$  is the limit as specified in subclause 6.2.5G.

The total UE configured maximum output power  $P_{\text{CMAX}}(p,q)$  in a subframe  $p$  of an E-UTRA uplink carrier and a subframe  $q$  of an E-UTRA V2X sidelink that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

$$P_{\text{CMAX}_L}(p,q) \leq P_{\text{CMAX}}(p,q) \leq P_{\text{CMAX}_H}(p,q)$$

with

$$P_{\text{CMAX}_L}(p,q) = P_{\text{CMAX}_L,c,E\text{-UTRA}}(p)$$

$$P_{\text{CMAX}_H}(p,q) = 10 \log_{10} [p_{\text{CMAX}_H,c,E\text{-UTRA}}(p) + p_{\text{CMAX}_H,c,V2X}(q)]$$

where  $p_{\text{CMAX}_H,c,V2X}$  and  $p_{\text{CMAX}_H,c,E\text{-UTRA}}$  are the limits  $P_{\text{CMAX}_H,c,V2X}(q)$  and  $P_{\text{CMAX}_H,c,E\text{-UTRA}}(p)$  expressed in linear scale.

The measured total maximum output power  $P_{\text{UMAX}}$  over both the E-UTRA uplink and E-UTRA V2X carriers is

$$P_{\text{UMAX}} = 10 \log_{10} [p_{\text{UMAX},c,E\text{-UTRA}} + p_{\text{UMAX},c,V2X}],$$

where  $P_{UMAX,c,E-UTRA}$  denotes the measured output power of serving cell  $c$  for the configured E-UTRA uplink carrier, and  $P_{UMAX,c,V2X}$  denotes the measured output power for the configured E-UTRA V2X carrier expressed in linear scale.

When a UE is configured for synchronous V2X sidelink and uplink transmissions,

$$P_{CMAX\_L}(p, q) - T_{LOW}(P_{CMAX\_L}(p, q)) \leq P_{UMAX} \leq P_{CMAX\_H}(p, q) + T_{HIGH}(P_{CMAX\_H}(p, q))$$

where  $P_{CMAX\_L}(p, q)$  and  $P_{CMAX\_H}(p, q)$  are the limits for the pair  $(p, q)$  and with the tolerances  $T_{LOW}(P_{CMAX})$  and  $T_{HIGH}(P_{CMAX})$  for applicable values of  $P_{CMAX}$  specified in Table 6.2.5G-2.  $P_{CMAX\_L}$  may be modified for any overlapping portion of subframes  $(p, q)$  and  $(p+1, q+1)$ .

When a UE is configured for asynchronous V2X and uplink transmissions, the subframe  $p$  for the E-UTRA uplink carrier and subframe  $q$  for the E-UTRA V2X carrier overlap in time and

1. if uplink carrier leads in time over  $q$  and V2X UE sidelink transmission has SCI whose “Priority” field is set to a value less than the high layer parameter  $thresSL-TxPrioritization$ , then  $p$  is the reference subframe and the  $(p, q)$  and  $(p, q-1)$  pairs are considered for determining the PCMAX tolerance
2. if uplink carrier leads in time over  $q$  and V2X UE sidelink transmission has SCI whose “Priority” field is set to a value larger than the high layer parameter  $thresSL-TxPrioritization$ , then  $q$  is the reference subframe and the  $(p, q)$  and  $(p+1, q)$  pairs are considered for determining the PCMAX tolerance
3. if V2X carrier leads in time over  $p$  and V2X UE sidelink transmission has SCI whose “Priority” field is set to a value less than the high layer parameter  $thresSL-TxPrioritization$ , then  $p$  is the reference subframe and the  $(p, q)$  and  $(p, q+1)$  pairs are considered for determining the PCMAX tolerance
4. if V2X carrier leads in time over  $p$  and V2X UE sidelink transmission has SCI whose “Priority” field is set to a value larger than the high layer parameter  $thresSL-TxPrioritization$ , then  $q$  is the reference subframe and the  $(p-1, q)$  and  $(p, q)$  pairs are considered for determining the PCMAX tolerance

For the reference subframe  $p$  duration when uplink carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,c,E-UTRA}(p)$$

$$P'_{CMAX\_H} = \text{MAX}\{P_{CMAX\_H}(p, q-1), P_{CMAX\_H}(p, q)\}$$

For the reference subframe  $p$  duration when V2X carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,c,E-UTRA}(p)$$

$$P'_{CMAX\_H} = \text{MAX}\{P_{CMAX\_H}(p, q), P_{CMAX\_H}(p, q+1)\}$$

For the reference subframe  $q$  duration when uplink carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,c,E-UTRA}(q)$$

$$P'_{CMAX\_H} = \text{MAX}\{P_{CMAX\_H}(p, q), P_{CMAX\_H}(p+1, q)\}$$

For the reference subframe  $q$  duration when V2X carrier leads:

$$P'_{CMAX\_L} = P_{CMAX\_L,c,E-UTRA}(p)$$

$$P'_{CMAX\_H} = \text{MAX}\{P_{CMAX\_H}(p-1, q), P_{CMAX\_H}(p, q)\}$$

where  $P_{CMAX\_L,c,E-UTRA}(p)$  and  $P_{CMAX\_H}$  are the applicable limits for each overlapping subframe pairs above 4case with  $(p, q)$ ,  $(p, q-1)$  or  $(p, q)$ ,  $(p, q+1)$  or  $(p, q)$ ,  $(p+1, q)$  or  $(p, q)$ ,  $(p-1, q)$ . The measured total configured maximum output power  $P_{UMAX}$  shall be within the following bounds:

$$P'_{CMAX\_L} - T_{LOW}(P'_{CMAX\_L}) \leq P_{UMAX} \leq P'_{CMAX\_H} + T_{HIGH}(P'_{CMAX\_H})$$

with the tolerances  $T_{LOW}(P_{CMAX})$  and  $T_{HIGH}(P_{CMAX})$  for applicable values of  $P_{CMAX}$  specified in Table 6.2.5G-2.

For intra-band contiguous multi-carrier operation,  $MPR_c = MPR$  and  $A-MPR_c = A-MPR$  with  $MPR$  and  $A-MPR$  specified in subclause 6.2.3G and subclause 6.2.4G respectively. There is one power management term for the UE, denoted P-MPR, and  $P-MPR_c = P-MPR$ .  $P_{CMAX,c}$  is calculated under the assumption that the transmit power is increased by the same amount in dB on all component carriers.



The total configured maximum output power  $P_{\text{CMAX}}$  shall be set within the following bounds:

$$P_{\text{CMAX}_L} \leq P_{\text{CMAX}} \leq P_{\text{CMAX}_H}$$

$$P_{\text{CMAX}_L} = \text{MIN}\{10 \log_{10} \sum p_{\text{EMAX},c} - \Delta T_C, P_{\text{PowerClass}} - \text{MAX}(\text{MPR} + \text{A-MPR} + \Delta T_{\text{IB},c} + \Delta T_C + \Delta T_{\text{ProSe}}, \text{P-MPR}), P_{\text{Regulatory}}\}$$

$$P_{\text{CMAX}_H} = \text{MIN}\{10 \log_{10} \sum p_{\text{EMAX},c}, P_{\text{PowerClass}}, P_{\text{Regulatory}}\}$$

where

- $p_{\text{EMAX},c}$  is the linear value of  $P_{\text{EMAX},c}$  which is given by IE *maxTxPower* in [7];
- $P_{\text{PowerClass}}$  is the maximum UE power specified in Table 6.2.2G-1 without taking into account the tolerance specified in the Table 6.2.2G-1;
- MPR and A-MPR are specified in subclause 6.2.3G and subclause 6.2.4G respectively;
- $\Delta T_{\text{IB},c}$  is the additional tolerance for serving cell  $c$  as specified in Table 6.2.5-2;
- P-MPR is the power management term for the UE;
- $\Delta T_C$  is the highest value  $\Delta T_{C,c}$  among all serving cells  $c$  in the subframe over both timeslots.  $\Delta T_{C,c} = 1.5$  dB when NOTE 2 in Table 6.2.2-1 applies, otherwise  $\Delta T_{C,c} = 0$  dB;
- $\Delta T_{\text{ProSe}}$  applies as specified in subclause 6.2.5.
- $P_{\text{Regulatory}} = 10 - G_{\text{post connector}}$  dBm when V2X UE is within the protected zone [13] of CEN DSRC tolling system and operating in Band 47;  $P_{\text{Regulatory}} = 33 - G_{\text{post connector}}$  dBm otherwise.

NOTE: The supported post antenna connector gain  $G_{\text{post connector}}$  declared by the UE following the principle described in annex I.

**Table 6.2.5G-1:  $\Delta T_{\text{IB},c}$  for inter-band con-current V2X operation (two bands)**

| V2X con-current band Combination | E-UTRA or V2X Operating Band | $\Delta T_{\text{IB},c}$ [dB] |
|----------------------------------|------------------------------|-------------------------------|
| V2X_3-47                         | 3                            | 0.0                           |
| V2X_5-47                         | 5                            | 0.2                           |
| V2X_7-47                         | 7                            | 0.0                           |
| V2X_8-47                         | 8                            | 0.0                           |
| V2X_20-47                        | 20                           | 0.2                           |
| V2X_28A-47A                      | 28                           | 0.2                           |
| V2X_34-47                        | 34                           | 0.0                           |
| V2X_39-47                        | 39                           | 0.0                           |
| V2X_41-47                        | 41                           | 0.0                           |
| V2X_71A-47A                      | 71                           | 0.0                           |

For V2X UE supporting Transmit Diversity, the transmitted power is configured per each UE.

If the UE transmits on two antenna connectors at the same time, the tolerance is specified in Table 6.2.5G-2 and 6.2.5G-3 for PC2 and PC3 V2X UE respectively.

**Table 6.2.5G-2:  $P_{\text{CMAX},c}$  tolerance in Transmit Diversity scheme for PC2 V2X UE**

| $P_{\text{CMAX},c}$ (dBm)        | Tolerance $T_{\text{LOW}}(P_{\text{CMAX}_L,c})$ (dB) | Tolerance $T_{\text{HIGH}}(P_{\text{CMAX}_H,c})$ (dB) |
|----------------------------------|--|---|
| $P_{\text{CMAX},c} \geq 26$      | 3.0  | 2.0   |
| $23 \leq P_{\text{CMAX},c} < 26$ | 4.0  | 2.0   |
| $22 \leq P_{\text{CMAX},c} < 23$ | 5.0  | 2.0   |
| $21 \leq P_{\text{CMAX},c} < 22$ | 5.0  | 3.0   |
| $20 \leq P_{\text{CMAX},c} < 21$ | 6.0  | 4.0   |

|                                   |     |
|-----------------------------------|-----|
| $16 \leq P_{\text{CMAX},c} < 20$  | 5.0 |
| $11 \leq P_{\text{CMAX},c} < 16$  | 6.0 |
| $-30 \leq P_{\text{CMAX},c} < 11$ | 7.0 |

**Table 6.2.5G-3:  $P_{\text{CMAX},c}$  tolerance in Transmit Diversity scheme for PC3 V2X UE**

| $P_{\text{CMAX},c}$<br>(dBm)      | Tolerance<br>$T_{\text{LOW}}(P_{\text{CMAX},L,c})$ (dB) | Tolerance<br>$T_{\text{HIGH}}(P_{\text{CMAX},H,c})$ (dB) |
|-----------------------------------|---|--|
| $P_{\text{CMAX},c} = 23$          | 3.0   | 2.0  |
| $22 \leq P_{\text{CMAX},c} < 23$  | 5.0   | 2.0  |
| $21 \leq P_{\text{CMAX},c} < 22$  | 5.0   | 3.0  |
| $20 \leq P_{\text{CMAX},c} < 21$  | 6.0   | 4.0  |
| $16 \leq P_{\text{CMAX},c} < 20$  | 5.0   |  |
| $11 \leq P_{\text{CMAX},c} < 16$  | 6.0   |  |
| $-40 \leq P_{\text{CMAX},c} < 11$ | 7.0   |  |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2.5-1 apply to the active antenna connector.

## 6.3 Output power dynamics

### 6.3.1 (Void)

### 6.3.2 Minimum output power

The minimum controlled output power of the UE is defined as the broadband transmit power of the UE, i.e. the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

#### 6.3.2.1 Minimum requirement

The minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2.1-1.

**Table 6.3.2.1-1: Minimum output power**

|                       | Channel bandwidth / Minimum output power / Measurement bandwidth |         |         |         |          |        |
|-----------------------|--|---------|---------|---------|----------|--------|
|                       | 1.4 MHz  | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Minimum output power  | -40 dBm  |         |         |         |          |        |
| Measurement bandwidth | 1.08 MHz   | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

### 6.3.2A UE Minimum output power for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands and intra-band contiguous and non-contiguous carrier aggregation, the minimum controlled output power of the UE is defined as the transmit power of the UE per component carrier, i.e., the power in the channel bandwidth of each component carrier for all transmit bandwidth configurations (resource blocks), when the power on both component carriers are set to a minimum value.

#### 6.3.2A.1 Minimum requirement for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the minimum output power is defined per carrier and the requirement is specified in subclause 6.3.2.1. If two contiguous component carriers are assigned to one E-UTRA band, the requirements in subclause 6.3.2A.1 apply for those component carriers.

For intra-band contiguous and non-contiguous carrier aggregation the minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2A.1-1.

**Table 6.3.2A.1-1: Minimum output power for intra-band contiguous and non-contiguous CA UE**

|                       | CC Channel bandwidth / Minimum output power / Measurement bandwidth |         |         |         |          |        |
|-----------------------|---|---------|---------|---------|----------|--------|
|                       | 1.4 MHz   | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Minimum output power  | -40 dBm   |         |         |         |          |        |
| Measurement bandwidth |   |         | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

## 6.3.2B UE Minimum output power for UL-MIMO

For UE supporting UL-MIMO, the minimum controlled output power is defined as the broadband transmit power of the UE, i.e. the sum of the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks) at each transmit antenna connector, when the UE power is set to a minimum value.

### 6.3.2B.1 Minimum requirement

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2B.1-1.

**Table 6.3.2B.1-1: Minimum output power**

|                       | Channel bandwidth / Minimum output power / Measurement bandwidth |         |         |         |          |        |
|-----------------------|--|---------|---------|---------|----------|--------|
|                       | 1.4 MHz  | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Minimum output power  | -40 dBm  |         |         |         |          |        |
| Measurement bandwidth | 1.08 MHz   | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.2 apply.

### 6.3.2C Void

<reserved for future use>

### 6.3.2D UE Minimum output power for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the requirements in subclause 6.3.2 apply for ProSe transmission.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.3.2A apply as specified for the corresponding inter-band aggregation with uplink assigned to two bands.

### 6.3.2F UE Minimum output power for category NB1 and NB2

For category NB1 and NB2 UE the single-tone and multi-tone transmission minimum output power requirement for the channel bandwidth is -40 dBm. For 3.75kHz sub-carrier spacing the minimum output power is defined as mean power in one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15kHz sub-carrier spacing the minimum output power is defined as mean power in one sub-frame (1ms).

## 6.3.2G UE Minimum output power for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the minimum output power shall not exceed the values specified in Table 6.3.2G-1.

**Table 6.3.2G-1: Minimum output power**

|                       | Channel bandwidth / Minimum output power / Measurement bandwidth |         |       |         |        |        |
|-----------------------|--|---------|-------|---------|--------|--------|
|                       | 1.4 MHz  | 3.0 MHz | 5 MHz | 10 MHz  | 15 MHz | 20 MHz |
| Minimum output power  | -30 dBm  |         |       |         |        |        |
| Measurement bandwidth |  |         |       | 9.0 MHz |        | 18 MHz |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements specified in subclause 6.3.2 shall apply for the uplink and the requirements specified in subclause 6.3.2G shall apply for the sidelink.

For intra-band contiguous E-UTRA V2X multiple carrier transmissions, the requirements specified in subclause 6.3.2G shall apply for each sidelink carrier.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified for single carrier.

If the UE transmits on a one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

## 6.3.3 Transmit OFF power

Transmit OFF power is defined as the mean power when the transmitter is OFF. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the UE is not considered to be OFF.

### 6.3.3.1. Minimum requirement

The transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power shall not exceed the values specified in Table 6.3.3.1-1.

**Table 6.3.3.1-1: Transmit OFF power**

|                       | Channel bandwidth / Transmit OFF power / Measurement bandwidth |         |         |         |          |        |
|-----------------------|--|---------|---------|---------|----------|--------|
|                       | 1.4 MHz  | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Transmit OFF power    | -50 dBm  |         |         |         |          |        |
| Measurement bandwidth | 1.08 MHz   | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

## 6.3.3A UE Transmit OFF power for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands and intra-band contiguous and non-contiguous carrier aggregation, transmit OFF power is defined as the mean power per component carrier when the transmitter is OFF on all component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During measurements gaps, the UE is not considered to be OFF.

### 6.3.3A.1 Minimum requirement for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, transmit OFF power requirement is defined per carrier and the requirement is specified in subclause 6.3.3.1. If two contiguous component carriers are assigned to one E-UTRA band, the requirements in subclause 6.3.3A.1 apply for those component carriers.

For intra-band contiguous and non-contiguous carrier aggregation the transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power shall not exceed the values specified in Table 6.3.3A.1-1.

**Table 6.3.3A.1-1: Transmit OFF power for intra-band contiguous and non-contiguous CA UE**

|                       | CC Channel bandwidth / Transmit OFF power / Measurement bandwidth |         |         |         |          |        |
|-----------------------|---|---------|---------|---------|----------|--------|
|                       | 1.4 MHz   | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Transmit OFF power    | -50 dBm   |         |         |         |          |        |
| Measurement bandwidth |   |         | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

### 6.3.3B UE Transmit OFF power for UL-MIMO

For UE supporting UL-MIMO, the transmit OFF power is defined as the mean power at each transmit antenna connector when the transmitter is OFF at all transmit antenna connectors. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the UE is not considered to be OFF.

#### 6.3.3B.1 Minimum requirement

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3.3B.1-1.

**Table 6.3.3B.1-1: Transmit OFF power per antenna port**

|                       | Channel bandwidth / Transmit OFF power/ Measurement bandwidth |         |         |         |          |        |
|-----------------------|---|---------|---------|---------|----------|--------|
|                       | 1.4 MHz   | 3.0 MHz | 5 MHz   | 10 MHz  | 15 MHz   | 20 MHz |
| Transmit OFF power    | -50 dBm   |         |         |         |          |        |
| Measurement bandwidth | 1.08 MHz  | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

### 6.3.3D Transmit OFF power for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the ProSe UE shall meet the Transmit OFF power at all times when the UE is not associated with a serving cell on the ProSe carrier and does not have knowledge of its geographical area or is provisioned with pre-configured radio parameters that are not associated with any known Geographical Area.

The requirements specified in subclause 6.3.3 shall apply to UE supporting ProSe when

- the UE is associated with a serving cell on the ProSe carrier, or
- the UE is not associated with a serving cell on the ProSe carrier and is provisioned with the preconfigured radio parameters for ProSe Direct Communications and/or ProSe Direct Discovery that are associated with known Geographical Area, or

- the UE is associated with a serving cell on a carrier different than the ProSe carrier, and the radio parameters for ProSe Direct Discovery on the ProSe carrier are provided by the serving cell, or
- the UE is associated with a serving cell on a carrier different than the ProSe carrier, and has a non-serving cell selected on the ProSe carrier that supports ProSe Direct Discovery and/or ProSe Direct Communication.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, transmit OFF power is defined as the mean power per component carrier when the transmitter is OFF on all component carriers. During measurement gaps and transmission/reception gaps for ProSe, the UE is not considered to be OFF. Transmit OFF power requirement as specified in subclause 6.3.3 apply per carrier.

### 6.3.3F Transmit OFF power for category NB1 and NB2

For category NB1 and NB2 UE the transmit OFF power requirement for the channel bandwidth is -50 dBm. For 3.75kHz sub-carrier spacing the transmit OFF power is defined as mean power in one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15kHz sub-carrier spacing the transmit OFF power is defined as mean power in one sub-frame (1ms).

### 6.3.3G Transmit OFF power for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the V2X UE shall meet the Transmit OFF power in subclause 6.3.3D.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.3.3A apply for as specified for the corresponding inter-band con-current operation with uplink assigned to two bands.

For intra-band contiguous E-UTRA V2X multiple carrier transmissions, the requirements in subclause 6.3.3A apply as specified for the corresponding intra band contiguous carrier aggregation.

The transmit OFF power is defined as the mean power at each transmit antenna connector.

The transmit OFF power at each transmit antenna connector shall not exceed the values specified for single carrier.

## 6.3.4 ON/OFF time mask

### 6.3.4.1 General ON/OFF time mask

The General ON/OFF time mask defines the observation period between Transmit OFF and ON power and between Transmit ON and OFF power. ON/OFF scenarios include; the beginning or end of DTX, measurement gap, contiguous, and non contiguous transmission

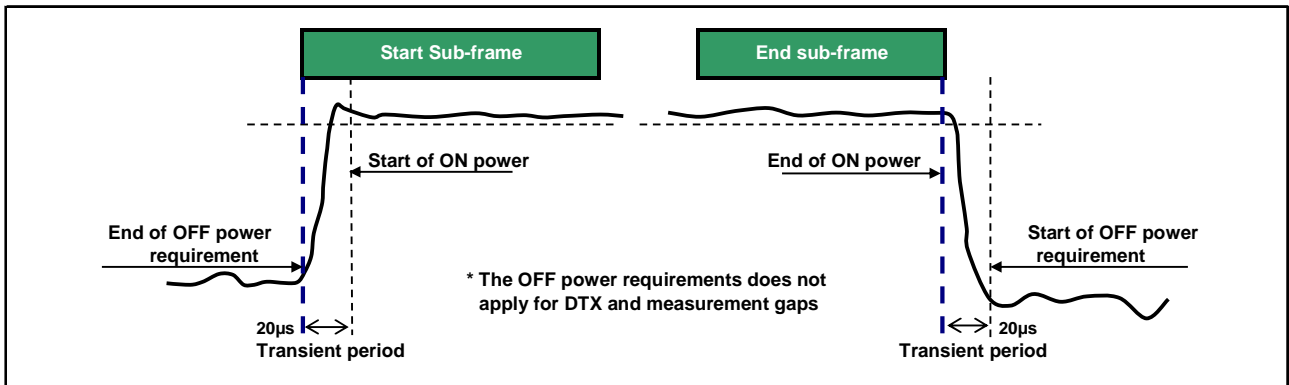
The OFF power measurement period is defined in a duration of at least one subframe, or one slot or one subslot for sTTI, excluding any transient periods. The ON power is defined as the mean power over one subframe, or one slot or one subslot for sTTI, excluding any transient period.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

The transient period length shall be no longer than the specified value in Table 6.3.4.1-1.

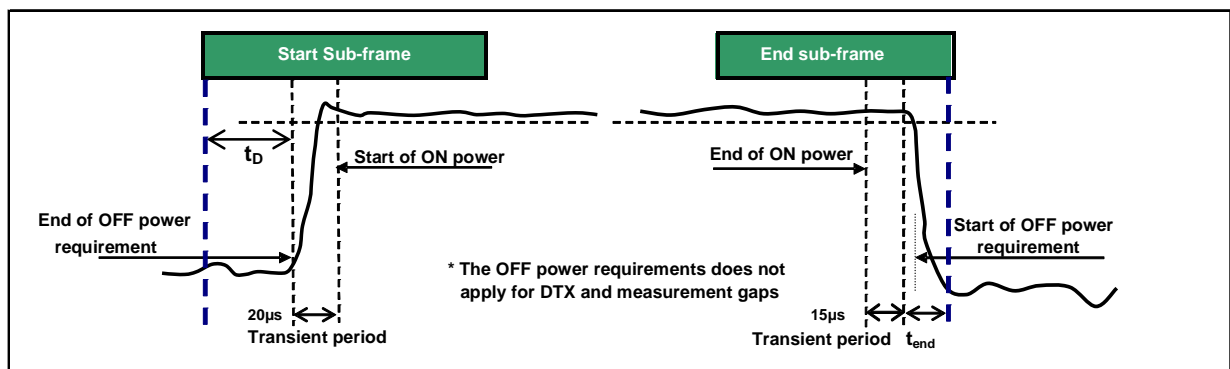
**Table 6.3.4.1-1: Transient period length depending on transmission length**

| TTI pattern  | Channel BW (MHz) | TTI Duration | Transient period length (μs) |
|--------------|------------------|--------------|------------------------------|
| Subframe TTI |                  | 1ms          | 20                           |
| Slot TTI     | 1.4              | 1 slot       | 20                           |
|              | > 1.4            | 1 slot       | 10                           |
| Subslot TTI  | 1.4              | 2os or 3 os  | 20                           |
|              | > 1.4            | 2os or 3 os  | 10                           |

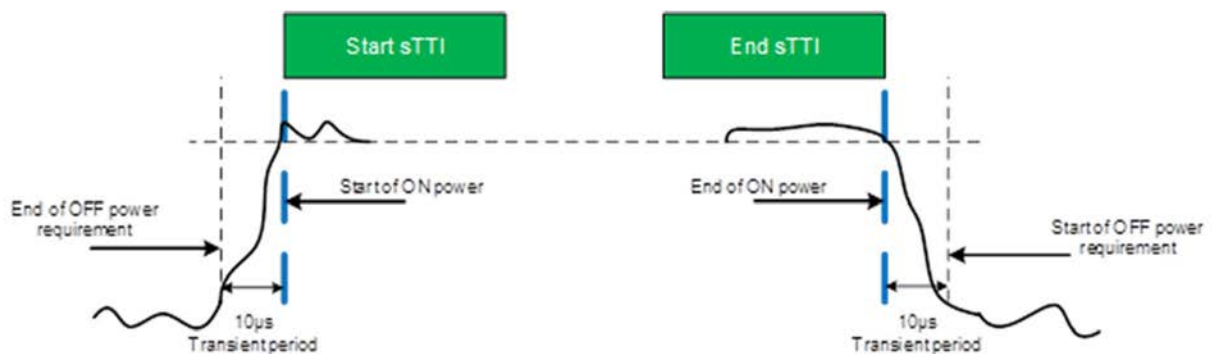


**Figure 6.3.4.1-1: General ON/OFF time mask for subframe TTI and for Frame Structure Type 1 and Frame Structure Type 2**

For Frame Structure Type 3 the general ON/OFF mask is specified in 6.3.4.1-1A with the PUSCH starting position modified by  $t_D = N_{start}^{FS3} T_s$  relative to the start of the sub-frame as indicated in the associated DCI, where  $N_{start}^{FS3}$  and the basic time unit  $T_s$  are specified in [4]. At the end of the sub-frame  $t_{end} = 0$  and  $t_{end} = T_{symp}$  with  $T_{symp}$  denoting the duration of the last SC-FDMA symbol when the bit indicating the PUSCH ending symbol in the associated DCI has value '0' and '1' as specified in [5], respectively; the OFF power requirement applies 5 µs after the end of the last symbol transmitted.



**Figure 6.3.4.1-1A: General ON/OFF time mask for subframe TTI and for Frame Structure Type 3**



**Figure 6.3.4.1-1B: General ON/OFF time mask for sTTI and for Frame Structure Type 1 and Frame Structure Type 2**

### 6.3.4.2 PRACH and SRS time mask

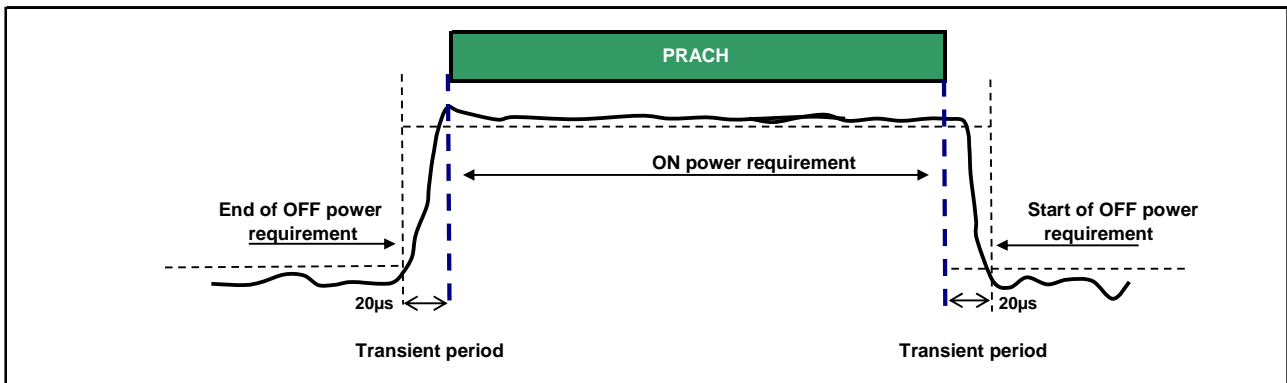
#### 6.3.4.2.1 PRACH time mask

The PRACH ON power is specified as the mean power over the PRACH measurement period excluding any transient periods as shown in Figure 6.3.4.2-1. The measurement period for different PRACH preamble format is specified in Table 6.3.4.2-1.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

**Table 6.3.4.2-1: PRACH ON power measurement period**

| PRACH preamble format | Measurement period (ms) |
|-----------------------|-------------------------|
| 0                     | 0.9031                  |
| 1                     | 1.4844                  |
| 2                     | 1.8031                  |
| 3                     | 2.2844                  |
| 4                     | 0.1479                  |



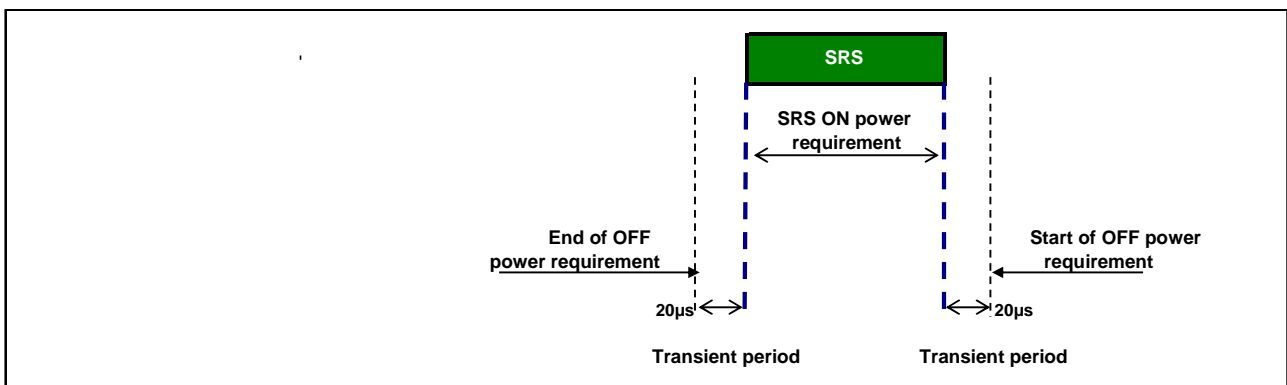
**Figure 6.3.4.2-1: PRACH ON/OFF time mask**

#### 6.3.4.2.2 SRS time mask

In the case a single SRS transmission, the ON power is defined as the mean power over the symbol duration excluding any transient period; Figure 6.3.4.2.2-1 and Figure 6.3.4.2.2-1A.

In the case a dual SRS transmission, the ON power is defined as the mean power for each symbol duration excluding any transient period. Figure 6.3.4.2.2-2

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3



**Figure 6.3.4.2.2-1: Single SRS time mask for Frame Structure Type 1 and Frame Structure Type 2**



For Frame Structure Type 3 and single SRS transmission, the SRS time mask is specified in 6.3.4.2-2A; the OFF power requirement applies [5]  $\mu$ s after the end of the SRS symbol.

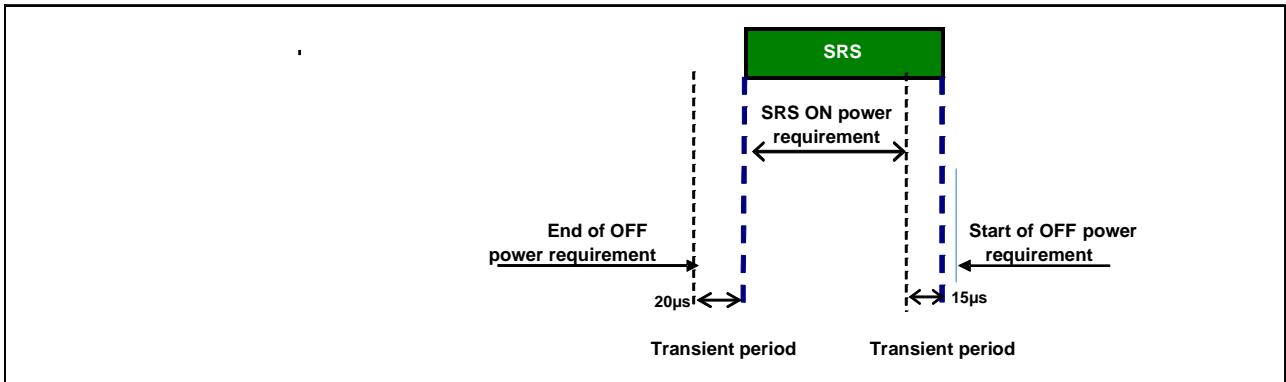


Figure 6.3.4.2-1A: Single SRS time mask for Frame Structure Type 3

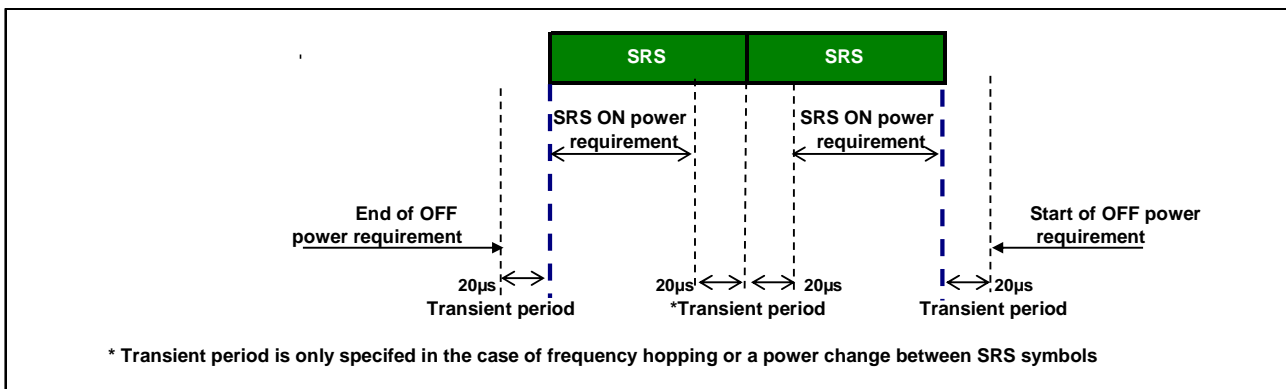


Figure 6.3.4.2-2: Dual SRS time mask for the case of UpPTS transmissions

For SRS transmission mapped to two or more OFDM symbols the ON power is defined as the mean power for each symbol duration excluding any transient period. For consecutive SRS transmissions without power change, Figure 6.3.4.2.2-3 applies.

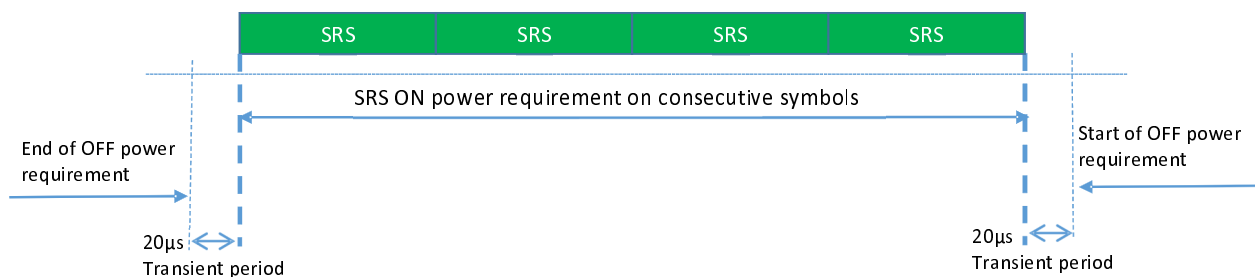


Figure 6.3.4.2-3: Consecutive SRS time mask for the case when no power change is required

When power change between consecutive SRS transmissions is required, then Figure 6.3.4.2.2-4 and Figure 6.3.4.2.2-5 apply.

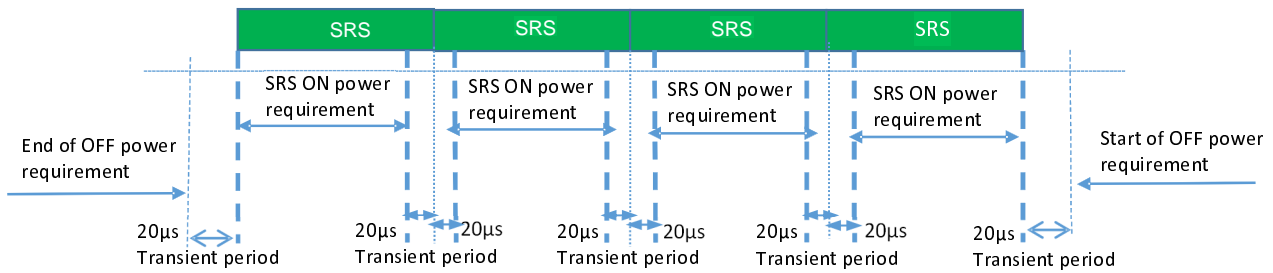


Figure 6.3.4.2.2-4: Consecutive SRS time mask for the case when power change is required

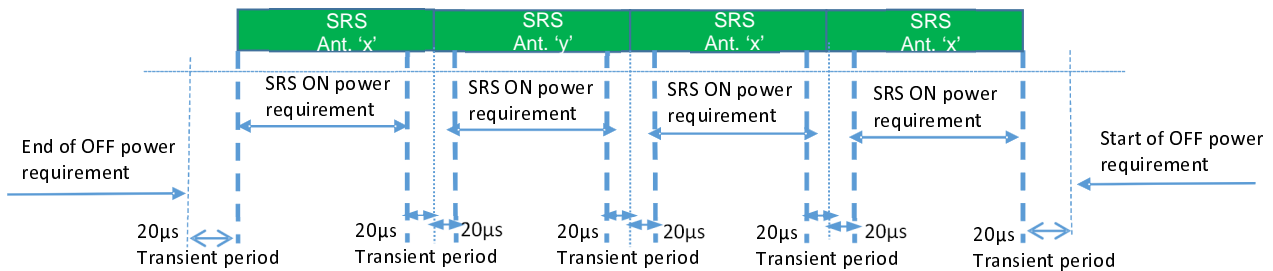


Figure 6.3.4.2.2-5: Time mask for SRS antenna switching

The above transient period applies to all the transmit CCs in CA with the CC sounding SRS. UE RF requirements do not apply during this transient period.

### 6.3.4.3 Slot / Sub frame boundary time mask for subframe TTI

The sub frame boundary time mask defines the observation period between the previous/subsequent sub-frame and the (reference) sub-frame. A transient period at a slot boundary within a sub-frame is only allowed in the case of Intra-sub frame frequency hopping. For the cases when the subframe contains SRS the time masks in subclause 6.3.4.4 apply.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

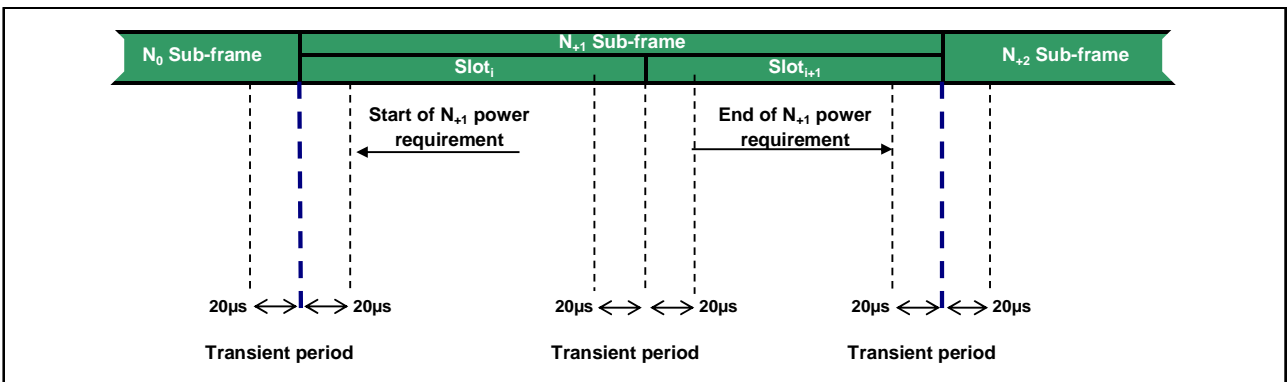
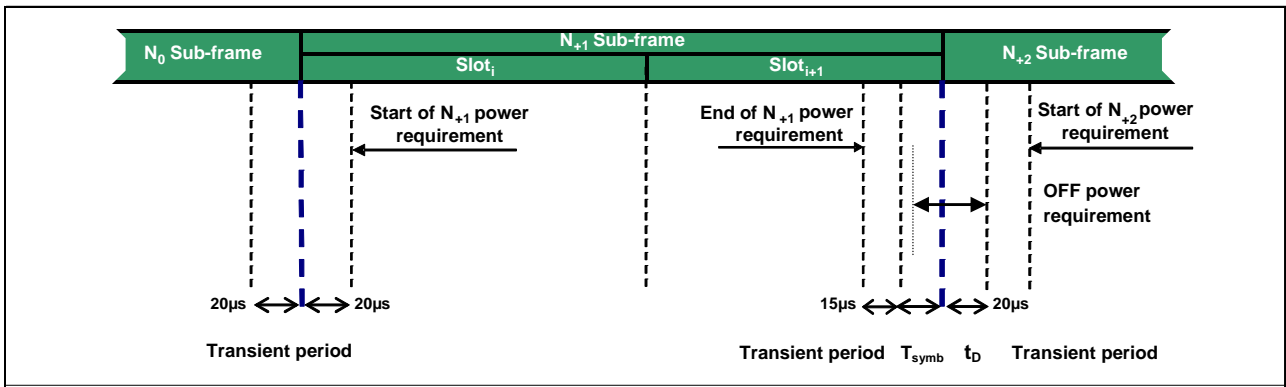


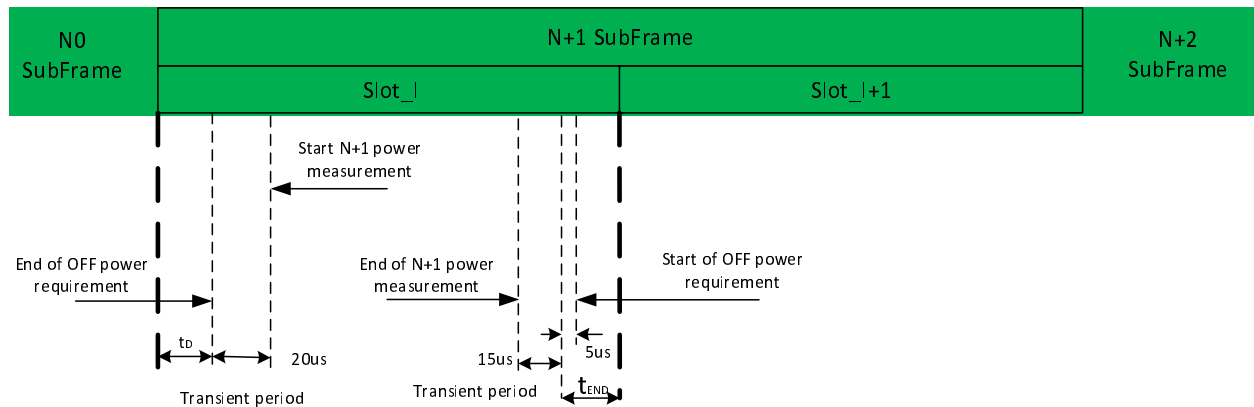
Figure 6.3.4.3-1: Transmission power template for Frame Structure Type 1 and Frame Structure Type 2

For Frame Structure Type 3 the sub-frame boundary time mask is specified in Figure 6.3.4.3-1A when the bit indicating the PUSCH ending symbol in the associated DCI has value ‘1’ and the PUSCH starting position is modified by  $t_D$  in the following subframe (clause 6.3.4.1);  $T_{symbol}$  denotes the duration of the ending SC-FDMA symbol. the OFF power requirement applies 5 µs after the end of the last symbol transmitted.



**Figure 6.3.4.3-1A: Transmission power template when the bit in the associated DCI indicating the PUSCH ending symbol has value ‘1’ for Frame Structure Type 3**

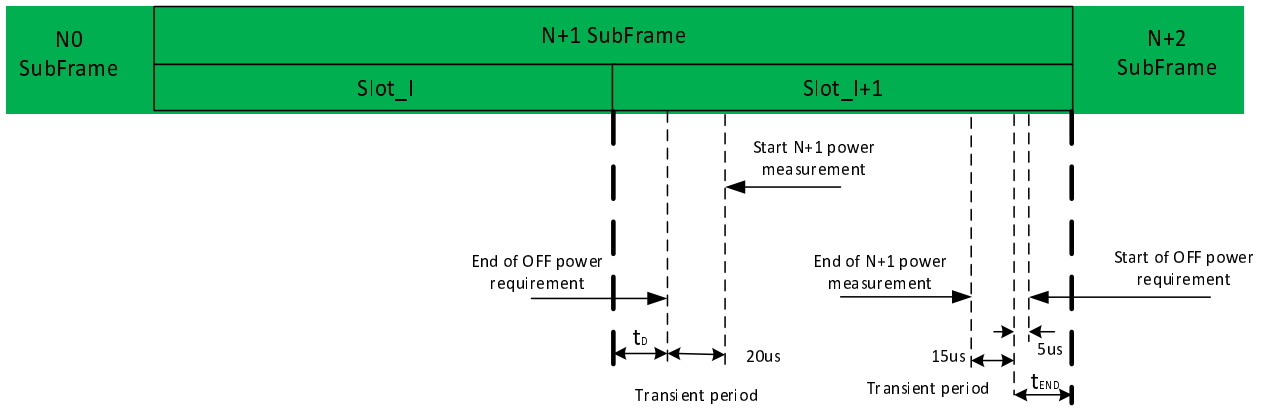
For Frame Structure Type 3 the first slot boundary time mask is specified in Figure 6.3.4.3-1B when the PUSCH mode is 3 indicated in DCI [4]. The PUSCH starting position modified by  $t_D = N_{start}^{FS3} T_s$  relative to the start of the sub-frame as indicated in the associated DCI, where  $N_{start}^{FS3}$  and the basic time unit  $T_s$  are specified in TS 36.211 [4]. At the end of the first slot  $t_{end} = 3 \cdot T_{symp}$  or  $t_{end} = 0$  with  $T_{symp}$  denoting the duration of one SC-FDMA symbol when the bit indicating the PUSCH ending symbol in the associated DCI is either fourth or seventh symbol as specified in TS 36.212 [5], respectively; the OFF power requirement applies 5 µs after the end of the last symbol transmitted.



**Figure 6.3.4.3-1B: Transmission power template for the first slot in one subframe for Frame Structure Type 3**

For Frame Structure Type 3 the second slot boundary time mask is specified in Figure 6.3.4.3-1C when the PUSCH mode is 2 indicated in DCI [4]. The PUSCH starting position modified by  $t_D = N_{start}^{FS3} T_s$  relative to the start of the second slot as indicated in the associated DCI, where  $N_{start}^{FS3}$  and the basic time unit  $T_s$  are specified in TS 36.211 [4]. At the end of the second slot  $t_{end} = T_{symp}$  or  $t_{end} = 0$  with  $T_{symp}$  denoting the duration of one SC-FDMA symbol when the bit indicating the PUSCH ending symbol in the associated DCI is either thirteenth or fourteenth symbol as specified in TS 36.212 [5], respectively; the OFF power requirement applies 5 µs after the end of the last symbol transmitted.

For Frame Structure Type 3 the second slot boundary time mask specified in Figure 6.3.4.3-1C can also be applied when the PUSCH mode is 1 indicated in DCI [4] and transmission starts at the eighth symbol. The PUSCH starting position  $t_D = 0$  relative to the start of the second slot. At the end of the second slot  $t_{end} = T_{symp}$  or  $t_{end} = 0$  with  $T_{symp}$  denoting the duration of one SC-FDMA symbol when the bit indicating the PUSCH ending symbol in the associated DCI is either thirteenth or fourteenth symbol as specified in TS 36.212 [5], respectively; the OFF power requirement applies 5 µs after the end of the last symbol transmitted.

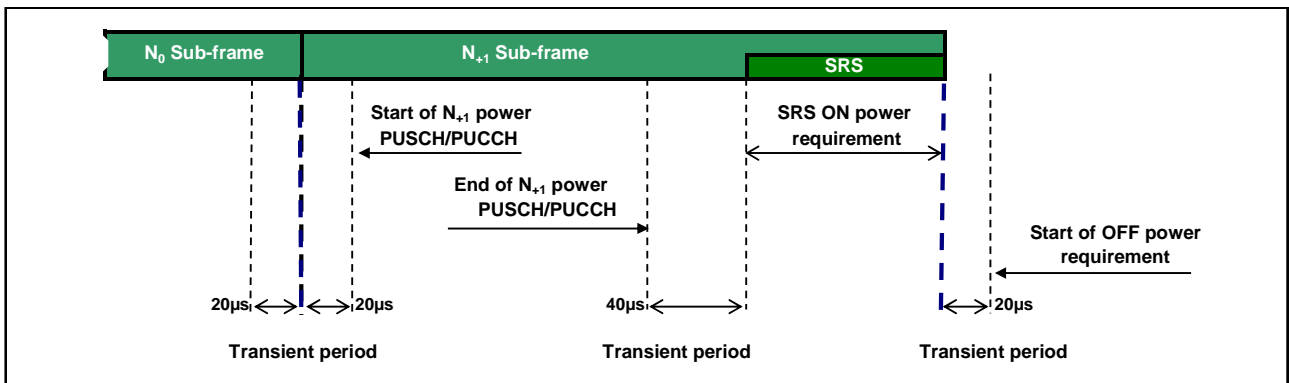


**Figure 6.3.4.3-1C: Transmission power template for the second slot in one subframe for Frame Structure Type 3**

6.3.4.4 PUCCH / PUSCH / SRS time mask for subframe TTI

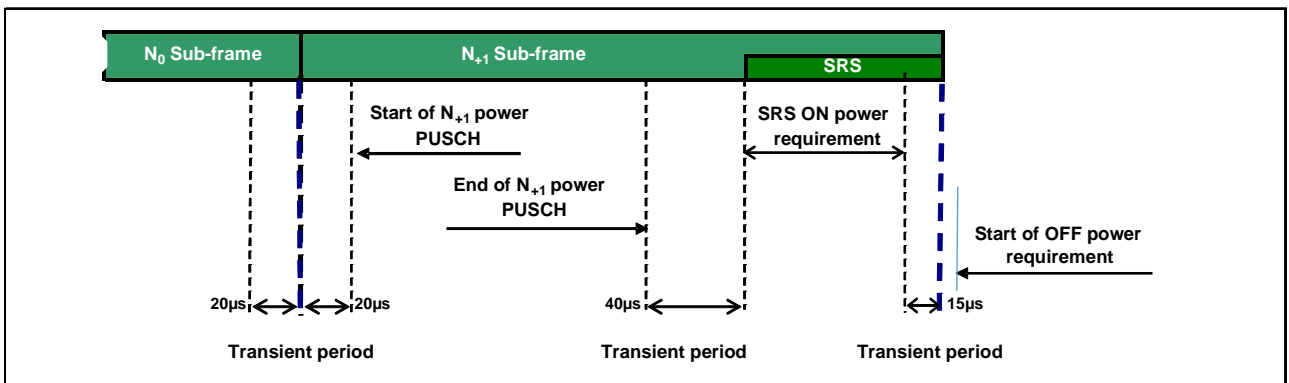
The PUCCH/PUSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) and an adjacent PUSCH/PUCCH symbol and subsequent sub-frame. The time masks apply for all types of frame structures and their allowed PUCCH/PUSCH/SRS transmissions unless otherwise stated.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3



**Figure 6.3.4.4-1: PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after for Frame Structure Type 1 and Frame Structure Type 2**

For Frame Structure Type 3 the PUSCH/SRS time mask when there is a transmission before SRS but not after is specified in Figure 6.3.4.4-1A; the OFF power requirement applies 5 μs after the end of the last symbol transmitted.



**Figure 6.3.4.4-1A: PUSCH/SRS time mask when there is a transmission before SRS but not after for Frame Structure Type 3**

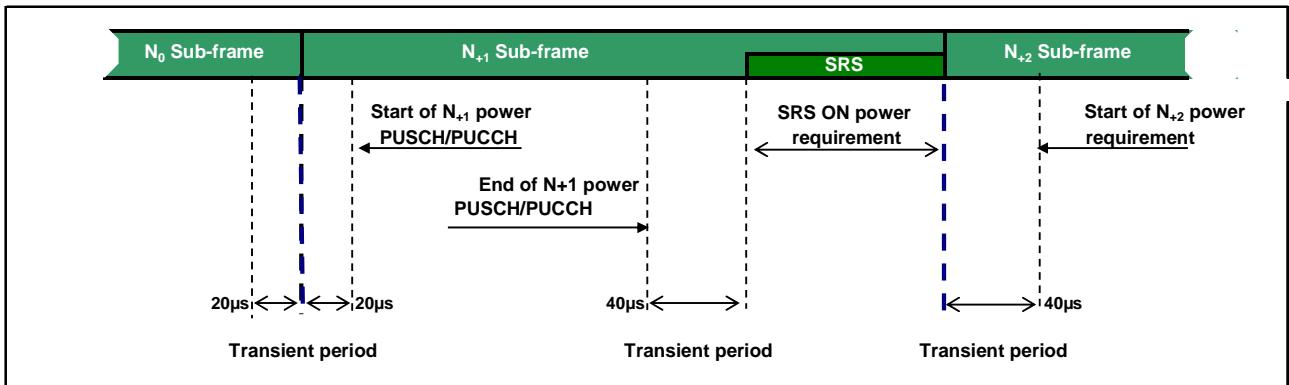


Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS

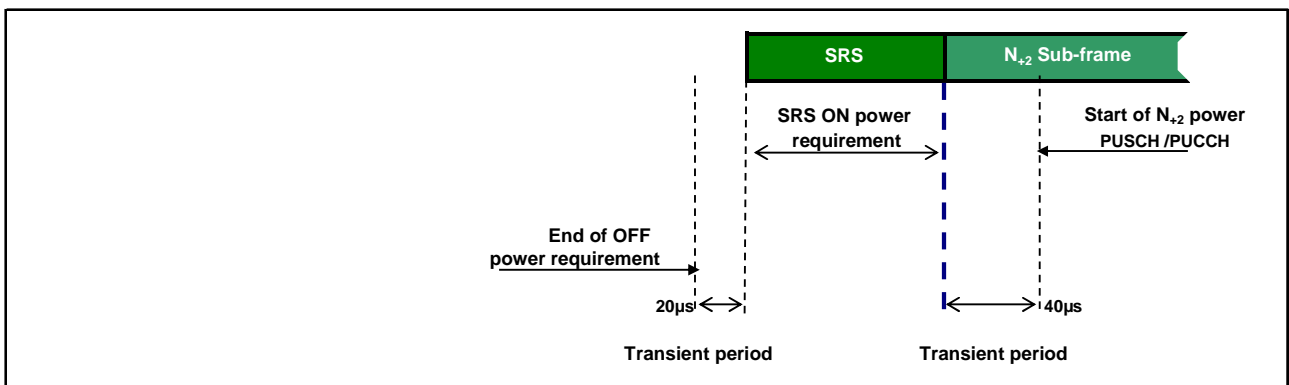


Figure 6.3.4.4-3: PUCCH/PUSCH/SRS time mask when there is a transmission after SRS but not before

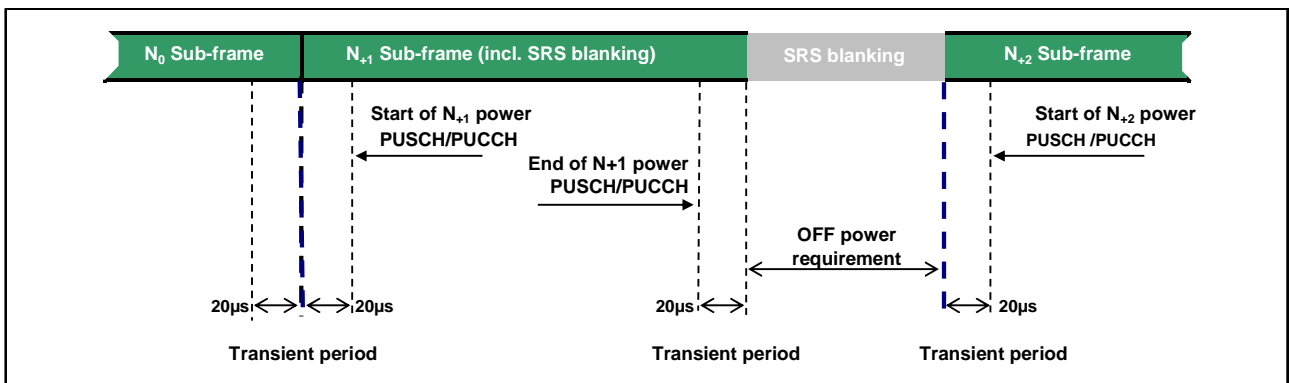


Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking for Frame Structure Type 1 and Frame Structure Type 2

For Frame Structure Type 3 the PUSCH/SRS time mask with transmission after the SRS symbol and the PUSCH starting position modified by  $t_D$  in the following subframe (clause 6.3.4.1) is specified in Figure 6.3.4.4-4A when there is SRS blanking.

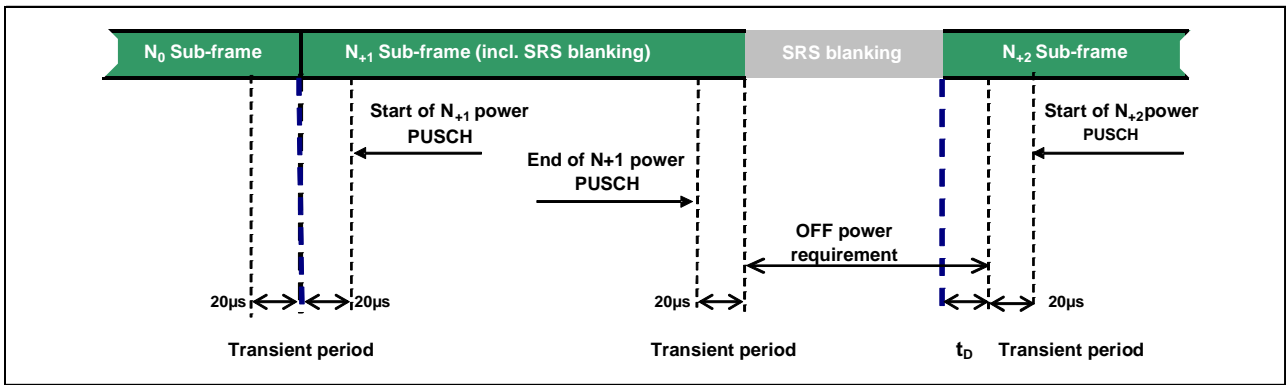


Figure 6.3.4.4-4A: SRS time mask when there is SRS blanking for Frame Structure Type 3

### 6.3.4.5 Symbol / Subslot boundary time mask for subslot TTI

The subslot boundary time mask defines the observation period between the previous/subsequent subslot and the (reference) subslot. A transient period at a symbol boundary within a subslot is only allowed in the case of Intra-subslot frequency hopping. For the cases when the subslot contains SRS the time masks in subclause 6.3.4.6 apply.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

Following time masks requirements shall be applied:

- the transient period shall be equally shared between two consecutive Reference symbols or Data symbols (figure 6.3.4.5-1 and figure 6.3.4.5-4).
- Otherwise, the transient period shall be placed in the Reference symbol (figure 6.3.4.5-2 and figure 6.3.4.5-3).

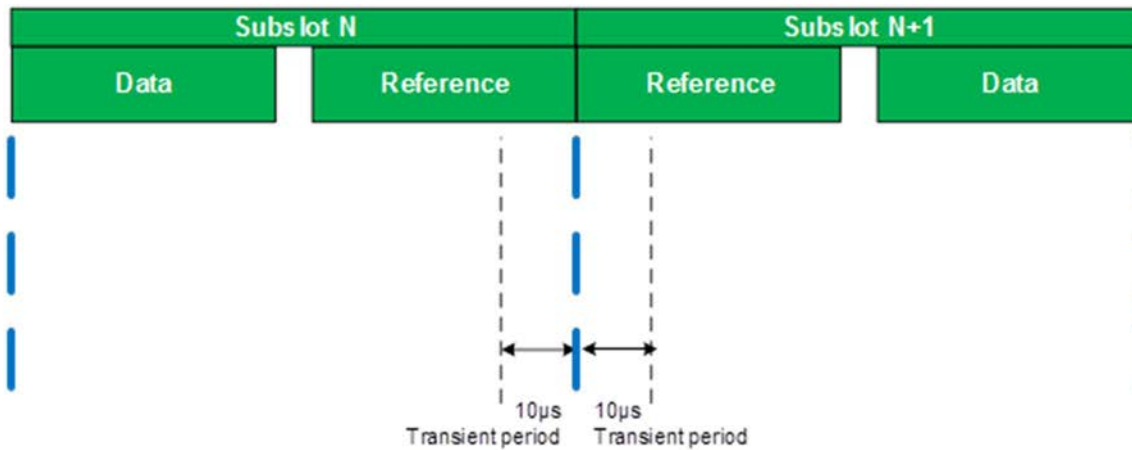


Figure 6.3.4.5-1: Transmission power template for subslot TTI – transient period shared

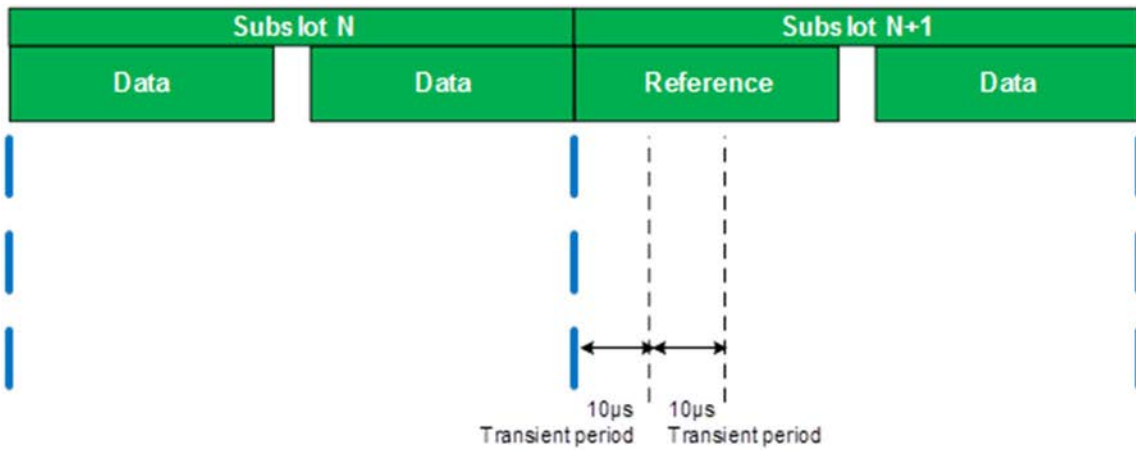


Figure 6.3.4.5-2: Transmission power template for subslot TTI – transient period not shared

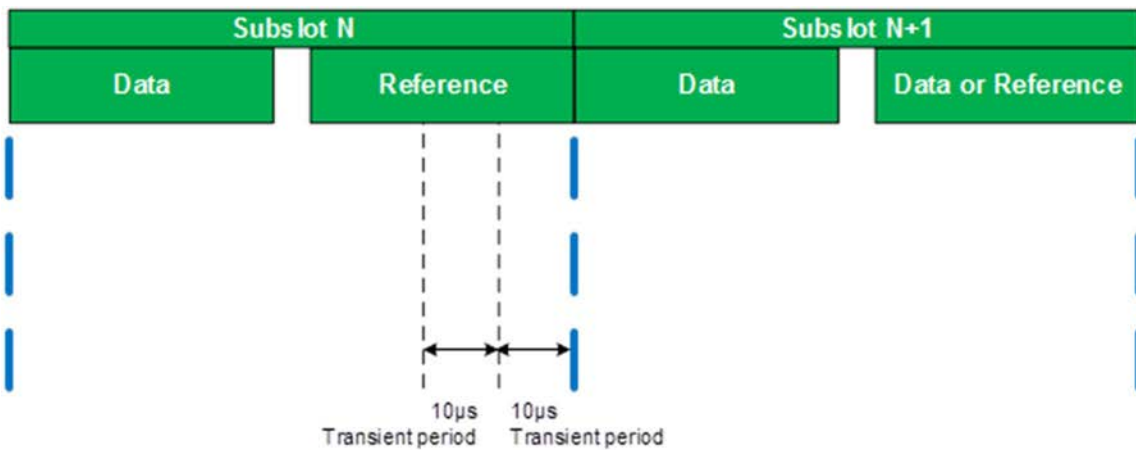


Figure 6.3.4.5-3: Transmission power template for subslot TTI – transient period not shared

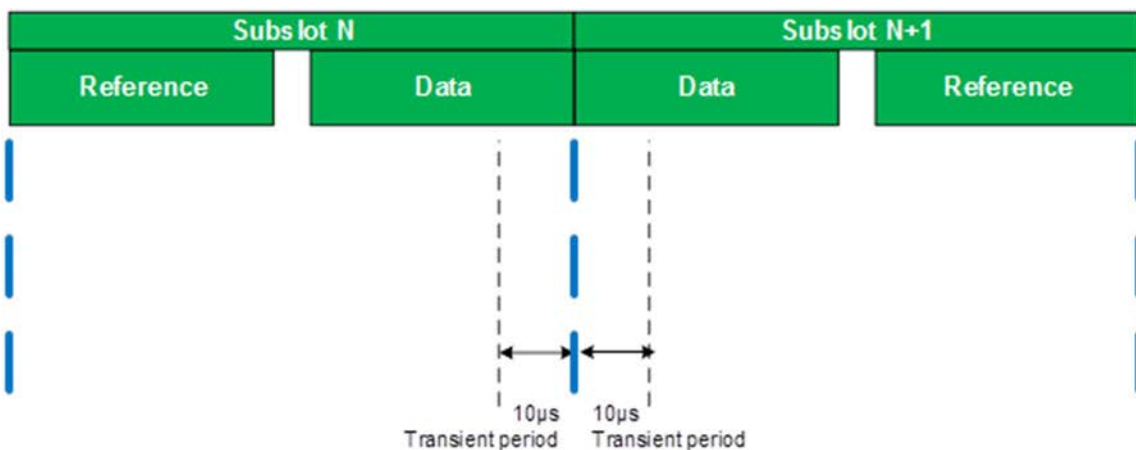


Figure 6.3.4.5-4: Transmission power template for subslot TTI – transient period shared

### 6.3.4.6 Subslot PUCCH / subslot PUSCH / SRS time mask for subslot TTI

The subslot PUCCH/subslot PUSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) in the last symbol in subslot N and an adjacent subslot PUSCH/subslot PUCCH symbol in subslot N+1.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

Following time masks requirement shall be applied when SRS is either transmitted or blanked:

- the transient period shall be placed in Reference symbol when the transient is in between Reference symbol and SRS (figure 6.3.4.6-1, figure 6.3.4.6-2, figure 6.3.4.6-5 and figure 6.3.4.6-7).
- the transient period shall be equally shared when the transient is in between Data symbol and SRS (figure 6.3.4.6-3 and figure 6.3.4.6-4).

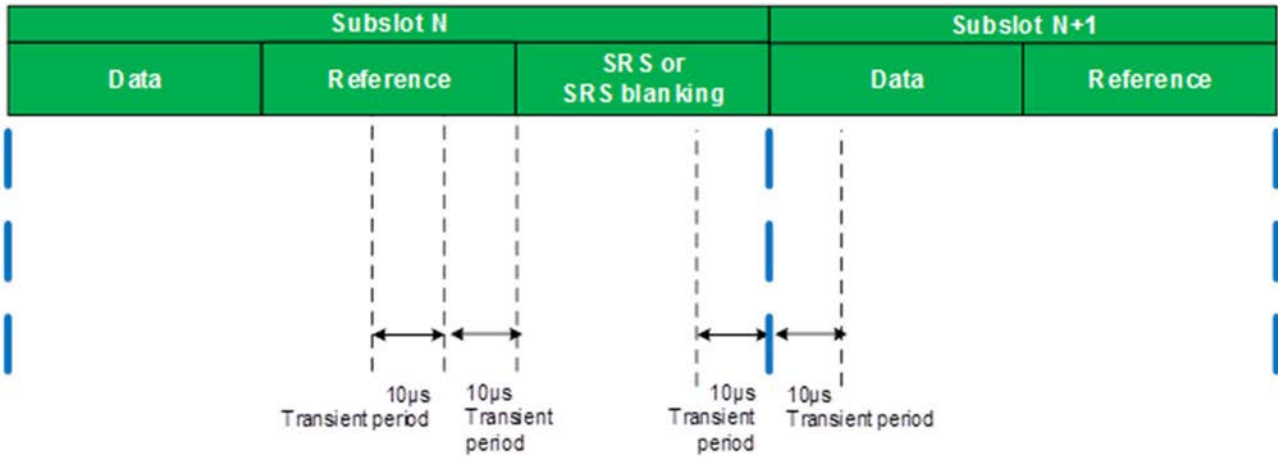


Figure 6.3.4.6-1: subslot PUSCH/SRS time mask when there is a Reference symbol before SRS (or SRS blanking) and data symbol after

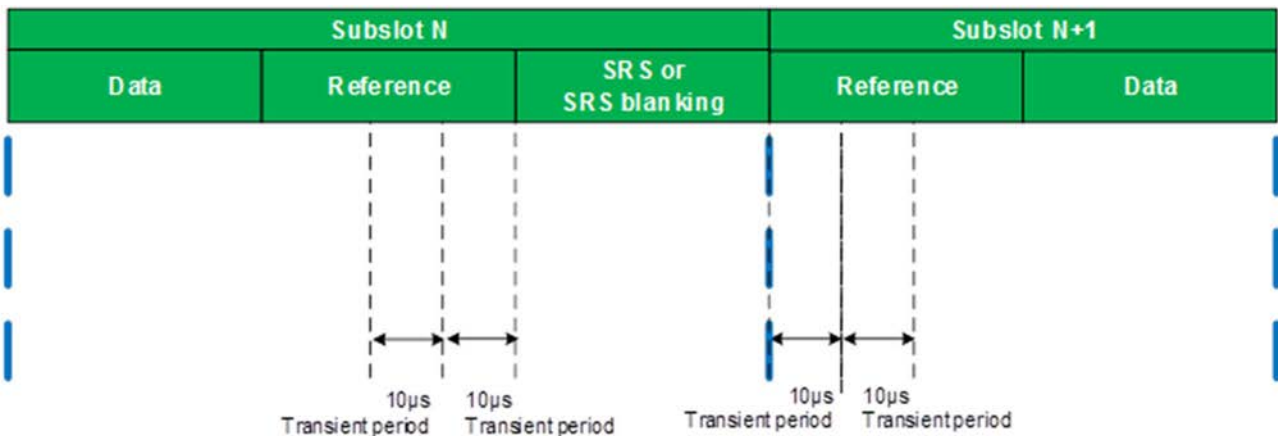


Figure 6.3.4.6-2: subslot PUSCH/SRS time mask when there is a Reference symbol before SRS (or SRS blanking) and Reference symbol after



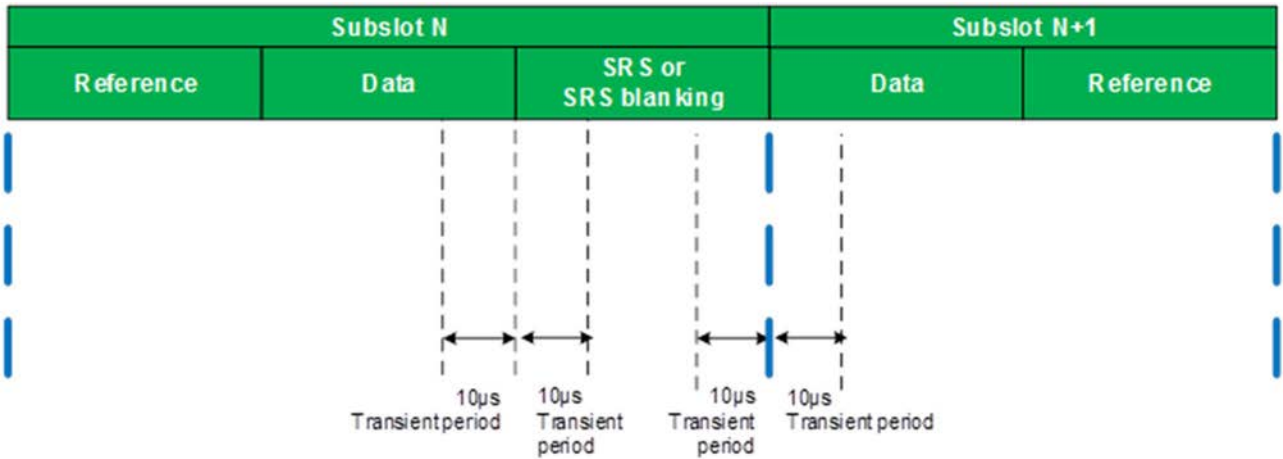


Figure 6.3.4.6-3: subslot PUSCH/SRS time mask when there is a data symbol before SRS (or SRS blanking) and data symbol after

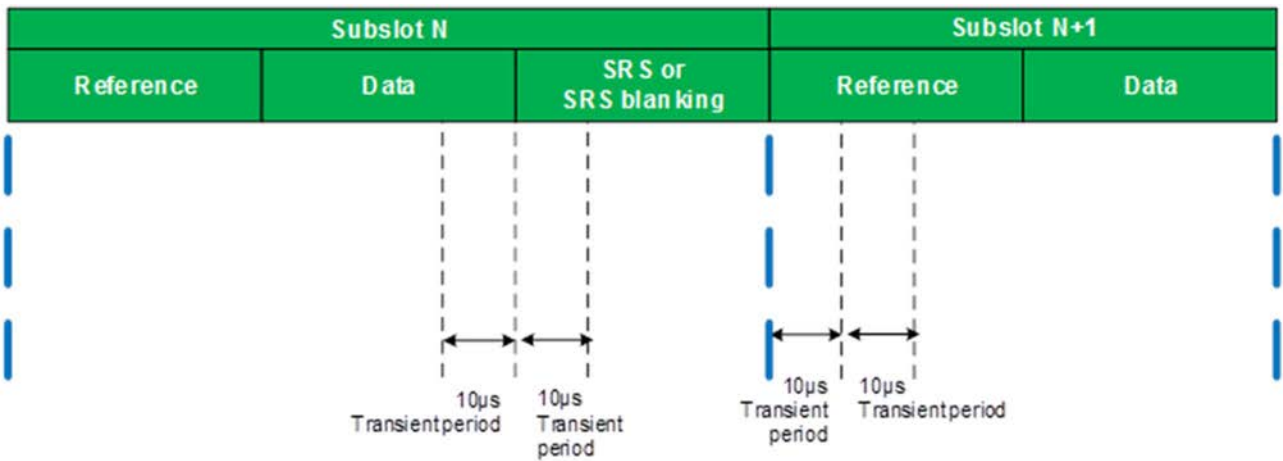


Figure 6.3.4.6-4: subslot PUSCH/SRS time mask when there is a data symbol before SRS (or SRS blanking) and Reference symbol after

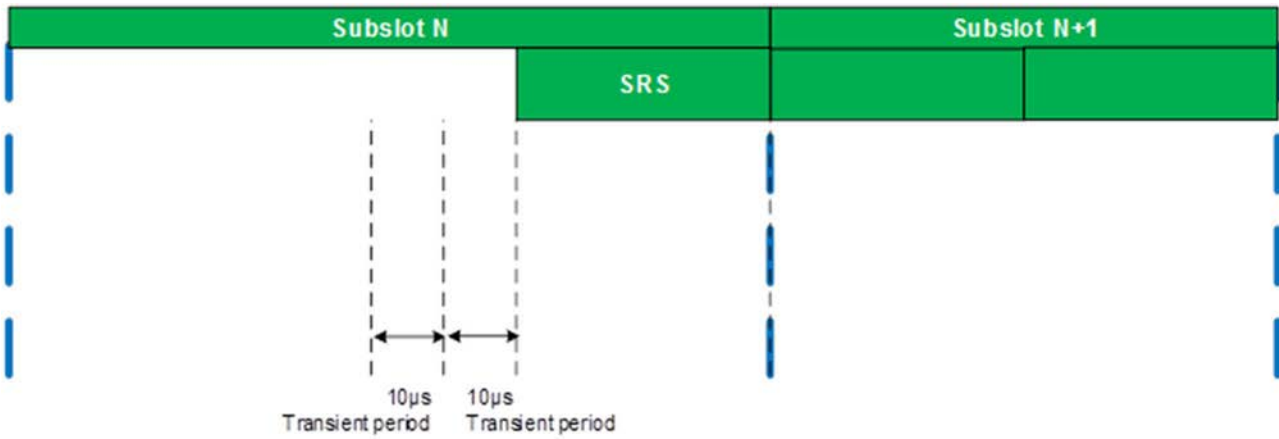


Figure 6.3.4.6-5: subslot PUSCH/SRS time mask when there is a no symbol before SRS

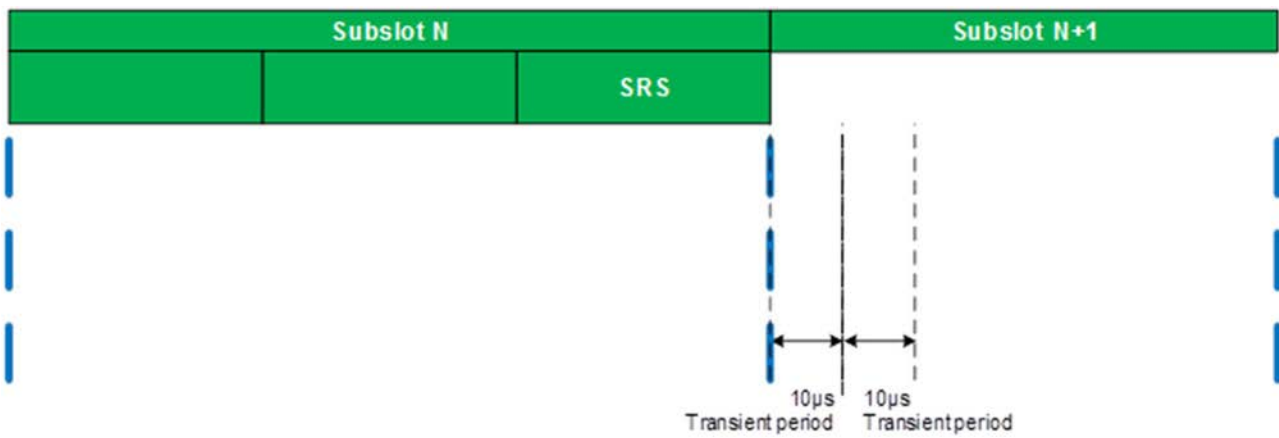


Figure 6.3.4.6-6: subslot PUSCH/SRS time mask when there is a no symbol after SRS

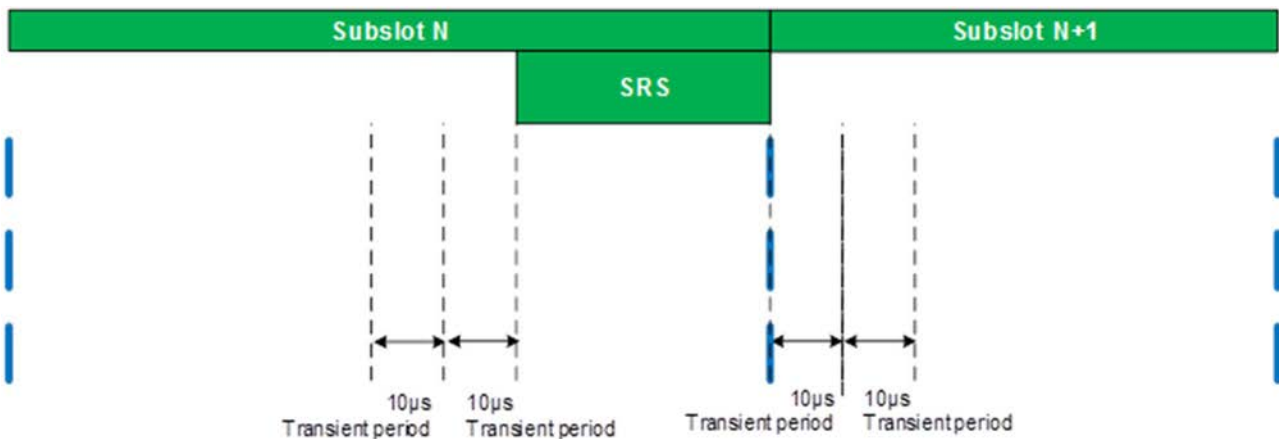


Figure 6.3.4.6-7: subslot PUSCH/SRS time mask when there is a no symbol before and after SRS

### 6.3.4.7 Symbol / Slot boundary time mask for slot TTI

The slot boundary time mask defines the observation period between the previous/subsequent slot and the (reference) slot. A transient period at a symbol boundary within a slot is only allowed in the case of Intra slot frequency hopping. For the cases when the slot contains SRS the time masks in subclause 6.3.4.8 shall apply.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

For slot boundary, the time masks specified in subclause 6.3.4.4 shall apply with a transient time of 10µs instead of 20µs.

For frequency hopping within the slot, the time masks specified in subclause 6.3.4.5 shall apply.

### 6.3.4.8 Slot PUCCH / slot PUSCH / SRS time mask for slot TTI

The slot PUCCH/slot PUSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) and an adjacent slot PUSCH/slot PUCCH symbol and subsequent slot.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

The time masks specified in subclause 6.3.4.4 shall apply.

### 6.3.4.9 Consecutive subslot and slot TTI or consecutive subslot and subframe TTI time mask

The consecutive subslot and slot boundary time mask or consecutive subslot and subframe boundary time mask defines the observation period between the subslot and the slot or subframe.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3.

In this case, the transient period shall be placed in the subframe TTI or the slot TTI (figure 6.3.4.9-1)

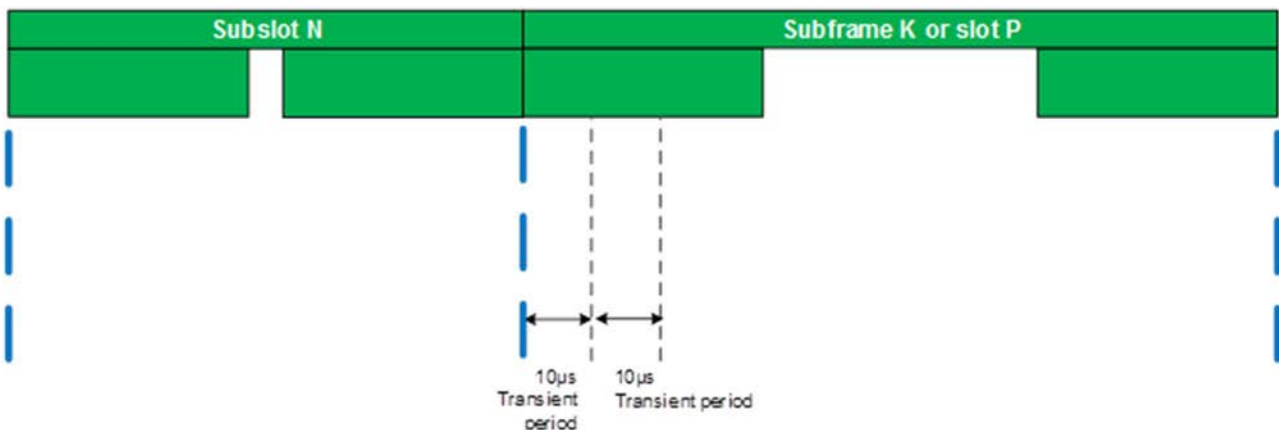
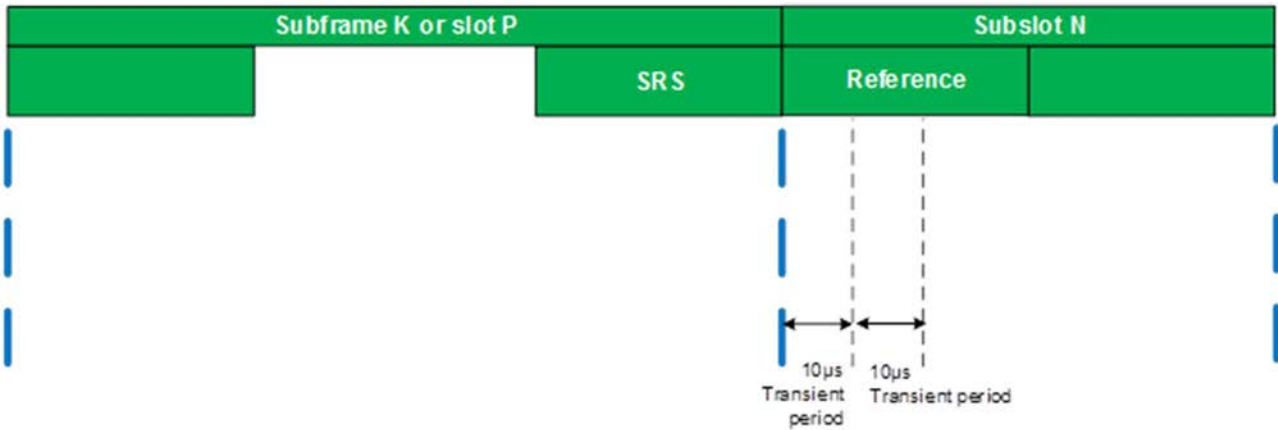


Figure 6.3.4.9-1: subslot TTI and subframe TTI boundary

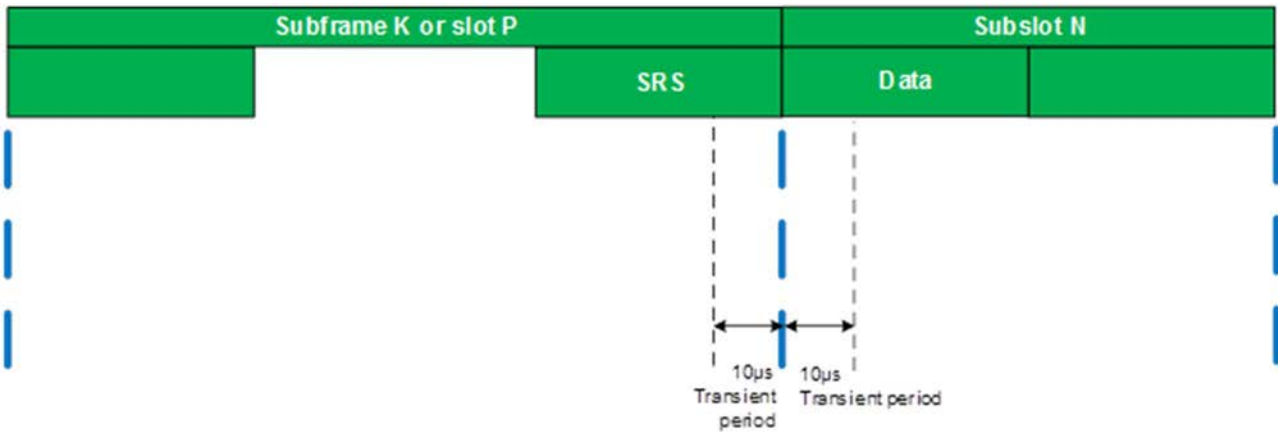
### 6.3.4.10 Consecutive subframe and subslot TTI or consecutive slot and subslot TTI time mask

The consecutive subframe and subslot boundary time mask or consecutive slot and subslot boundary time mask defines the observation period between the slot or subframe and the subslot.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

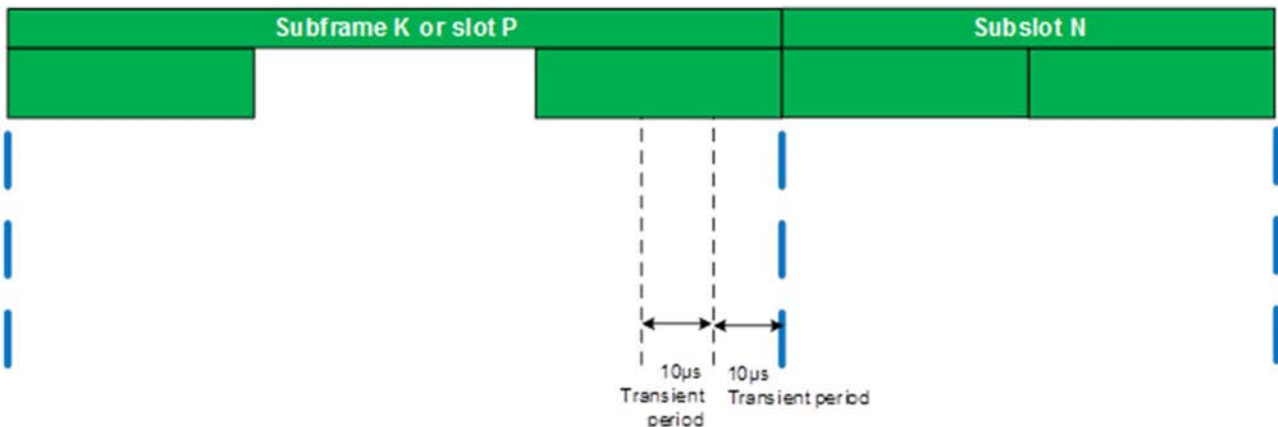


**Figure 6.3.4.10-1: Subframe TTI and subslot TTI boundary with SRS in last subframe TTI symbol and Reference Symbol in first subslot TTI symbol**



**Figure 6.3.4.10-2: Subframe TTI and subslot TTI boundary with SRS in last subframe TTI symbol and data Symbol in first subslot TTI symbol**

When the last symbol of the Subframe or slot is not SRS then the transient period is placed in the Subframe or Slot.



**Figure 6.3.4.10-3: subframe TTI and subslot TTI boundary**

6.3.4.11 Consecutive TTI and slot TTI or consecutive slot TTI and TTI time mask

The consecutive subframe and slot boundary time mask or consecutive slot and subframe boundary time mask defines the observation period between the subframe and the slot or the slot and the subframe.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3

The time masks at subframe boundary specified in subclause 6.3.4.3 or at slot boundary specified in subclause 6.3.4.7 shall apply.

### 6.3.4A ON/OFF time mask for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands and intra-band contiguous and non-contiguous carrier aggregation, the general output power ON/OFF time mask specified in subclause 6.3.4.1 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in subclause 6.3.4.1 shall only be applicable for each component carrier when all the component carriers are OFF.

### 6.3.4B ON/OFF time mask for UL-MIMO

For UE supporting UL-MIMO, the ON/OFF time mask requirements in subclause 6.3.4 apply at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the general ON/OFF time mask requirements specified in subclause 6.3.4.1 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.4 apply.

### 6.3.4D ON/OFF time mask for ProSe

For ProSe Direct Discovery and ProSe Direct Communications, additional requirements on ON/OFF time masks for ProSe physical channels and signals are specified in this clause.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.3.4D apply for ProSe transmission and the requirements in subclause 6.3.4 apply for uplink transmission.

#### 6.3.4D.1 General time mask for ProSe

The General ON/OFF time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSDCH, PSCCH, and PSSCH transmissions in a subframe wherein the last symbol is punctured to create a guard period.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3.

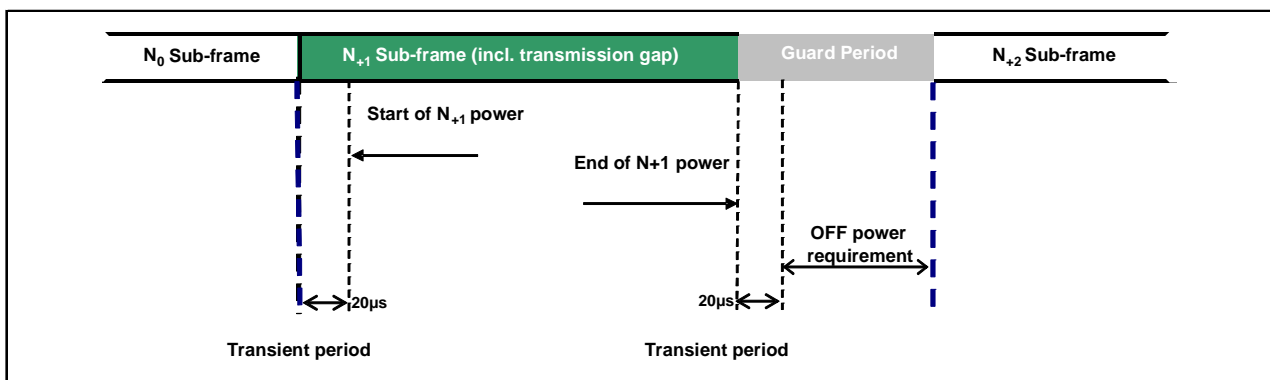


Figure 6.3.4D.1-1: PSDCH/PSCCH/PSSCH time mask

### 6.3.4D.2 PSSS/SSSS time mask

The PSSS time mask / SSSS time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSSS/SSSS transmissions in a subframe when not multiplexed with PSBCH in that subframe.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3.

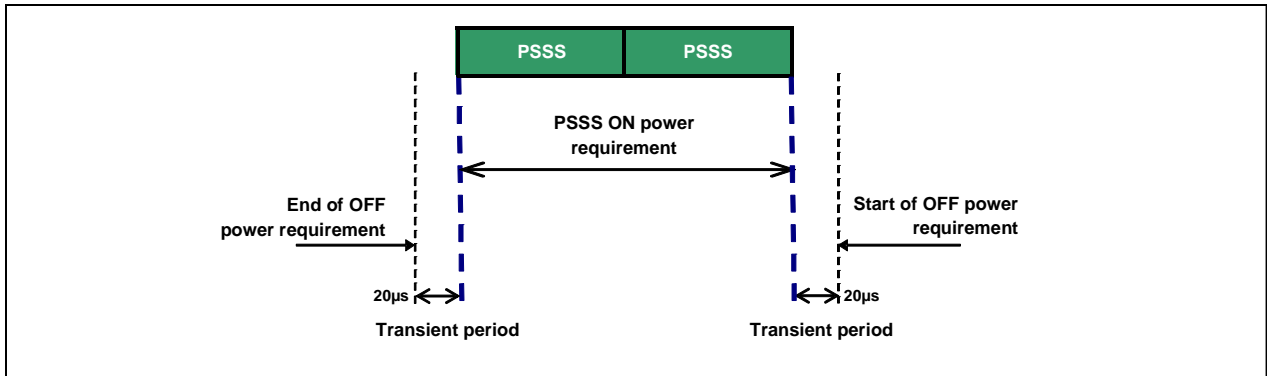


Figure 6.3.4D.2-1: PSSS time mask for normal CP transmission (when not time-multiplexed with PSBCH)

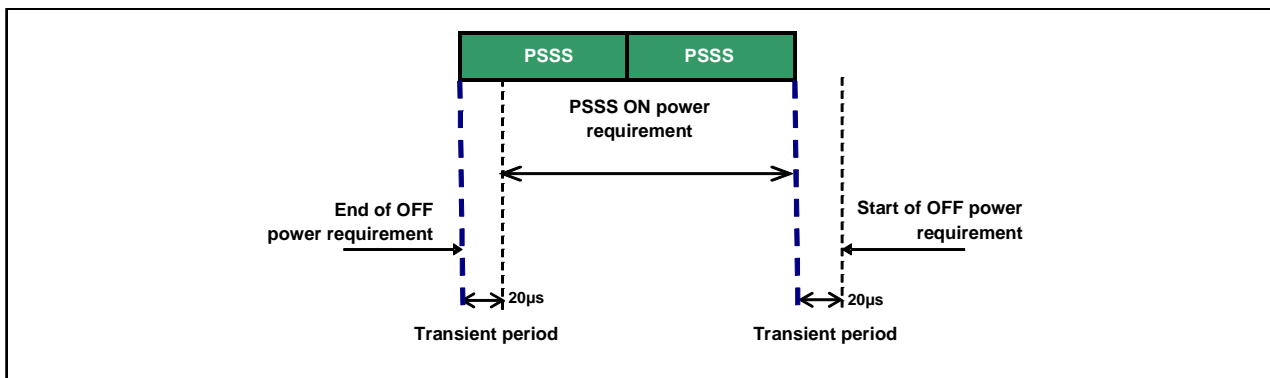


Figure 6.3.4D.2-2: PSSS time mask for extended CP transmission (when not time-multiplexed with PSBCH)

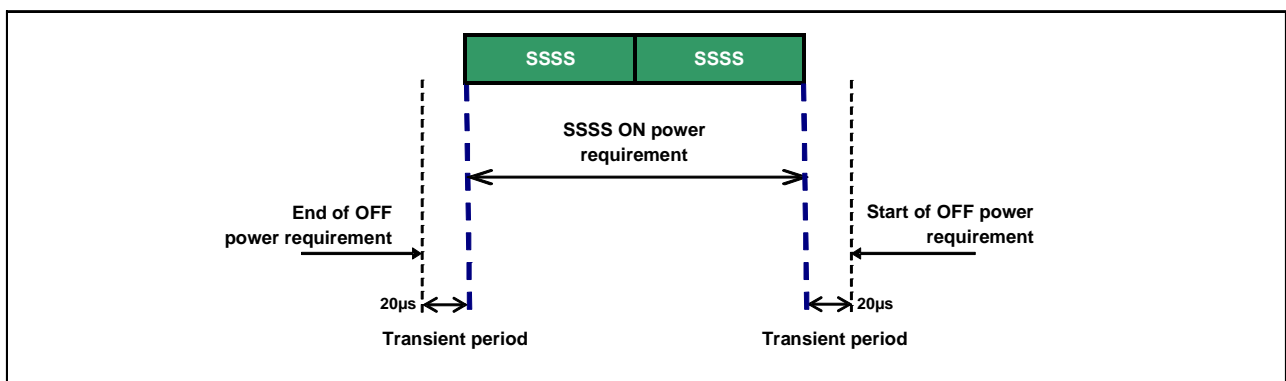


Figure 6.3.4D.2-3: SSSS time mask (when not time-multiplexed with PSBCH)

### 6.3.4D.3 PSSS / SSSS / PSBCH time mask

The PSSS/SSSS/PSBCH time mask defines the observation period between SSSS and adjacent PSSS/PSBCH symbols in a subframe, with last symbol punctured to create a guard period.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3.

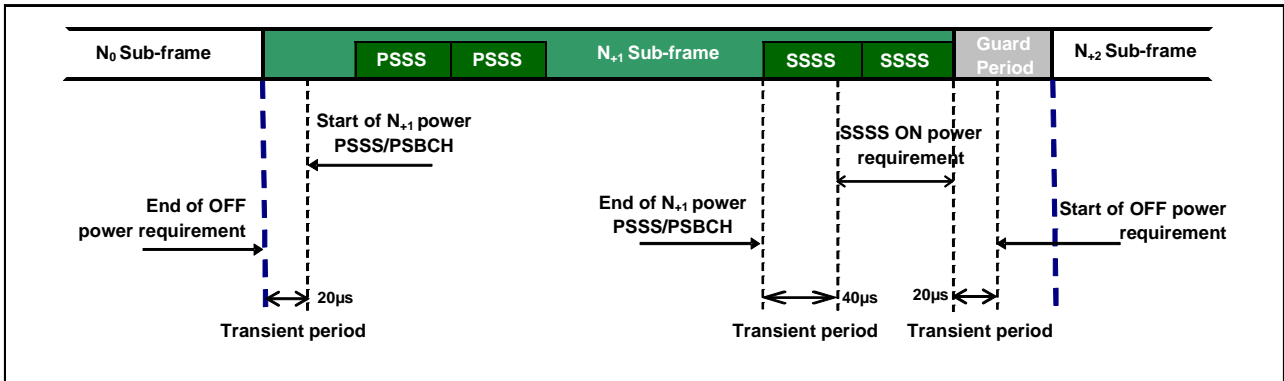


Figure 6.3.4D.3-1: PSSS/SSSS/PSBCH time mask for normal CP transmission

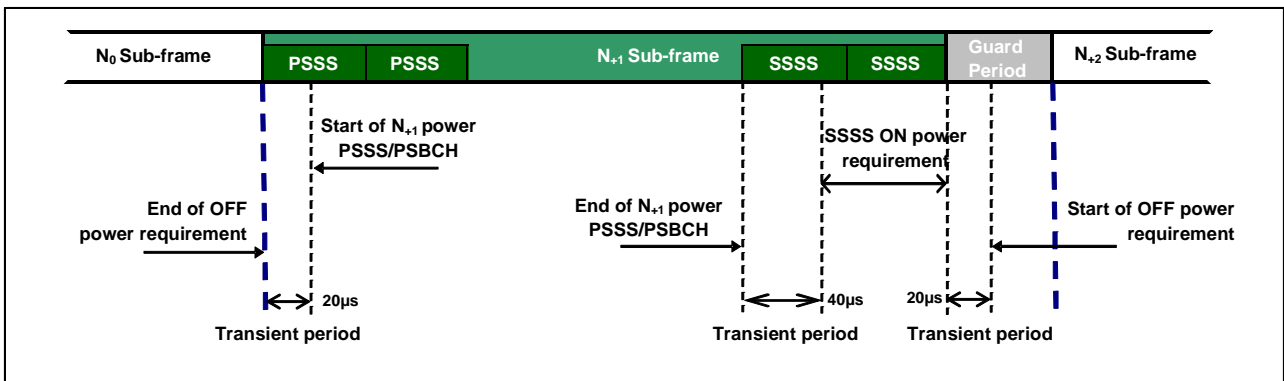


Figure 6.3.4D.3-2: PSSS/SSSS/PSBCH time mask for extended CP transmission

### 6.3.4D.4 PSSCH / SRS time mask

The PSSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) and an adjacent PSSCH symbol and subsequent sub-frame.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2 and subclause 6.6.2.3.

The PSSCH/SRS time mask shall follow the PUSCH/PUCCH/SRS time mask as specified in subclause 6.3.4.4.

### 6.3.4F ON/OFF time mask for category NB1 and NB2

#### 6.3.4F.1 General ON/OFF time mask

E-UTRA general ON/OFF time mask in subclause 6.3.4.1 applies for category NB1 and NB2 UE with an exception that for 3.75kHz sub-carrier spacing the transmit OFF power is defined as mean power in one slot (2ms) and for 15kHz sub-

carrier spacing the transmit OFF power is defined as mean power in one sub-frame (1ms), excluding any transient periods. The ON power is defined as the mean power over one RU excluding any transient periods.

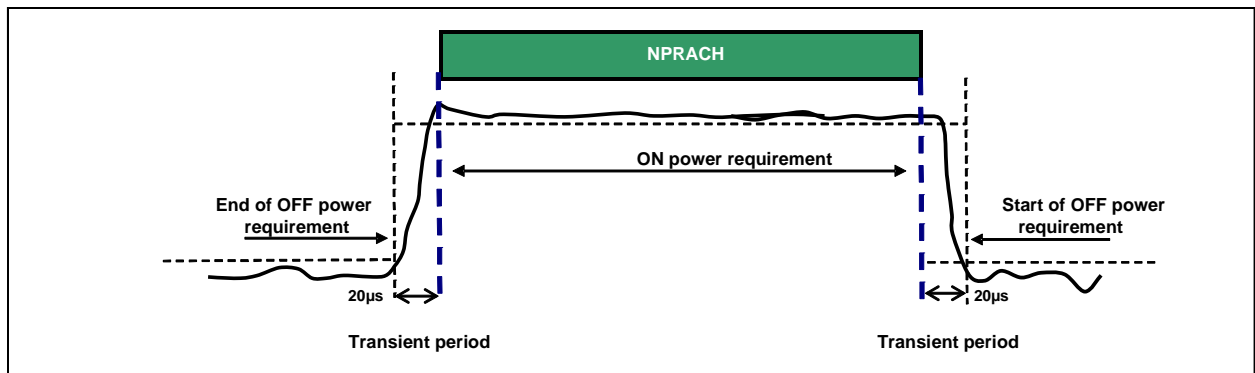
### 6.3.4F.2 NPRACH time mask

The NPRACH ON power is specified as the mean power over the NPRACH measurement period excluding any transient periods as shown in Figure 6.3.4F.2-1. The measurement period for different NPRACH preamble format is specified in Table 6.3.4F.2-1.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2.2F and subclause 6.6.2.3F.

**Table 6.3.4F.2-1: NPRACH ON power measurement period**

| NPRACH preamble format | Measurement period (ms) |
|------------------------|-------------------------|
| 0                      | 5.6                     |
| 1                      | 6.4                     |



**Figure 6.3.4F.2-1: NPRACH ON/OFF time mask**

### 6.3.4G ON/OFF time mask for V2X Communication

For V2X Communications, additional requirements on ON/OFF time masks for V2X physical channels and signals are specified in this clause.

The General ON/OFF time mask in subclause 6.3.4D.1 and PSSS/SSSS time mask in subcluse 6.3.4D.2 are applied for E-UTRA V2X sidelink UE.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.3.4G apply for the V2X sidelink transmission and the requirements in subclause 6.3.4 apply for the E-UTRA uplink transmission.

For intra-band contiguous multi-carrier operation the general ON/OFF time mask is applicable for each component carrier during the ON power period and the transient periods. The OFF period shall only be applicable for each component carrier when all the component carriers are OFF.

For V2X UE supporting Transmit Diversity, the ON/OFF time mask requirements apply at each transmit antenna connector.

If the UE transmits on two antenna connectorsat the same time, the general ON/OFF time mask requirements apply to each transmit antenna connector.

If the UE transmits on one antenna connector at a time, the general ON/OFF time mask requirements apply to the active antenna connector.



### 6.3.4G.1 PSSS / SSSS / PSBCH time mask

The PSSS/SSSS/PSBCH time mask for V2X UE defines the observation period between SSSS and adjacent PSSS/PSBCH symbols in a sub-frame, with last symbol punctured to create a guard period.

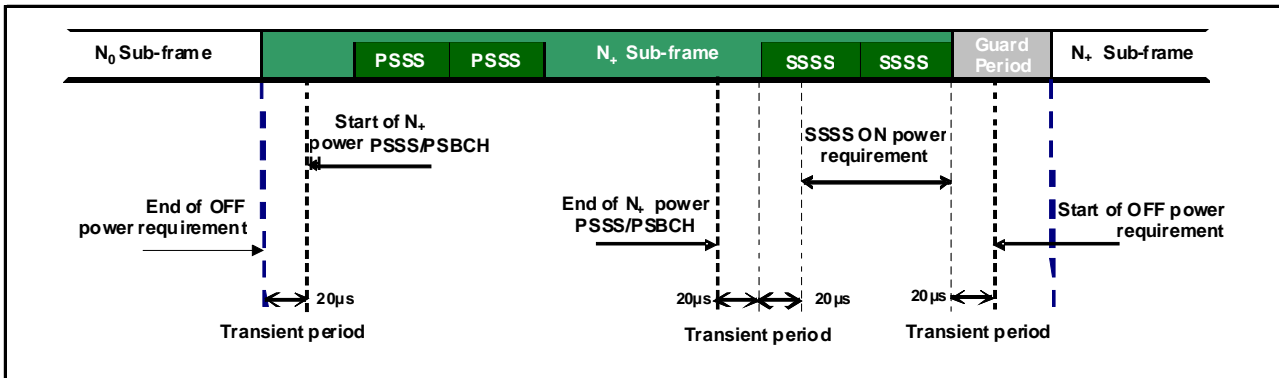


Figure 6.3.4G.1-1: PSSS/SSSS/PSBCH time mask for normal CP transmission for V2X Service

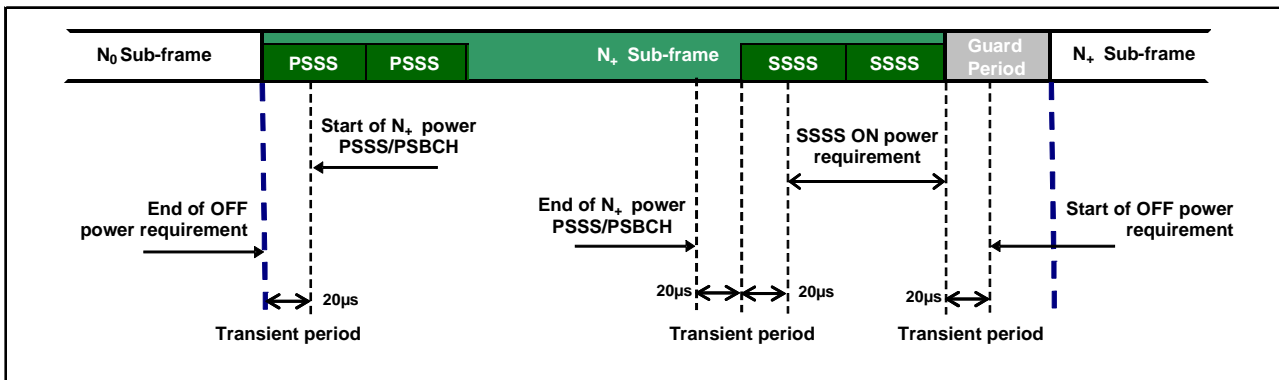


Figure 6.3.4G.1-2: PSSS/SSSS/PSBCH time mask for extended CP transmission for V2X Service

## 6.3.5 Power Control

### 6.3.5.1 Absolute power tolerance

Absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 20ms. This tolerance includes the channel estimation error (the absolute RSRP accuracy requirement specified in subclause 9.1 of TS 36.133). In the case of a PRACH transmission, the absolute tolerance is specified for the first preamble. The absolute power tolerance includes the channel estimation error (the absolute RSRP accuracy requirement specified in subclause 9.1 of TS 36.133).

#### 6.3.5.1.1 Minimum requirements

The minimum requirement for absolute power tolerance is given in Table 6.3.5.1.1-1 over the power range bounded by the Maximum output power as defined in subclause 6.2.2 and the Minimum output power as defined in subclause 6.3.2.

For operating bands under NOTE 2 in Table 6.2.2-1, the absolute power tolerance as specified in Table 6.3.5.1.1-1 is relaxed by reducing the lower limit by 1.5 dB when the transmission bandwidth is confined within  $F_{UL\_low}$  and  $F_{UL\_low} + 4$  MHz or  $F_{UL\_high} - 4$  MHz and  $F_{UL\_high}$ .

**Table 6.3.5.1.1-1: Absolute power tolerance**

| Conditions | Tolerance     |
|------------|---------------|
| Normal     | $\pm 9.0$ dB  |
| Extreme    | $\pm 12.0$ dB |

### 6.3.5.2 Relative Power tolerance

The relative power tolerance is the ability of the UE transmitter to set its output power in a target sub-frame relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is  $\leq 20$  ms.

For PRACH transmission, the relative tolerance is the ability of the UE transmitter to set its output power relatively to the power of the most recently transmitted preamble. The measurement period for the PRACH preamble is specified in Table 6.3.4.2-1.

#### 6.3.5.2.1 Minimum requirements

The requirements specified in Table 6.3.5.2.1-1 apply when the power of the target and reference sub-frames are within the power range bounded by the Minimum output power as defined in subclause 6.3.2 and the measured PUMAX as defined in subclause 6.2.5 (i.e, the actual power as would be measured assuming no measurement error). This power shall be within the power limits specified in subclause 6.2.5.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of two test patterns. The test patterns are a monotonically increasing power sweep and a monotonically decreasing power sweep over a range bounded by the requirements of minimum power and maximum power specified in subclauses 6.3.2 and 6.2.2. For these exceptions the power tolerance limit is a maximum of  $\pm 6.0$  dB in Table 6.3.5.2.1-1

**Table 6.3.5.2.1-1 Relative power tolerance for transmission (normal conditions)**

| Power step $\Delta P$<br>(Up or down)<br>[dB]   | All combinations<br>of PUSCH and<br>PUCCH<br>transitions [dB] | All combinations of<br>PUSCH/PUCCH and<br>SRS transitions<br>between sub-<br>frames [dB] | PRACH [dB] |
|---|---|--|------------|
| $\Delta P < 2$  | $\pm 2.5$ (NOTE 3)  | $\pm 3.0$  | $\pm 2.5$  |
| $2 \leq \Delta P < 3$   | $\pm 3.0$   | $\pm 4.0$  | $\pm 3.0$  |
| $3 \leq \Delta P < 4$   | $\pm 3.5$   | $\pm 5.0$  | $\pm 3.5$  |
| $4 \leq \Delta P \leq 10$   | $\pm 4.0$   | $\pm 6.0$  | $\pm 4.0$  |
| $10 \leq \Delta P < 15$   | $\pm 5.0$   | $\pm 8.0$  | $\pm 5.0$  |
| $15 \leq \Delta P$  | $\pm 6.0$   | $\pm 9.0$  | $\pm 6.0$  |
| NOTE 1: For extreme conditions an additional $\pm 2.0$ dB relaxation is allowed<br>NOTE 2: For operating bands under NOTE 2 in Table 6.2.2-1, the relative power tolerance is relaxed by increasing the upper limit by 1.5 dB if the transmission bandwidth of the reference sub-frames is confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ and the target sub-frame is not confined within any one of these frequency ranges; if the transmission bandwidth of the target sub-frame is confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ and the reference sub-frame is not confined within any one of these frequency ranges, then the tolerance is relaxed by reducing the lower limit by 1.5 dB.<br>NOTE 3: For PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods for TDD: for a power step $\Delta P \leq 1$ dB, the relative power tolerance for transmission is $\pm 1.0$ dB. |   |  |            |

The power step ( $\Delta P$ ) is defined as the difference in the calculated setting of the UE Transmit power between the target and reference sub-frames with the power setting according to subclause 5.1 of [TS 36.213]. The error is the difference

between  $\Delta P$  and the power change measured at the UE antenna port with the power of the cell-specific reference signals kept constant. The error shall be less than the relative power tolerance specified in Table 6.3.5.2.1-1.

For sub-frames not containing an SRS symbol, the power change is defined as the relative power difference between the mean power of the original reference sub-frame and the mean power of the target subframe not including transient durations. The mean power of successive sub-frames shall be calculated according to Figure 6.3.4.3-1 and Figure 6.3.4.1-1 if there is a transmission gap between the reference and target sub-frames.

If at least one of the sub-frames contains an SRS symbol, the power change is defined as the relative power difference between the mean power of the last transmission within the reference sub-frame and the mean power of the first transmission within the target sub-frame not including transient durations. A transmission is defined as PUSCH, PUCCH or an SRS symbol. The mean power of the reference and target sub-frames shall be calculated according to Figures 6.3.4.1-1, 6.3.4.2-1, 6.3.4.4-1, 6.3.4.4-2 and 6.3.4.4-3 for these cases.

### 6.3.5.3 Aggregate power control tolerance

Aggregate power control tolerance is the ability of a UE to maintain its power in non-contiguous transmission within 21 ms in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in TS 36.213 are constant. For HD-FDD UEs that support coverage enhancement (CE), the requirements on aggregate power control tolerance in 6.3.5E.3 apply.

#### 6.3.5.3.1 Minimum requirement

The UE shall meet the requirements specified in Table 6.3.5.3.1-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2 and the maximum output power as defined in subclause 6.2.2.

**Table 6.3.5.3.1-1: Aggregate power control tolerance**

| TPC command  | UL channel | Aggregate power tolerance within 21 ms |
|--|------------|--|
| 0 dB   | PUCCH      | $\pm 2.5$ dB                           |
| 0 dB   | PUSCH      | $\pm 3.5$ dB                           |
| NOTE: The UE transmission gap is 4 ms. TPC command is transmitted via PDCCH 4 subframes preceding each PUCCH/PUSCH transmission. |            |  |

### 6.3.5A Power control for CA

The requirements apply for one single PUCCH, PUSCH or SRS transmission of contiguous PRB allocation per component carrier with power setting in accordance with Clause 5.1 of [6].

#### 6.3.5A.1 Absolute power tolerance

The absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on each active component carriers larger than 20ms. For component carriers with Frame Structure Type 3 the absolute power tolerance requirements apply when the said transmission gaps are larger than 40 ms. The requirement can be tested by time aligning any transmission gaps on the component carriers.

When SRS carrier based switching is used, then the above mentioned absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on component carriers (to which SRS switching occurs) larger than 40ms.

##### 6.3.5A.1.1 Minimum requirements

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the absolute power control tolerance is specified on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by maximum output power as defined in subclause 6.2.2A. The requirements defined in Table

6.3.5.1.1-1 shall apply on each component carrier with all component carriers active. The requirements can be tested by time aligning any transmission gaps on all the component carriers.

For intra-band contiguous carrier aggregation bandwidth class B, C and D and intra-band non-contiguous carrier aggregation the absolute power control tolerance per component carrier is given in Table 6.3.5.1.1-1.

## 6.3.5A.2 Relative power tolerance

### 6.3.5A.2.1 Minimum requirements

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the relative power tolerance is specified when the power of the target and reference sub-frames on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by  $P_{UMAX}$  as defined in subclause 6.2.5A. The requirements shall apply on each component carrier with all component carriers active. The UE transmitter shall have the capability of changing the output power independently on all component carriers in the uplink and:

- a) the requirements for all combinations of PUSCH and PUCCH transitions per component carrier is given in Table 6.3.5.2.1-1.
- b) for SRS the requirements for combinations of PUSCH/PUCCH and SRS transitions between subframes given in Table 6.3.5.2.1-1 apply per component carrier when the target and reference subframes are configured for either simultaneous SRS or simultaneous PUSCH.
- c) for RACH the requirements apply for the primary cell and are given in Table 6.3.5.2.1-1.

For component carriers with Frame Structure Type 3 the requirements for the target sub-frame relative to the power of the most recently transmitted reference sub-frame shall be met with a transmission gap  $\leq 40$  ms.

For intra-band contiguous carrier aggregation bandwidth class B, C and D and intra-band non-contiguous carrier aggregation, the requirements apply when the power of the target and reference sub-frames on each component carrier exceed -20 dBm and the total power is limited by  $P_{UMAX}$  as defined in subclause 6.2.5A. For the purpose of these requirements, the power in each component carrier is specified over only the transmitted resource blocks.

The UE shall meet the following requirements for transmission on both assigned component carriers when the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame:

- a) for all possible combinations of PUSCH and PUCCH transitions per component carrier, the corresponding requirements given in Table 6.3.5.2.1-1;
- b) for SRS transitions on each component carrier, the requirements for combinations of PUSCH/PUCCH and SRS transitions given in Table 6.3.5.2.1-1 with simultaneous SRS of constant SRS bandwidth allocated in the target and reference subframes;
- c) for RACH on the primary component carrier, the requirements given in Table 6.3.5.2.1-1 for PRACH.

For a) and b) above, the power step  $\Delta P$  between the reference and target subframes shall be set by a TPC command and/or an uplink scheduling grant transmitted by means of an appropriate DCI Format.

For a), b) and c) above, two exceptions are allowed for each component carrier for a power per carrier ranging from -20 dBm to  $P_{UMAX,c}$  as defined in subclause 6.2.5. For these exceptions the power tolerance limit is  $\pm 6.0$  dB in Table 6.3.5.2.1-1.

## 6.3.5A.3 Aggregate power control tolerance

Aggregate power control tolerance is the ability of a UE to maintain its power in non-contiguous transmission within 21 ms in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in [6] are constant on all active component carriers.

### 6.3.5A.3.1 Minimum requirements

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the aggregate power tolerance is specified on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by maximum output power as defined in subclause 6.2.2A. The requirements defined in Table

6.3.5.3.1-1 shall apply on each component carrier with all component carriers active. The requirements can be tested by time aligning any transmission gaps on both the component carriers.

For intra-band contiguous carrier aggregation bandwidth class B, C and D and intra-band non-contiguous carrier aggregation, the aggregate power tolerance per component carrier is given in Table 6.3.5.3.1-1 with either simultaneous PUSCH or simultaneous PUCCH-PUSCH (if supported by the UE) configured. The average power per PRB shall be aligned across both assigned carriers before the start of the test. The requirement can be tested with the transmission gaps time aligned between component carriers.

## 6.3.5B Power control for UL-MIMO

For UE supporting UL-MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.5 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL-MIMO configurations specified in Table 6.2.2B-2, wherein

- The Maximum output power requirements for UL-MIMO are specified in subclause 6.2.2B
- The Minimum output power requirements for UL-MIMO are specified in subclause 6.3.2B
- The requirements for configured transmitted power for UL-MIMO are specified in subclause 6.2.5B.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.5 apply.

## 6.3.5D Power Control for ProSe

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.3.5D apply for ProSe transmission and the requirements in subclause 6.3.5 apply for uplink transmission.

### 6.3.5D.1 Absolute power tolerance

For ProSe transmissions, the absolute power tolerance requirements specified in subclause 6.3.5.1 shall apply for each ProSe transmission.

## 6.3.5E Power control for category M1 and M2

### 6.3.5E.1 Absolute power tolerance

The absolute power tolerance requirements specified in subclause 6.3.5.1 apply, wherein

- The Maximum output power requirements are specified in subclause 6.2.2E
- The Minimum output power requirements are specified in subclause 6.3.2
- The requirements for configured transmitted power are specified in subclause 6.2.5.

### 6.3.5E.2 Relative Power tolerance

The relative power tolerance requirements specified in subclause 6.3.5.2 apply, wherein

- The Maximum output power requirements are specified in subclause 6.2.2E
- The Minimum output power requirements are specified in subclause 6.3.2
- The requirements for configured transmitted power are specified in subclause 6.2.5.

### 6.3.5E.3 Aggregate power control tolerance

Aggregate power control tolerance is the ability of a UE to maintain its power in non-contiguous transmission in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in TS 36.213 are constant.

For category M1 and M2 TDD and FD-FDD UEs, the aggregate power control tolerance requirements specified in Table 6.3.5E.3.1-0 apply. For category M1 and M2 HD-FDD UEs and for continuous uplink transmissions of duration  $\leq 64$  ms, the aggregate power control tolerance requirements specified in Table 6.3.5E.3.1-0 apply.

For category M1 and M2 HD-FDD UEs and for continuous uplink transmissions of duration  $> 64$  ms, the aggregate power control tolerance requirements specified in Table 6.3.5E.3.1-1 apply.

#### 6.3.5E.3.1 Minimum requirement

The category M1 and M2 TDD and FD-FDD UEs shall meet the requirements specified in Table 6.3.5E.3.1-0 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2, the maximum output power as defined in subclause 6.2.2E, and the requirements for configured transmitted power are specified in subclause 6.2.5.

The category M1 and M2 HD-FDD UEs and for continuous uplink transmissions of duration  $\leq 64$  ms, shall meet the requirements specified in Table 6.3.5E.3.1-0 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2, the maximum output power as defined in subclause 6.2.2E, and the requirements for configured transmitted power are specified in subclause 6.2.5.

**Table 6.3.5E.3.1-0: Aggregate power control tolerance**

| TPC command  | UL channel | Aggregate power tolerance within 21 ms <sup>2</sup> |
|--|------------|---|
| 0 dB   | PUCCH      | $\pm 2.5$ dB  |
| 0 dB   | PUSCH      | $\pm 3.5$ dB  |
| NOTE 1: The UE transmission gap is 4 ms for full-duplex FDD and TDD.<br>For UE of half-duplex FDD with the channel bandwidth 5 MHz / 10 MHz / 15 MHz / 20 MHz, the transmission gap is 1 ms after subframe #4 and 7 ms after subframe #6.<br>For UE of half-duplex FDD with the CBW 1.4 / 3 MHz, the transmission gap is 9 ms.<br>TPC command is transmitted via MPDCCH 4 subframes preceding each PUCCH/PUSCH transmission. |            |   |
| NOTE 2: For UE of half-duplex FDD with the CBW 1.4 / 3 MHz, the test interval is 41 ms.  |            |   |

The category M1 and M2 HD-FDD UE and for continuous uplink transmissions of duration  $> 64$  ms shall meet the requirements specified in Table 6.3.5E.3.1-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2 and the maximum output power as defined in subclause 6.2.2E.

**Table 6.3.5E.3.1-1: Aggregate power control tolerance**

| TPC command  | UL channel | Aggregate power tolerance within 129 ms |
|--|------------|---|
| 0 dB   | PUCCH      | $\pm 2.5$ dB                            |
| 0 dB   | PUSCH      | $\pm 3.5$ dB                            |
| NOTE: The UE transmission gap is 5 ms. TPC command is transmitted via MPDCCH 4 subframes preceding each PUCCH/ PUSCH transmission. |            |   |

### 6.3.5F Power Control for category NB1 and NB2

Power control requirements in this clause apply for category NB1 and NB2 UE.

### 6.3.5F.1 Absolute power tolerance

The minimum requirement for absolute power tolerance is given in Table 6.3.5F.1-1 over the power range bounded by the Maximum output power as defined in subclause 6.2.2F and the Minimum output power as defined in subclause 6.3.2F.

**Table 6.3.5F.1-1: Absolute power tolerance - I**

| Conditions | Tolerance     |
|------------|---------------|
| Normal     | $\pm 9.0$ dB  |
| Extreme    | $\pm 12.0$ dB |

In case of  $-15 \text{ dB} \leq \hat{E}_s/I_{ot} < -6 \text{ dB}$ , the absolute power tolerance given in Table 6.3.5F.1-2 applies if the UE transmit power is not mandated to be  $P_{\text{CMAX},c}$  according to the UE uplink power control procedure or random access procedure in Section 16 of [6] (e.g. the lowest configured repetition level is used for NPRACH transmission or the number of repetitions of the allocated NPUSCH RUs is no more than 2).

**Table 6.3.5F.1-2: Absolute power tolerance - II**

| Conditions | Tolerance     |
|------------|---------------|
| Normal     | $\pm 13.3$ dB |
| Extreme    | $\pm 16.3$ dB |

### 6.3.5F.2 Relative power tolerance

Category NB1 and NB2 UE relative power control requirement is defined for NPRACH power step values of 0, 2, 4 and 6 dB. For NPRACH transmission, the relative tolerance is the ability of the UE transmitter to set its output power relatively to the power of the most recently transmitted preamble. The measurement period for the NPRACH preamble is specified in Table 6.3.4F.2-1.

The requirements specified in Table 6.3.5F.2-1 apply when the power of the target and reference sub-frames are within the power range bounded by the Minimum output power as defined in subclause 6.3.2F and the maximum output power as defined in subclause 6.2.2F.

**Table 6.3.5F.2-1: Relative power tolerance for category NB1 and NB2 NPRACH transmission (normal conditions)**

| Power step $\Delta P$ [dB] | NPRACH [dB]  |
|----------------------------|--|
| $\Delta P = 0$             | $\pm 1.5$  |
| $\Delta P = 2$             | $\pm 2.0$  |
| $\Delta P = 4$             | $\pm 3.5$  |
| $\Delta P = 6$             | $\pm 4.0$  |
| NOTE:                      | For extreme conditions an additional $\pm 2.0$ dB relaxation is allowed. |

The power step ( $\Delta P$ ) is defined as the difference in the calculated setting of the UE transmit power between the target and reference sub-frames. The error is the difference between  $\Delta P$  and the power change measured at the UE antenna port with the power of the cell-specific reference signals kept constant. The error shall be less than the relative power tolerance specified in Table 6.3.5F.2-1.

### 6.3.5F.3 Aggregate power control tolerance for category NB1 and NB2

Category NB1 and NB2 aggregate power control tolerance is the ability of a UE to maintain its output power in non-contiguous transmission with respect to the first UE transmission, when the uplink power control parameters as defined in TS 36.213 are constant and  $\alpha$  is set to 0.

#### 6.3.5F.3.1 Minimum requirement

The UE shall meet the requirements specified in Table 6.3.5F.3.1-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2F and the maximum output power as defined in subclause 6.2.2F.

**Table 6.3.5F.3.1-1: Aggregate power control tolerance for HD-FDD**

| UL channel   | Aggregate power tolerance         |                                  |
|--|-----------------------------------|----------------------------------|
|  | 15 kHz / 12 tones<br>within 53 ms | 15 kHz / 1 tone<br>within 104 ms |
| NPUSCH   | $\pm 3.5$ dB                      |                                  |
| NOTE: For five consecutive UE transmissions the transmission gaps are 12 ms for 12 tone and 16 ms for single tone transmissions. Uplink scheduling grant is transmitted via NPDCCH eight subframes before NPUSCH transmission. |                                   |                                  |

**Table 6.3.5F.3.1-2: Aggregate power control tolerance for TDD**

| UL channel   | Aggregate power tolerance         |                                  |
|--|-----------------------------------|----------------------------------|
|  | 15 kHz / 12 tones<br>within 81 ms | 15 kHz / 1 tone<br>within 177 ms |
| NPUSCH   | $\pm 3.5$ dB                      |                                  |
| NOTE: For five consecutive UE transmissions the transmission gaps are 19 ms for 12 tone and 23 ms for single tone transmissions. Uplink scheduling grant is transmitted via NPDCCH eight subframes before NPUSCH transmission. |                                   |                                  |

### 6.3.5G Power Control for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table Table 5.5G-1, the requirements in subclause 6.3.5G.1 apply for E-UTRA V2X sidelink transmission.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.3.5G.1 apply for V2X sidelink transmission and the requirements in subclause 6.3.5 apply for the E-UTRA uplink transmission.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the power control tolerance for single carrier shall apply to the sum of output power at each transmit antenna connector.

If the UE transmit on one -antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

#### 6.3.5G.1 Absolute power tolerance

Absolute power tolerance is the ability of the UE to set its output power to a specific value for each subframe.

For V2X sidelink communication transmissions in the operating bands specified in Table 5.5G-1, the minimum requirement for absolute power tolerance is given in Table 6.3.5G.1-1 over the power range bounded by the Maximum output power as defined in subclause 6.2.2G and the Minimum output power as defined in subclause 6.3.2G.



For operating bands under NOTE 2 in Table 6.2.2-1, the absolute power tolerance as specified in Table 6.3.5G.1-1 is relaxed by reducing the lower limit by 1.5 dB when the transmission bandwidth is confined within  $F_{UL\_low}$  and  $F_{UL\_low} + 4$  MHz or  $F_{UL\_high} - 4$  MHz and  $F_{UL\_high}$ .

**Table 6.3.5G.1-1: Absolute power tolerance**

| Conditions | Tolerance     |
|------------|---------------|
| Normal     | $\pm 9.0$ dB  |
| Extreme    | $\pm 12.0$ dB |

For intra-band contiguous multi-carrier operation the absolute power control tolerance specified in Table 6.3.5G.1-1 shall apply for each component carrier.

## 6.4 Void

## 6.5 Transmit signal quality

### 6.5.1 Frequency error

The UE modulated carrier frequency shall be accurate to within  $\pm 0.1$  PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the E-UTRA Node B

#### 6.5.1A Frequency error for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the frequency error requirements defined in subclause 6.5.1 shall apply on each component carrier with all component carriers active.

For intra-band contiguous carrier aggregation the UE modulated carrier frequencies per band shall be accurate to within  $\pm 0.1$  PPM observed over a period of one timeslot compared to the carrier frequency of primary component carrier received from the E-UTRA in the corresponding band.

For intra-band non-contiguous carrier aggregation the requirements in Section 6.5.1 applies per component carrier.

#### 6.5.1B Frequency error for UL-MIMO

For UE(s) supporting UL-MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within  $\pm 0.1$  PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the E-UTRA Node B.

#### 6.5.1D Frequency error for ProSe

The UE modulated carrier frequency for ProSe sidelink transmissions shall be accurate to within  $\pm 0.1$  PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the synchronization source. The synchronization source can be E-UTRA Node B or a ProSe UE transmitting sidelink synchronization signals.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.5.1D apply for ProSe transmission and the requirements in subclause 6.5.1 apply for uplink transmission.

#### 6.5.1E Frequency error for UE category M1 and M2

For category M1 and M2 TDD UEs and FD-FDD UEs, the frequency error requirements in Clause 6.5.1 apply.

For category M1 and M2 HD-FDD UEs and for continuous uplink transmissions of duration  $\leq 64$  ms, the frequency error requirements in Clause 6.5.1 apply.

For category M1 and M2 HD-FDD UEs and for continuous uplink transmissions of duration  $> 64$  ms, the UE modulated carrier frequency shall be accurate to within the limits in Table 6.5.1E-1 observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the E-UTRA Node B.

**Table 6.5.1E-1: Frequency error requirement for HD-FDD UE category M1 and M2**

| Carrier frequency [GHz] | Frequency error [ppm] |
|-------------------------|-----------------------|
| $\leq 1$                | $\pm 0.2$             |
| $> 1$                   | $\pm 0.1$             |

## 6.5.1F Frequency error for UE category NB1 and NB2

For UE category NB1 and NB2, the UE modulated carrier frequency shall be accurate to within the following limits

**Table 6.5.1F-1: Frequency error requirement for UE category NB1 and NB2**

| Carrier frequency [GHz] | Frequency error [ppm] |
|-------------------------|-----------------------|
| $\leq 1$                | $\pm 0.2$             |
| $> 1$                   | $\pm 0.1$             |

Observed over a period of one time slot (0.5 ms for 15 kHz sub-carrier spacing and 2 ms excluding the 2304Ts gap for 3.75 kHz sub-carrier spacing) and averaged over  $72/L_{Ctone}$  slots (where  $L_{Ctone} = \{1, 3, 6, 12\}$  is the number of sub-carriers used for the transmission), compared to the carrier frequency received from the E-UTRA Node B.

## 6.5.1G Frequency error for V2X Communication

The UE modulated carrier frequency for V2X sidelink transmissions shall be accurate to within  $\pm 0.1$  PPM observed over a period of one time slot (0.5 ms) compared to the absolute frequency in case of using GNSS synchronization source. The same requirements applied over a period of one time slot (0.5 ms) compared to the relative frequency in case of using the E-UTRA Node B or V2X UE sidelink synchronization signals.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.5.1G apply for V2X sidelink transmission and the requirements in subclause 6.5.1 apply for the E-UTRA uplink transmission.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within  $\pm 0.1$  PPM observed over a period of one time slot (0.5 ms) in case of using GNSS synchronization source. The same requirements applied over a period of one time slot (0.5 ms) compared to the relative frequency in case of using the E-UTRA Node B or V2X UE sidelink synchronization signals.

If the UE transmits on one antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

## 6.5.2 Transmit modulation quality

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the UE. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)
- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process
- Carrier leakage
- In-band emissions for the non-allocated RB

All the parameters defined in subclause 6.5.2 are defined using the measurement methodology specified in Annex F.

### 6.5.2.1 Error Vector Magnitude

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further modified by selecting the absolute phase and absolute amplitude of the Tx chain. The EVM result is defined after the front-end IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH, and as specified in Table 6.5.2.1-1 for the PUCCH and PUSCH in the time domain. When the PUSCH or PUCCH transmission slot or subslot is shortened due to multiplexing with SRS, the EVM measurement interval is reduced by one symbol, accordingly. Likewise, when the PUSCH starting position is modified or when second last symbol is the ending symbol of the PUSCH subframe for Frame Structure Type 3, the EVM measurement interval is reduced accordingly. The PUSCH or PUCCH EVM measurement interval is also reduced when the mean power, modulation or allocation between slots or subslots is expected to change. In the case of PUSCH transmission, the measurement interval is reduced by a time interval equal to the sum of 5  $\mu$ s and the applicable exclusion period defined in subclause 6.3.4, adjacent to the boundary where the power change is expected to occur. The PUSCH exclusion period is applied to the signal obtained after the front-end IDFT. In the case of PUCCH transmission with power change, the PUCCH EVM measurement interval is reduced by one symbol adjacent to the boundary where the power change is expected to occur.

**Table 6.5.2.1-1: Measurement interval for EVM**

| TTI pattern | Measurement interval |
|-------------|----------------------|
| Subframe    | 7OS                  |
| Slot        | 7OS                  |
| Subslot     | 2OS, 3OS             |

#### 6.5.2.1.1 Minimum requirement

The RMS average of the basic EVM measurements for 10 subframes excluding any transient period for the average EVM case, and 60 subframes excluding any transient period for the reference signal EVM case, for the different modulations schemes shall not exceed the values specified in Table 6.5.2.1.1-1 for the parameters defined in Table 6.5.2.1.1-2. For EVM evaluation purposes, [all PRACH preamble formats 0-4 and] all PUCCH formats 1, 1a, 1b, 2, 2a and 2b are considered to have the same EVM requirement as QPSK modulated.

**Table 6.5.2.1.1-1: Minimum requirements for Error Vector Magnitude**

| Parameter    | Unit | Average EVM Level | Reference Signal EVM Level |
|--------------|------|-------------------|----------------------------|
| QPSK or BPSK | %    | 17.5              | 17.5                       |
| 16 QAM       | %    | 12.5              | 12.5                       |
| 64 QAM       | %    | 8                 | 8                          |
| 256 QAM      | %    | 3.5               | 3.5                        |

**Table 6.5.2.1.1-2: Parameters for Error Vector Magnitude**

| Parameter                   | Unit | Level             |
|-----------------------------|------|-------------------|
| UE Output Power             | dBm  | $\geq -40$        |
| UE Output Power for 256 QAM | dBm  | $\geq -30$        |
| Operating conditions        |      | Normal conditions |

### 6.5.2.2 Carrier leakage

Carrier leakage is an additive sinusoid waveform that has the same frequency as a modulated waveform carrier frequency. The measurement interval is one slot in the time domain.

6.5.2.2.1 Minimum requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.5.2.2.1-1.

**Table 6.5.2.2.1-1: Minimum requirements for relative carrier leakage power**

| Parameters  | Relative limit (dBc) | Applicable frequencies           |
|---|----------------------|----------------------------------|
| Output power >10 dBm  | -28                  | Carrier center frequency < 1 GHz |
|   | -25                  | Carrier center frequency ≥ 1 GHz |
| 0 dBm ≤ Output power ≤ 10 dBm   | -25                  |                                  |
| -30 dBm ≤ Output power ≤ 0 dBm  | -20                  |                                  |
| -40 dBm ≤ Output power < -30 dBm<br>(NOTE 1)  | -10                  |                                  |
| NOTE 1: The requirement in this power range is not applicable for V2X sidelink transmission for E-UTRA V2X operating bands specified in Table 5.5G-1. |                      |                                  |

6.5.2.3 In-band emissions

The in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non-allocated RB to the UE output power in an allocated RB.

The basic in-band emissions measurement interval is defined over one slot in the time domain. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one SC-FDMA symbol, accordingly. Likewise, when the PUSCH starting position is modified or when the second last symbol is the ending symbol of the PUSCH sub-frame for Frame Structure Type 3, the in-band emissions measurement interval is reduced accordingly.

6.5.2.3.1 Minimum requirements

The relative in-band emission shall not exceed the values specified in Table 6.5.2.3.1-1.

**Table 6.5.2.3.1-1: Minimum requirements for in-band emissions**

| Parameter description   | Unit | Limit (NOTE 1)  |   | Applicable Frequencies         |
|---|------|---|---|--------------------------------|
| <b>General</b>  | dB   | For Frame Structure Type 1 and Frame Structure Type 2:<br>$\max \left\{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), \right.$ $20 \cdot \log_{10} EVM - 3 - 5 \cdot ( \Delta_{RB}  - 1) / L_{CRB},$ $\left. -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \right\}$ For Frame Structure Type 3, 10 MHz and 20 MHz channel bandwidths:<br>$\max \left\{ -10 - 6( \Delta_{RB}  - 1), \right.$ $\left. -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \right\}$ |   | Any non-allocated (NOTE 2)     |
|   |      | -28   | Image frequencies when carrier center frequency < 1 GHz and Output power > 10 dBm |                                |
| <b>IQ Image</b>   | dB   | -25   | Image frequencies when carrier center frequency < 1 GHz and Output power ≤ 10 dBm |                                |
|   |      | -25   | Image frequencies when carrier center frequency ≥ 1 GHz                           |                                |
| <b>Carrier leakage</b>  | dBc  | -28   | Output power > 10 dBm and carrier center frequency < 1 GHz                        | Carrier frequency (NOTES 4, 5) |
|   |      | -25   | Output power > 10 dBm and carrier center frequency ≥ 1 GHz                        |                                |
|   |      | -25   | 0 dBm ≤ Output power ≤ 10 dBm   |                                |
|   |      | -20   | -30 dBm ≤ Output power ≤ 0 dBm  |                                |
|   |      | -10   | -40 dBm ≤ Output power < -30 dBm (NOTE 12)  |                                |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of $P_{RB} - 30$ dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. $P_{RB}$ is defined in NOTE 10. |      |   |   |                                |

- NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Frame Structure Type 3 and 20 MHz channel bandwidth, the requirement applies for QPSK, 16QAM and 64QAM modulation with  $|\Delta_{RB}| \leq 5$  for any non-allocated RB and  $RIV = 1$  in the uplink scheduling grant with  $RIV$  specified in [6]. For Frame Structure Type 3 and 10 MHz channel bandwidth in Band 49, the requirement applies for QPSK, 16QAM and 64QAM modulation with  $|\Delta_{RB}| \leq 3$  for any non-allocated RB and  $RIV = '01000$  in the uplink scheduling grant.
- NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated RBs. For Frame Structure Type 3 with 20 MHz channel bandwidth, the applicable frequency is  $n_{PRB} = 98$  for QPSK, 16QAM and 64QAM modulation. For Frame Structure Type 3 and 10 MHz channel bandwidth in Band 49, the applicable frequency is  $n_{PRB} = 48$  for QPSK, 16QAM and 64QAM modulation.
- NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs. For Frame Structure Type 3 and 20 MHz channel bandwidth, the requirement applies for QPSK, 16QAM and 64QAM modulation with  $RIV = 5$  in the uplink scheduling grant. For Frame Structure Type 3 and 10 MHz channel bandwidth in Band 49, the requirement applies for QPSK, 16QAM and 64QAM modulation with  $RIV = '00100$  in the uplink scheduling grant.
- NOTE 5: The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if  $N_{RB}$  is odd, or in the two RBs immediately adjacent to the DC frequency if  $N_{RB}$  is even, but excluding any allocated RB.
- NOTE 6:  $L_{CRB}$  is the Transmission Bandwidth (see Figure 5.6-1).
- NOTE 7:  $N_{RB}$  is the Transmission Bandwidth Configuration (see Figure 5.6-1).
- NOTE 8:  $EVM$  is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.
- NOTE 9:  $\Delta_{RB}$  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  $\Delta_{RB} = 1$  or  $\Delta_{RB} = -1$  for the first adjacent RB outside of the allocated bandwidth).
- NOTE 10:  $P_{RB}$  is the transmitted power per 180 kHz in allocated RBs, measured in dBm.
- [NOTE 11: For V2V-V2X waveforms, the requirements are applied when PSSCH and PSCCH are adjacent in frequency. The limit values (General, IQ Image or Carrier leakage) of each channel is calculated separately as  $P_{general, PSSCH}$ ,  $P_{IQ, PSSCH}$ ,  $P_{LO, PSSCH}$ ,  $P_{general, PSCCH}$ ,  $P_{IQ, PSCCH}$ ,  $P_{LO, PSCCH}$ , respectively. In-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of  $P_{RB, PSSCH} - 30$  dB and the  $P_{sumIBE, SSCH}$ , where  $P_{sumIBE, SSCH}$  is the linear sum of  $P_{general, PSSCH}$ ,  $P_{IQ, PSSCH}$ ,  $P_{LO, PSSCH}$ ,  $P_{general, PSCCH}$ ,  $P_{IQ, PSCCH}$ ,  $P_{LO, PSCCH}$ .]
- NOTE 12: The requirement in this power range is not applicable for V2X sidelink transmission for E-UTRA V2X operating bands specified in Table 5.5G-1.

NOTE: For Frame Structure 3 and operations in Band 46, in-band emissions requirements are not specified for the 10 MHz channel bandwidth.

#### 6.5.2.4 EVM equalizer spectrum flatness

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex F) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block. The basic measurement interval is the same as for EVM.

##### 6.5.2.4.1 Minimum requirements

The peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.5.2.4.1-1 for normal conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 5 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 7 dB (see Figure 6.5.2.4.1-1).

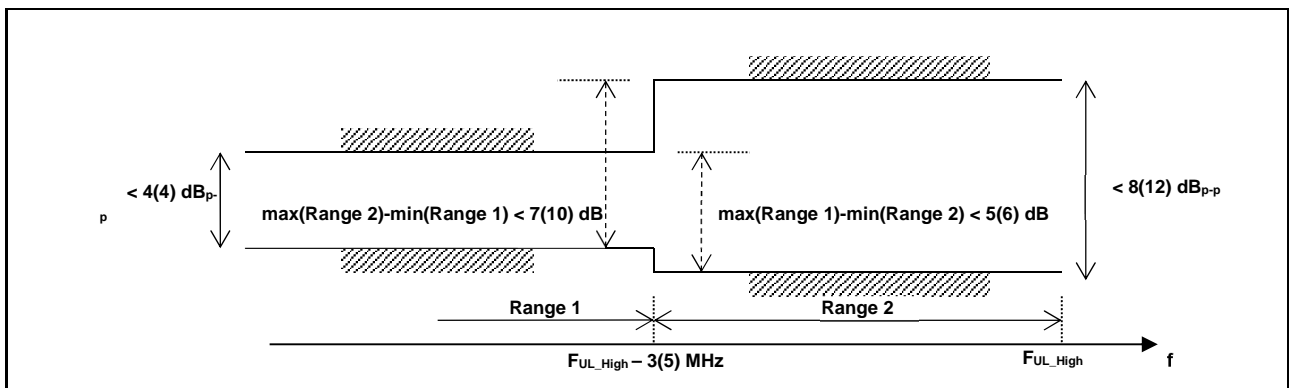
The EVM equalizer spectral flatness shall not exceed the values specified in Table 6.5.2.4.1-2 for extreme conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 10 dB (see Figure 6.5.2.4.1-1).

**Table 6.5.2.4.1-1: Minimum requirements for EVM equalizer spectrum flatness (normal conditions)**

| Frequency range   | Maximum ripple [dB] |
|---|---------------------|
| $F_{UL\_Meas} - F_{UL\_Low} \geq 3$ MHz and $F_{UL\_High} - F_{UL\_Meas} \geq 3$ MHz<br>(Range 1)           | 4 (p-p)             |
| $F_{UL\_Meas} - F_{UL\_Low} < 3$ MHz or $F_{UL\_High} - F_{UL\_Meas} < 3$ MHz<br>(Range 2)                  | 8 (p-p)             |
| NOTE 1: $F_{UL\_Meas}$ refers to the sub-carrier frequency for which the equalizer coefficient is evaluated |                     |
| NOTE 2: $F_{UL\_Low}$ and $F_{UL\_High}$ refer to each E-UTRA frequency band specified in Table 5.5-1       |                     |

**Table 6.5.2.4.1-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)**

| Frequency range   | Maximum Ripple [dB] |
|---|---------------------|
| $F_{UL\_Meas} - F_{UL\_Low} \geq 5$ MHz and $F_{UL\_High} - F_{UL\_Meas} \geq 5$ MHz<br>(Range 1)           | 4 (p-p)             |
| $F_{UL\_Meas} - F_{UL\_Low} < 5$ MHz or $F_{UL\_High} - F_{UL\_Meas} < 5$ MHz<br>(Range 2)                  | 12 (p-p)            |
| NOTE 1: $F_{UL\_Meas}$ refers to the sub-carrier frequency for which the equalizer coefficient is evaluated |                     |
| NOTE 2: $F_{UL\_Low}$ and $F_{UL\_High}$ refer to each E-UTRA frequency band specified in Table 5.5-1       |                     |



**Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).**

### 6.5.2A Transmit modulation quality for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the requirements shall apply on each component carrier as defined in clause 6.5.2 with all component carriers active. If two contiguous component carriers are assigned to one E-UTRA band, the requirements in subclauses 6.5.2A.1, 6.5.2A.2, and 6.5.2A.3 apply for those component carriers.

The requirements in this clause apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

### 6.5.2A.1 Error Vector Magnitude

For the intra-band contiguous and non-contiguous carrier aggregation, the Error Vector Magnitude requirement should be defined for each component carrier. Requirements only apply with PRB allocation in one of the component carriers. Similar transmitter impairment removal procedures are applied for CA waveform before EVM calculation as is specified for non-CA waveform in sub-section 6.5.2.1.

When a single component carrier is configured Table 6.5.2.1.1-1 apply.

The EVM requirements are according to Table 6.5.2A.1-1 if CA is configured in uplink with the parameters defined in Table 6.5.2.1.1-2.

**Table 6.5.2A.1-1: Minimum requirements for Error Vector Magnitude**

| Parameter    | Unit | Average EVM Level per CC | Reference Signal EVM Level |
|--------------|------|--------------------------|----------------------------|
| QPSK or BPSK | %    | 17.5                     | 17.5                       |
| 16 QAM       | %    | 12.5                     | 12.5                       |
| 64 QAM       | %    | 8                        | 8                          |
| 256 QAM      | %    | 3.5                      | 3.5                        |

### 6.5.2A.2 Carrier leakage for CA

Carrier leakage is an additive sinusoid waveform that is confined within the aggregated transmission bandwidth configuration. The carrier leakage requirement is defined for each component carrier and is measured on the component carrier with PRBs allocated. The measurement interval is one slot in the time domain.

#### 6.5.2A.2.1 Minimum requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.5.2A.2.1-1.

**Table 6.5.2A.2.1-1: Minimum requirements for Relative Carrier Leakage Power**

| Parameters                       | Relative Limit (dBc) |
|----------------------------------|----------------------|
| Output power >0 dBm              | -25                  |
| -30 dBm ≤ Output power ≤ 0 dBm   | -20                  |
| -40 dBm ≤ Output power < -30 dBm | -10                  |

### 6.5.2A.3 In-band emissions

#### 6.5.2A.3.1 Minimum requirement for CA

For intra-band contiguous carrier aggregation bandwidth class B, C and D, the requirements in Table 6.5.2A.3.1-1 and 6.5.2A.3.1-2 apply within the aggregated transmission bandwidth configuration with both component carrier (s) active and one single contiguous PRB allocation of bandwidth  $L_{CRB}$  at the edge of the aggregated transmission bandwidth configuration.

The inband emission is defined as the interference falling into the non allocated resource blocks for all component carriers. The measurement method for the inband emissions in the component carrier with PRB allocation is specified in annex F. For a non allocated component carrier a spectral measurement is specified.

For intra-band non-contiguous carrier aggregation the requirements for in-band emissions should be defined for each component carrier. Requirements only apply with PRB allocation in one of the component carriers according to Table 6.5.2.3.1.

**Table 6.5.2A.3.1-1: Minimum requirements for in-band emissions (allocated component carrier)**

| Parameter       | Unit | Limit  | Applicable Frequencies                   |
|-----------------|------|--|--|
| General         | dB   | $\max \{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), 20 \cdot \log_{10} EVM - 3 - 5 \cdot ( \Delta_{RB}  - 1) / L_{CRB}, -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \}$ | Any non-allocated (NOTE 2)               |
| IQ Image        | dB   | -25  | Exception for IQ image (NOTE 3)          |
| Carrier leakage | dBc  | -25  | Exception for Carrier frequency (NOTE 4) |
|                 |      | -20  |  |
|                 |      | -10  |  |

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of  $P_{RB} - 30$  dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply.  $P_{RB}$  is defined in NOTE 9. The limit is evaluated in each non-allocated RB.

NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs

NOTE 3: Exceptions to the general limit are allowed for up to  $L_{CRBs} + 1$  RBs within a contiguous width of  $L_{CRBs} + 1$  non-allocated RBs. The measurement bandwidth is 1 RB.

NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.

NOTE 5:  $L_{CRB}$  is the Transmission Bandwidth (see Figure 5.6-1) not exceeding  $\lfloor N_{RB} / 2 - 1 \rfloor$

NOTE 6:  $N_{RB}$  is the Transmission Bandwidth Configuration (see Figure 5.6-1) of the component carrier with RBs allocated.

NOTE 7:  $EVM$  is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

NOTE 8:  $\Delta_{RB}$  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  $\Delta_{RB} = 1$  or  $\Delta_{RB} = -1$  for the first adjacent RB outside of the allocated bandwidth).

NOTE 9:  $P_{RB}$  is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

NOTE 10: For V2X intra-band contiguous multi-carrier operation the in-band emission requirement (General, IQ Image or Carrier leakage) of each channel is calculated separately as  $P_{general, PSSCH,c(i)}, P_{IQ, PSSCH,c(i)}, P_{LO, PSSCH,c(i)}, P_{general, PSCCH,c(i)}, P_{IQ, PSCCH,c(i)}, P_{LO, PSCCH,c(i)}$  for each carrier respectively. In-band emissions combined limit for the aggregated bandwidth is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the  $P_{sumIBE,CA}$ , where  $P_{sumIBE,CA}$  is the linear sum of  $P_{general, PSSCH,c(i)}, P_{IQ, PSSCH,c(i)}, P_{LO, PSSCH,c(i)}, P_{general, PSCCH,c(i)}, P_{IQ, PSCCH,c(i)}, P_{LO, PSCCH,c(i)}$  for all carriers.

**Table 6.5.2A.3.1-2: Minimum requirements for in-band emissions (not allocated component carrier)**

| Parameter | Unit | Meas BW NOTE 1                  | Limit  | remark   | Applicable Frequencies  |
|-----------|------|---------------------------------|--|--|---|
| General   | dB   | BW of 1 RB (180KHz rectangular) | $\max \{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), 20 \cdot \log_{10} EVM - 3 - 5 \cdot ( \Delta_{RB}  - 1) / L_{CRB}, -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \}$ | The reference value is the average power per allocated RB in the allocated component carrier | Any RB in the non allocated component carrier. The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| IQ Image  | dB   | BW of 1 RB (180KHz rectangular) | -25<br>NOTE 2  | The reference value is the average power per allocated RB in the allocated                   | The frequencies of the $L_{CRB}$ contiguous non-allocated RBs are unknown.  |



|  |     |                                 |        |                                  |  |  |
|--|-----|---------------------------------|--------|----------------------------------|--|--|
|  |     |                                 |        | component carrier                | The frequency raster of the RBs is derived when this component carrier is allocated with RBs   |  |
| Carrier leakage  | dBc | BW of 1 RB (180KHz rectangular) | NOTE 3 |                                  | The reference value is the total power of the allocated RBs in the allocated component carrier | The frequencies of the up to 2 non-allocated RBs are unknown. The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
|  |     |                                 | -25    | Output power > 0 dBm             |  |  |
|  |     |                                 | -20    | -30 dBm ≤ Output power ≤ 0 dBm   |  |  |
|  |     |                                 | -10    | -40 dBm ≤ Output power < -30 dBm |  |  |
| <p>NOTE 1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.</p> <p>NOTE 2: Exceptions to the general limit is are allowed for up to <math>L_{CRB} + 1</math> RBs within a contiguous width of <math>L_{CRB} + 1</math> non-allocated RBs.</p> <p>NOTE 3: Two Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs</p> <p>NOTE 4: NOTES 1, 5, 6, 7, 8, 9 from Table 6.5.2A.3.1-1 apply for Table 6.5.2A.3.1-2 as well.</p> <p>NOTE 5: <math>\Delta_{RB}</math> for measured non-allocated RB in the non allocated component carrier may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.</p> <p>NOTE 6: For V2X intra-band contiguous multi-carrier operation the in-band emission requirement (General, IQ Image or Carrier leakage) of each channel is calculated separately as <math>P_{general, PSSCH,c(i)}</math>, <math>P_{IQ, PSSCH,c(i)}</math>, <math>P_{LO, PSSCH,c(i)}</math>, <math>P_{general, PSCCH,c(i)}</math>, <math>P_{IQ, PSCCH,c(i)}</math>, <math>P_{LO, PSCCH,c(i)}</math> for each carrier respectively. In-band emissions combined limit for the aggregated bandwidth is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the <math>P_{sumIBE,CA}</math>, where <math>P_{sumIBE,CA}</math> is the linear sum of <math>P_{general, PSSCH,c(i)}</math>, <math>P_{IQ, PSSCH,c(i)}</math>, <math>P_{LO, PSSCH,c(i)}</math>, <math>P_{general, PSCCH,c(i)}</math>, <math>P_{IQ, PSCCH,c(i)}</math>, <math>P_{LO, PSCCH,c(i)}</math> for all carriers.</p> |     |                                 |        |                                  |  |  |

### 6.5.2B Transmit modulation quality for UL-MIMO

For UE supporting UL-MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.2 apply.

The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)
- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process
- Carrier leakage (caused by IQ offset)
- In-band emissions for the non-allocated RB

#### 6.5.2B.1 Error Vector Magnitude

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in Table 6.5.2.1.1-1 which is defined in subclause 6.5.2.1 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

### 6.5.2B.2 Carrier leakage

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Relative Carrier Leakage Power requirements specified in Table 6.5.2.2.1-1 which is defined in subclause 6.5.2.2 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

### 6.5.2B.3 In-band emissions

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the In-band Emission requirements specified in Table 6.5.2.3.1-1 which is defined in subclause 6.5.2.3 apply at each transmit antenna connector. The requirements shall be met with the uplink MIMO configurations specified in Table 6.2.2B-2.

### 6.5.2B.4 EVM equalizer spectrum flatness for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the EVM Equalizer Spectrum Flatness requirements specified in Table 6.5.2.4.1-1 and Table 6.5.2.4.1-2 which are defined in subclause 6.5.2.4 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

## 6.5.2D Transmit modulation quality for ProSe

The requirements in this clause apply to ProSe sidelink transmissions.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.5.2D apply for ProSe transmission and the requirements in subclause 6.5.2 apply for uplink transmission.

### 6.5.2D.1 Error Vector Magnitude

For ProSe sidelink physical channels PSDCH, PSCCH, PSSCH, and PSBCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in subclause 6.5.2.1 for the corresponding modulation and transmission bandwidth. When ProSe transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

For PSBCH the duration over which EVM is averaged shall be 24 subframes.

This requirement is not applicable for ProSe physical signals PSSS and SSSS.

### 6.5.2D.2 Carrier leakage

The requirements of subclause 6.5.2.2 shall apply for ProSe transmissions.

### 6.5.2D.3 In-band emissions

For ProSe sidelink physical channels PSDCH, PSCCH, PSSCH, and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.5.2.3 for the corresponding modulation and transmission bandwidth. When ProSe transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

### 6.5.2D.4 EVM equalizer spectrum flatness for ProSe

The requirements of subclause 6.5.2.4 shall apply for ProSe transmissions.

## 6.5.2E Transmit modulation quality for category M1 and M2

### 6.5.2E.1 Error Vector Magnitude

The Error Vector Magnitude is defined in section 6.5.2.1.

## 6.5.2E.2 Carrier leakage

Carrier leakage is an additive sinusoid waveform that has the same frequency as a modulated waveform carrier frequency. For UE of UL Categories M1 and M2, the sinusoid waveform may lie at the center of the narrowband assigned for transmission. The measurement interval is one slot in the time domain.

### 6.5.2E.2.1 Minimum requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power at the center of the channel bandwidth or the center of the narrowband assigned for transmission shall not exceed the values specified in Table 6.5.2.2.1-1.

## 6.5.2E.3 In-band emissions

The in-band emission is defined in clause 6.5.2.3 and measurement condition specified in Annex F.

### 6.5.2E.3.1 Minimum requirements

The relative in-band emission when the center carrier frequency is either at the center of channel bandwidth or at the center of the narrowband assigned for transmission shall not exceed the values specified in Table 6.5.2E.3.1-1

**Table 6.5.2E.3.1-1: Minimum requirements for in-band emissions**

| Parameter description  | Unit | Limit (NOTE 1)   |   | Applicable Frequencies  |
|--|------|--|---|---|
| General  | dB   | $-18 - [5] \cdot ( \Delta_{SubG}  - 1) / L_{SCG}$  |   | Any non-allocated Subcarrier Group within the subPRB allocation (NOTE 11,12,13) |
|  |      | $\max \left\{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), \right.$ $20 \cdot \log_{10} EVM - 3 - 5 \cdot ( \Delta_{RB}  - 1) / L_{CRB},$ $\left. -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \right\}$ |   | Any non-allocated (NOTE 2)  |
| IQ Image   | dB   | -28  | Image frequencies when carrier center frequency < 1 GHz and Output power > 10 dBm | Image frequencies (NOTES 2, 3)  |
|  |      | -25  | Image frequencies when carrier center frequency < 1 GHz and Output power ≤ 10 dBm |   |
|  |      | -25  | Image frequencies when carrier center frequency ≥ 1 GHz                           |   |
| Carrier leakage  | dBc  | -28  | Output power > 10 dBm and carrier center frequency < 1 GHz                        | Carrier frequency (NOTES 4, 5)  |
|  |      | -25  | Output power > 10 dBm and carrier center frequency ≥ 1 GHz                        |   |
|  |      | -25  | 0 dBm ≤ Output power ≤ 10 dBm   |   |
|  |      | -20  | -30 dBm ≤ Output power ≤ 0 dBm  |   |
|  |      | -10  | -40 dBm ≤ Output power < -30 dBm  |   |
| <p>NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of <math>P_{RB} - 30</math> dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. <math>P_{RB}</math> is defined in NOTE 10.</p> <p>NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.</p> <p>NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated RBs. For UE of UL Categories M1 and M2, the applicable frequencies shall alternatively include those found by reflection on the center of the assigned narrowband, but excluding any allocated RBs.</p> <p>NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.</p> <p>NOTE 5: The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if <math>N_{RB}</math> is odd, or in the two RBs immediately adjacent to the DC frequency if <math>N_{RB}</math> is even, but excluding any allocated RB. For UE of UL Categories M1 and M2, the applicable frequencies shall alternatively be the centre frequency of the supported 6RBs.</p> |      |  |   |   |

NOTE 6:  $L_{CRB}$  is the Transmission Bandwidth (see Figure 5.6-1).

NOTE 7:  $N_{RB}$  is the Transmission Bandwidth Configuration (see Figure 5.6-1).

NOTE 8:  $EVM$  is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

NOTE 9:  $\Delta_{RB}$  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  $\Delta_{RB} = 1$  or  $\Delta_{RB} = -1$  for the first adjacent RB outside of the allocated bandwidth).

NOTE 10:  $P_{RB}$  is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

NOTE 11: The measurement bandwidth is 1 subcarrier group ( [3] subcarrier per subcarrier group) and the limit is expressed as a ratio of measured power in one non-allocated subcarrier group to the measured total power in all allocated subcarrier.

NOTE 12:  $\Delta_{SubG}$  is the starting frequency offset between the allocated subcarrier group and the measured non-allocated subcarrier group (e.g.  $\Delta_{SubG} = 1$  or  $\Delta_{SubG} = -1$  for the first adjacent subcarrier group outside the allocated subcarrier group.)

NOTE 13:  $L_{SCG}$  is the Transmission bandwidth (number of subcarrier group).

## 6.5.2F Transmit modulation quality for Category NB1 and NB2

### 6.5.2F.1 Error Vector Magnitude

The RMS average of the basic EVM measurements for  $240/L_{Ctone}$  slots excluding any transient period for the average EVM case, where  $L_{Ctone} = \{1, 3, 6, 12\}$  is the number of subcarriers for the category NB1 and NB2 transmission, for the different modulations schemes shall not exceed the values specified in Table 6.5.2.1.1-1 for the parameters defined in Table 6.5.2.1.1-2. For EVM evaluation purposes, both NPRACH formats are considered to have the same EVM requirement as QPSK modulated.

### 6.5.2F.2 Carrier leakage

Carrier leakage is an additive sinusoid waveform that has the same frequency as a modulated waveform carrier frequency. The measurement interval is one slot in the time domain. The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power of category NB1 or NB2 UE shall not exceed the values specified in Table 6.5.2F.2-1.

**Table 6.5.2F.2-1: Minimum requirements for relative carrier leakage power**

| Parameters  | Relative limit (dBc) |
|---|----------------------|
| $0 \text{ dBm} \leq \text{Output power}$                      | -25                  |
| $-30 \text{ dBm} \leq \text{Output power} \leq 0 \text{ dBm}$ | -20                  |
| $-40 \text{ dBm} \leq \text{Output power} < -30 \text{ dBm}$  | -10                  |

### 6.5.2F.3 In-band emissions

The in-band emission is defined as a function of the tone offset from the edge of the allocated UL transmission tone(s) within the transmission bandwidth configuration. The in-band emission is measured as the ratio of the UE output power in a non-allocated tone to the UE output power in an allocated tone. The basic in-band emissions measurement interval is defined over one slot in the time domain.

The category NB1 and NB2 UE relative in-band emission shall not exceed the values specified in Table 6.5.2F.3-1.

**Table 6.5.2F.3-1: Minimum requirements for in-band emissions**

| Parameter description | Unit | Limit (NOTE 1)   | Applicable Frequencies     |
|-----------------------|------|--|----------------------------|
| General               | dB   | $\max \left\{ \begin{aligned} & -15 - 10 \cdot \log_{10} (N_{tone} / L_{Ctone}), \\ & -18 - 5 \cdot ( \Delta_{tone}  - 1) / L_{Ctone}, \\ & -57 \text{ dBm} / (3.75 \text{ kHz or } 15 \text{ kHz}) - P_{tone} \end{aligned} \right\}$ | Any non-allocated (NOTE 2) |

| IQ Image        | dB  | -25 |   | Image frequencies (NOTES 2, 3) |
|-----------------|-----|-----|---|--------------------------------|
| Carrier leakage | dBc | -25 | $0 \text{ dBm} \leq \text{Output power}$                      | Carrier frequency (NOTES 4, 5) |
|                 |     | -20 | $-30 \text{ dBm} \leq \text{Output power} \leq 0 \text{ dBm}$ |                                |
|                 |     | -10 | $-40 \text{ dBm} \leq \text{Output power} < -30 \text{ dBm}$  |                                |

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated tone. For each such tone, the minimum requirement is calculated as the higher of  $P_{\text{tone}} - 30 \text{ dB}$  and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply.  $P_{\text{tone}}$  is defined in NOTE 9.

NOTE 2: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured average power per allocated tone, where the averaging is done across all allocated tones.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated tones.

NOTE 4: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured total power in all allocated tones.

NOTE 5: The applicable frequencies for this limit are those that are enclosed in the tones containing the DC frequency if  $N_{\text{tone}}$  is odd, or in the two tones immediately adjacent to the DC frequency if  $N_{\text{tone}}$  is even, but excluding any allocated tone.

NOTE 6:  $L_{\text{Ctone}}$  is the Transmission Bandwidth (tones).

NOTE 7:  $N_{\text{tone}}$  is the Transmission Bandwidth Configuration (tones).

NOTE 8:  $\Delta_{\text{tone}}$  is the starting frequency offset between the allocated tone and the measured non-allocated tone. (e.g.  $\Delta_{\text{tone}} = 1$  or  $\Delta_{\text{tone}} = -1$  for the first adjacent tone outside of the allocated bandwidth).

NOTE 9:  $P_{\text{tone}}$  is the transmitted power per 3.75 kHz or 15 kHz in allocated tones, measured in dBm.

## 6.5.2G Transmit modulation quality for V2X Communication

The requirements in this clause apply to V2X sidelink transmissions.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.5.2G apply for V2X sidelink transmission and the requirements in subclause 6.5.2 apply for the E-UTRA uplink transmission.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna-connectors at the same time, the transmit modulation quality requirements for single carrier shall apply to each transmit antenna connector.

If V2X UE transmits on one-antenna connector at a time, the requirements specified for single carrier apply to the active antenna connector.

### 6.5.2G.1 Error Vector Magnitude

For V2X physical channels PSCCH, PSSCH and PSBCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in subclause 6.5.2.1 for the corresponding modulation and transmission bandwidth.

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the Error Vector Magnitude requirements shall be as specified separately for PSSCH and PSCCH for the corresponding modulation and transmission bandwidth. The measurement period for EVM of PSSCH and PSCCH is 15 subframes. The measurement period for reference signal EVM is 30 subframes. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

For PSBCH the duration over which EVM is averaged shall be 24 subframes.

For intra-band contiguous multi-carrier operation the EVM requirement shall apply for each component carrier.

### 6.5.2G.2 Carrier leakage

The requirements of subcaluse 6.5.2.2 shall apply for V2X transmissions.

For intra-band contiguous multi-carrier operation the carrier leakage requirement of subclause 6.5.2A.2 shall apply.

### 6.5.2G.3 In-band emissions

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.5.2.3 for the corresponding modulation and transmission bandwidth. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

For intra-band contiguous multi-carrier operation the in-band emission requirement of subclause 6.5.2A.3 shall apply.

### 6.5.2G.4 EVM equalizer spectrum flatness

The requirements of subclause 6.5.2.4 shall apply for V2X transmissions.

For intra-band contiguous multi-carrier operation the EVM equalizer spectrum flatness requirement of subclause 6.5.2.4 shall apply for each component carrier.

## 6.6 Output RF spectrum emissions

The output UE transmitter spectrum consists of the three components; the emission within the occupied bandwidth (channel bandwidth), the Out Of Band (OOB) emissions and the far out spurious emission domain.

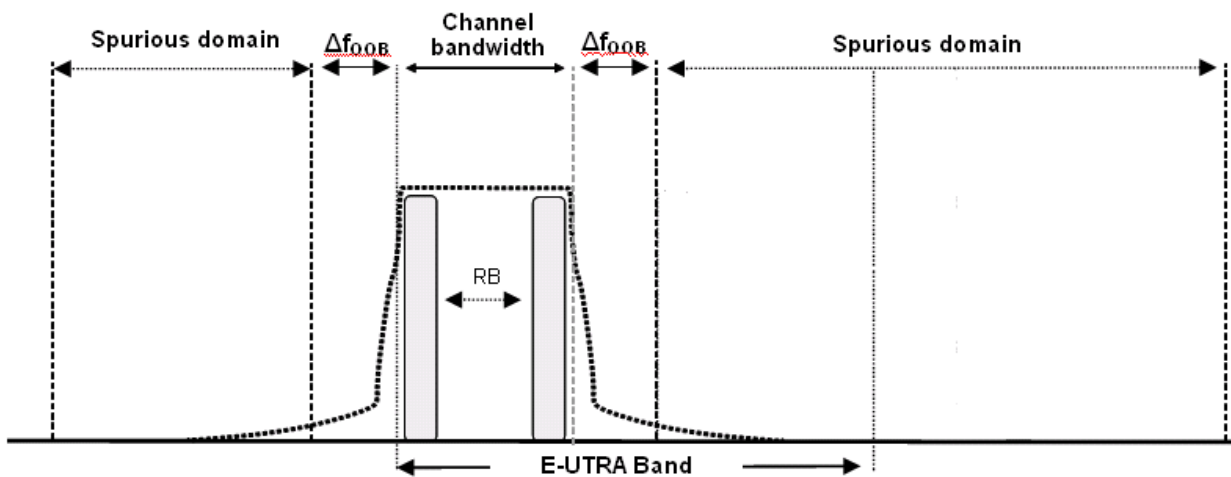


Figure 6.6-1: Transmitter RF spectrum

### 6.6.1 Occupied bandwidth

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.6.1-1

Table 6.6.1-1: Occupied channel bandwidth

|                         | Occupied channel bandwidth / Channel bandwidth |         |       |        |        |        |
|-------------------------|--|---------|-------|--------|--------|--------|
|                         | 1.4 MHz  | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Channel bandwidth (MHz) | 1.4  | 3       | 5     | 10     | 15     | 20     |

### 6.6.1.1 Additional minimum requirement for E-UTRA (network signalled value "NS\_29")

For E-UTRA CA bands including one uplink LAA Scell in Band 46 with "NS\_29" indicated, the occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than or equal to 19 MHz and 19.7MHz for E-UTRA carriers of 20 MHz bandwidth assigned within 5150-5350 MHz and 5470-5725 MHz, respectively.

### 6.6.1A Occupied bandwidth for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands the occupied bandwidth is defined per component carrier. Occupied bandwidth is the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on assigned channel bandwidth on the component carrier. The occupied bandwidth shall be less than the channel bandwidth specified in Table 6.6.1-1.

For intra-band contiguous carrier aggregation the occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated power of the transmitted spectrum. The OBW shall be less than the aggregated channel bandwidth defined in subclause 5.6A.

For intra-band non-contiguous carrier aggregation sub-block occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the sub-block. In case the sub-block consist of one component carrier the occupied bandwidth of the sub-block shall be less than the channel bandwidth specified in Table 6.6.1-1.

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the occupied bandwidth is the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on each E-UTRA band. The OBW shall be less than the channel bandwidth as specified in Table 6.6.1-1 for the E-UTRA band supporting one component carrier. The OBW shall be less than the aggregated channel bandwidth as specified in subclause 5.6A for the E-UTRA band supporting two contiguous component carriers.

### 6.6.1B Occupied bandwidth for UL-MIMO

For UE supporting UL-MIMO, the requirements for occupied bandwidth is specified at each transmit antenna connector. The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified in Table 6.6.1B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

**Table 6.6.1B-1: Occupied channel bandwidth**

|                         | Occupied channel bandwidth / Channel bandwidth |         |       |        |        |        |
|-------------------------|--|---------|-------|--------|--------|--------|
|                         | 1.4 MHz  | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Channel bandwidth (MHz) | 1.4  | 3       | 5     | 10     | 15     | 20     |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.6.1 apply.

### 6.6.1F Occupied bandwidth for category NB1 and NB2

The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at the transmit antenna connector. Occupied bandwidth shall be less than the channel bandwidth of category NB1 and NB2 specified in Section 5.6F.

## 6.6.1G Occupied bandwidth for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table Table 5.5G-1, the requirements in subclause 6.6.1 apply for E-UTRA V2X sidelink transmission.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.6.1 apply for V2X sidelink transmission and the E-UTRA uplink transmission.

For intra-band contiguous multi-carrier operation, the occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated power of the transmitted spectrum. The OBW shall be less than the aggregated channel bandwidth defined in subclause 5.6A.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements for occupied bandwidth is specified at each transmit antenna connector and the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified for single carrier.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

## 6.6.2 Out of band emission

The Out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an Adjacent Channel Leakage power Ratio.

### 6.6.2.1 Spectrum emission mask

The spectrum emission mask of the UE applies to frequencies ( $\Delta f_{\text{OOB}}$ ) starting from the  $\pm$  edge of the assigned E-UTRA channel bandwidth. For frequencies offset greater than  $\Delta f_{\text{OOB}}$  as specified in Table 6.6.2.1.1-1 the spurious requirements in subclause 6.6.3 are applicable.

#### 6.6.2.1.1 Minimum requirement

The power of any UE emission shall not exceed the levels specified in Table 6.6.2.1.1-1 for the specified channel bandwidth.

**Table 6.6.2.1.1-1: General E-UTRA spectrum emission mask**

| Spectrum emission limit (dBm)/ Channel bandwidth |            |            |          |           |           |           |                          |
|--|------------|------------|----------|-----------|-----------|-----------|--------------------------|
| $\Delta f_{\text{OOB}}$<br>(MHz)                 | 1.4<br>MHz | 3.0<br>MHz | 5<br>MHz | 10<br>MHz | 15<br>MHz | 20<br>MHz | Measurement<br>bandwidth |
| $\pm 0-1$  | -10        | -13        | -15      | -18       | -20       | -21       | 30 kHz                   |
| $\pm 1-2.5$                                      | -10        | -10        | -10      | -10       | -10       | -10       | 1 MHz                    |
| $\pm 2.5-2.8$                                    | -25        | -10        | -10      | -10       | -10       | -10       | 1 MHz                    |
| $\pm 2.8-5$                                      |            | -10        | -10      | -10       | -10       | -10       | 1 MHz                    |
| $\pm 5-6$  |            | -25        | -13      | -13       | -13       | -13       | 1 MHz                    |
| $\pm 6-10$                                       |            |            | -25      | -13       | -13       | -13       | 1 MHz                    |
| $\pm 10-15$                                      |            |            |          | -25       | -13       | -13       | 1 MHz                    |
| $\pm 15-20$                                      |            |            |          |           | -25       | -13       | 1 MHz                    |
| $\pm 20-25$                                      |            |            |          |           |           | -25       | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.



### 6.6.2.1A Spectrum emission mask for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the spectrum emission mask of the UE is defined per component carrier while both component carriers are active and the requirements are specified in subclauses 6.6.2.1 and 6.6.2.2. If for some frequency spectrum emission masks of component carriers overlap then spectrum emission mask allowing higher power spectral density applies for that frequency. If for some frequency a component carrier spectrum emission mask overlaps with the channel bandwidth of another component carrier, then the emission mask does not apply for that frequency.

For intra-band contiguous carrier aggregation the spectrum emission mask of the UE applies to frequencies ( $\Delta f_{\text{OOB}}$ ) starting from the  $\pm$  edge of the aggregated channel bandwidth (Table 5.6A-1) For intra-band contiguous carrier aggregation the bandwidth class B, C and D, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.1A-0, Table 6.6.2.1A-1 and Table 6.6.2.1A-2 for the specified channel bandwidth.

**Table 6.6.2.1A-0: General E-UTRA CA spectrum emission mask for Bandwidth Class B**

| $\Delta f_{\text{OOB}}$<br>(MHz) | 25RB+25RB<br>(9.8MHz) | 25RB+50RB<br>(14.95 MHz) | 25RB+75RB<br>(19.8MHz) | 50RB+50RB<br>(19.9 MHz) | Measurement<br>bandwidth |
|----------------------------------|-----------------------|--------------------------|------------------------|-------------------------|--------------------------|
| $\pm 0-1$                        | -18                   | -20                      | -21                    | -21                     | 30 kHz                   |
| $\pm 1-5$                        | -10                   | -10                      | -10                    | -10                     | 1 MHz                    |
| $\pm 5-9.8$                      | -13                   | -13                      | -13                    | -13                     | 1 MHz                    |
| $\pm 9.8-14.8$                   | -25                   | -13                      | -13                    | -13                     | 1 MHz                    |
| $\pm 14.8-14.95$                 |                       | -13                      | -13                    | -13                     | 1 MHz                    |
| $\pm 14.95-19.80$                |                       | -25                      | -13                    | -13                     | 1 MHz                    |
| $\pm 19.80-19.90$                |                       | -25                      | -25                    | -13                     | 1 MHz                    |
| $\pm 19.90-19.95$                |                       | -25                      | -25                    | -25                     | 1 MHz                    |
| $\pm 19.95-24.80$                |                       |                          | -25                    | -25                     | 1 MHz                    |
| $\pm 24.80-24.90$                |                       |                          |                        | -25                     | 1 MHz                    |

**Table 6.6.2.1A-1: General E-UTRA CA spectrum emission mask for Bandwidth Class C**

| Spectrum emission limit [dBm]/BW <sub>Channel_CA</sub> |                          |                          |                          |                       |                           |                           |                          |
|--|--------------------------|--------------------------|--------------------------|-----------------------|---------------------------|---------------------------|--------------------------|
| $\Delta f_{\text{OOB}}$<br>(MHz)                       | 25RB+100RB<br>(24.95MHz) | 50RB+75RB<br>(24.75 MHz) | 50RB+100RB<br>(29.9 MHz) | 75RB+75RB<br>(30 MHz) | 75RB+100RB<br>(34.85 MHz) | 100RB+100RB<br>(39.8 MHz) | Measurement<br>bandwidth |
| $\pm 0-1$  | -22                      | -22                      | -22.5                    | -22.5                 | -23.5                     | -24                       | 30 kHz                   |
| $\pm 1-5$  | -10                      | -10                      | -10                      | -10                   | -10                       | -10                       | 1 MHz                    |
| $\pm 5-24.75$  | -13                      | -13                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 24.75-24.95$                                      | -13                      | -25                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 24.95-29.75$                                      | -25                      | -25                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 29.75-29.9$                                       | -25                      |                          | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 29.9-29.95$                                       | -25                      |                          | -25                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 29.95-30$   |                          |                          | -25                      | -13                   | -13                       | -13                       | 1 MHz                    |
| $\pm 30-34.85$   |                          |                          | -25                      | -25                   | -13                       | -13                       | 1 MHz                    |
| $\pm 34.85-34.9$                                       |                          |                          | -25                      | -25                   | -25                       | -13                       | 1 MHz                    |
| $\pm 34.9-35$  |                          |                          |                          | -25                   | -25                       | -13                       | 1 MHz                    |
| $\pm 35-39.8$  |                          |                          |                          |                       | -25                       | -13                       | 1 MHz                    |
| $\pm 39.8-39.85$                                       |                          |                          |                          |                       | -25                       | -25                       | 1 MHz                    |
| $\pm 39.85-44.8$                                       |                          |                          |                          |                       |                           | -25                       | 1 MHz                    |

**Table 6.6.2.1A-2: General E-UTRA CA spectrum emission mask for Bandwidth Class D**

| Spectrum emission limit [dBm]/BW <sub>Channel_CA</sub> |                                  |                               |                                    |                                   |                                    |                                     |                          |
|--|----------------------------------|-------------------------------|------------------------------------|-----------------------------------|------------------------------------|-------------------------------------|--------------------------|
| $\Delta f_{\text{OOB}}$<br>(MHz)                       | 50RB+75R<br>B+100RB<br>(44.6MHz) | 75RB+75R<br>B+75RB<br>(45MHz) | 50RB+100R<br>B+100 RB<br>(49.7MHz) | 75RB+75RB<br>+100RB<br>(49.85MHz) | 75RB+100R<br>B+100RB<br>(54.65MHz) | 100RB+100<br>RB+100 RB<br>(59.6MHz) | Measurement<br>bandwidth |
| $\pm 0-1$  | -22                              | -22                           | -22.5                              | -22.5                             | -23.5                              | -24                                 | 30 kHz                   |
| $\pm 1-5$  | -10                              | -10                           | -10                                | -10                               | -10                                | -10                                 | 1 MHz                    |
| $\pm 5-44.6$   | -13                              | -13                           | -13                                | -13                               | -13                                | -13                                 | 1 MHz                    |
| $\pm 44.6-45$  | -25                              | -13                           | -13                                | -13                               | -13                                | -13                                 | 1 MHz                    |
| $\pm 45-49.6$  | -25                              | -25                           | -13                                | -13                               | -13                                | -13                                 | 1 MHz                    |
| $\pm 49.6-49.7$  |                                  | -25                           | -13                                | -13                               | -13                                | -13                                 | 1 MHz                    |

|                  |  |     |     |     |     |     |       |
|------------------|--|-----|-----|-----|-----|-----|-------|
| $\pm 49.7-49.85$ |  | -25 | -25 | -13 | -13 | -13 | 1 MHz |
| $\pm 49.85-50$   |  | -25 | -25 | -25 | -13 | -13 | 1 MHz |
| $\pm 50-54.65$   |  |     | -25 | -25 | -13 | -13 | 1 MHz |
| $\pm 54.65-54.7$ |  |     | -25 | -25 | -25 | -13 | 1 MHz |
| $\pm 54.7-54.85$ |  |     |     | -25 | -25 | -13 | 1 MHz |
| $\pm 54.85-59.6$ |  |     |     |     | -25 | -13 | 1 MHz |
| $\pm 59.6-59.65$ |  |     |     |     | -25 | -25 | 1 MHz |
| $\pm 59.65-64.6$ |  |     |     |     |     | -25 | 1 MHz |

For intra-band non-contiguous carrier aggregation transmission the spectrum emission mask requirement is defined as a composite spectrum emissions mask. Composite spectrum emission mask applies to frequencies up to  $\pm \Delta f_{\text{OoB}}$  starting from the edges of the sub-blocks. Composite spectrum emission mask is defined as follows

- a) Composite spectrum emission mask is a combination of individual sub-block spectrum emissions masks
- b) In case the sub-block consist of one component carrier the sub-block general spectrum emission mask is defined in subclause 6.6.2.1.1
- c) If for some frequency sub-block spectrum emission masks overlap then spectrum emission mask allowing higher power spectral density applies for that frequency
- d) If for some frequency a sub-block spectrum emission mask overlaps with the sub-block bandwidth of another sub-block, then the emission mask does not apply for that frequency.

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the spectrum emission mask of the UE is defined per E-UTRA band while all component carriers are active. For the E-UTRA band supporting one component carrier the requirements in subclauses 6.6.2.1 and 6.6.2.2 apply. For the E-UTRA band supporting two contiguous component carriers the requirements specified in subclause 6.6.2.1A apply. If for some frequency spectrum emission masks of single component carrier and two contiguous component carriers overlap then spectrum emission mask allowing higher power spectral density applies for that frequency. If for some frequency spectrum emission masks of single component carrier or two contiguous component carriers overlap then the emission mask does not apply for that frequency.

## 6.6.2.2 Additional spectrum emission mask

This requirement is specified in terms of an "additional spectrum emission" requirement.

### 6.6.2.2.1 Minimum requirement (network signalled value "NS\_03", "NS\_11", "NS\_20", and "NS\_21")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_03", "NS\_11", "NS\_20" or "NS\_21" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.1-1.

**Table 6.6.2.2.1-1: Additional requirements**

| $\Delta f_{\text{OoB}}$<br>(MHz) | Spectrum emission limit (dBm)/ Channel bandwidth |         |       |        |        |        | Measurement bandwidth |
|----------------------------------|--|---------|-------|--------|--------|--------|-----------------------|
|                                  | 1.4 MHz  | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |                       |
| $\pm 0-1$                        | -10  | -13     | -15   | -18    | -20    | -21    | 30 kHz                |
| $\pm 1-2.5$                      | -13  | -13     | -13   | -13    | -13    | -13    | 1 MHz                 |
| $\pm 2.5-2.8$                    | -25  | -13     | -13   | -13    | -13    | -13    | 1 MHz                 |
| $\pm 2.8-5$                      |  | -13     | -13   | -13    | -13    | -13    | 1 MHz                 |
| $\pm 5-6$                        |  | -25     | -13   | -13    | -13    | -13    | 1 MHz                 |
| $\pm 6-10$                       |  |         | -25   | -13    | -13    | -13    | 1 MHz                 |
| $\pm 10-15$                      |  |         |       | -25    | -13    | -13    | 1 MHz                 |
| $\pm 15-20$                      |  |         |       |        | -25    | -13    | 1 MHz                 |
| $\pm 20-25$                      |  |         |       |        |        | -25    | 1 MHz                 |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.6.2.2.2 Minimum requirement (network signalled value "NS\_04")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.2-1.

**Table 6.6.2.2.2-1: Additional requirements**

| $\Delta f_{\text{OoB}}$<br>(MHz) | Spectrum emission limit (dBm)/ Channel bandwidth |           |           |           |                          |
|----------------------------------|--|-----------|-----------|-----------|--------------------------|
|                                  | 5<br>MHz   | 10<br>MHz | 15<br>MHz | 20<br>MHz | Measurement<br>bandwidth |
| $\pm 0-1$                        | -15  | -18       | -20       | -21       | 30 kHz                   |
| $\pm 1-2.5$                      | -10  | -10       | -10       | -10       | 1 MHz                    |
| $\pm 2.5-2.8$                    | -10  | -10       | -10       | -10       | 1 MHz                    |
| $\pm 2.8-5$                      | -10  | -10       | -10       | -10       | 1 MHz                    |
| $\pm 5-6$                        | -13  | -13       | -13       | -13       | 1 MHz                    |
| $\pm 6-9$                        | -25  | -13       | -13       | -13       | 1 MHz                    |
| $\pm 9-10$                       | -25  | -25       | -13       | -13       | 1 MHz                    |
| $\pm 10-13.5$                    |  | -25       | -13       | -13       | 1 MHz                    |
| $\pm 13.5-15$                    |  | -25       | -25       | -13       | 1 MHz                    |
| $\pm 15-18$                      |  |           | -25       | -13       | 1 MHz                    |
| $\pm 18-20$                      |  |           | -25       | -25       | 1 MHz                    |
| $\pm 20-25$                      |  |           |           | -25       | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.6.2.2.3 Minimum requirement (network signalled value "NS\_06" or "NS\_07")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_06" or "NS\_07" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.3-1.

**Table 6.6.2.2.3-1: Additional requirements**

| $\Delta f_{\text{OoB}}$<br>(MHz) | Spectrum emission limit (dBm)/ Channel bandwidth |            |          |           |                          |
|----------------------------------|--|------------|----------|-----------|--------------------------|
|                                  | 1.4<br>MHz                                       | 3.0<br>MHz | 5<br>MHz | 10<br>MHz | Measurement<br>bandwidth |
| $\pm 0-0.1$                      | -13  | -13        | -15      | -18       | 30 kHz                   |
| $\pm 0.1-1$                      | -13  | -13        | -13      | -13       | 100 kHz                  |
| $\pm 1-2.5$                      | -13  | -13        | -13      | -13       | 1 MHz                    |
| $\pm 2.5-2.8$                    | -25  | -13        | -13      | -13       | 1 MHz                    |
| $\pm 2.8-5$                      |  | -13        | -13      | -13       | 1 MHz                    |
| $\pm 5-6$                        |  | -25        | -13      | -13       | 1 MHz                    |
| $\pm 6-10$                       |  |            | -25      | -13       | 1 MHz                    |
| $\pm 10-15$                      |  |            |          | -25       | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.6.2.2.4 Minimum requirement (network signalled value "NS\_33" or "NS\_34")

The additional spectrum mask in Table 6.6.2.2.4-1 applies for E-UTRA V2X UE within 5 855 MHz to 5 950 MHz according to ETSI EN 302 571. Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_33" or "NS\_34" is indicated in the cell, the power of any V2X UE emission shall not exceed the levels specified in Table 6.6.2.2.4-1.

**Table 6.6.2.2.4-1: Additional requirements for 10MHz channel bandwidth**

| Spectrum emission limit (dBm EIRP)/ Channel bandwidth |  |                       |
|---|--|-----------------------|
| $\Delta f_{\text{OoB}}$ (MHz)                         | 10 MHz   | Measurement bandwidth |
| $\pm 0-0.5$   | $[-13 - 12 \left( \frac{ \Delta f_{\text{OoB}} }{\text{MHz}} \right)]$                 | 100 kHz               |
| $\pm 0.5-5$   | $[-19 - \frac{16}{9} \left( \frac{ \Delta f_{\text{OoB}} }{\text{MHz}} - 0.5 \right)]$ | 100 kHz               |
| $\pm 5-10$  | $[-27 - 2 \left( \frac{ \Delta f_{\text{OoB}} }{\text{MHz}} - 5.0 \right)]$            | 100 kHz               |

NOTE 1: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE 2: Additional SEM for V2X overrides any other requirements in frequency range 5855-5950MHz.

NOTE 3: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain  $G_{\text{post connector}}$  declared by the UE following the principle described in annex I.

#### 6.6.2.2.5 Minimum requirement (network signalled value "NS\_27" and "NS\_43")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_27" or "NS\_43" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.5-1.

**Table 6.6.2.2.5-1: Additional requirements**

| $\Delta f_{\text{OoB}}$ (MHz)   | Spectrum emission limit (dBm)/ Channel bandwidth |        |        |        | Measurement bandwidth |
|---|--|--------|--------|--------|-----------------------|
|   | 5 MHz  | 10 MHz | 15 MHz | 20 MHz |                       |
| $\pm 0-1$   | -13  | -13    | -13    | -13    | Note 1                |
| $\pm 1-10$  | -13  | -13    | -13    | -13    | 1 MHz                 |
| $\pm 10-15$   |  | -25    | -25    | -25    | 1 MHz                 |
| $\pm 15-20$   |  |        | -25    | -25    | 1 MHz                 |
| $\pm 20-25$   |  |        |        | -25    | 1 MHz                 |
| Note 1: The measurement bandwidth is 1% of the applicable E-UTRA channel bandwidth. |  |        |        |        |                       |

### 6.6.2.2.6 Minimum requirement (network signalled value "NS\_28")

When "NS\_28" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.6-1 for E-UTRA channels assigned within the frequency ranges 5150-5350 and 5470-5725 MHz.

**Table 6.6.2.2.6-1: Additional requirements**

| Frequency offset of measurement filter -3dB point, $\Delta f$ | Frequency offset of measurement filter centre frequency, $f_{\text{offset}}$ | Minimum requirement [dBm]                                 | Measurement bandwidth |
|---|--|---|-----------------------|
| $0 \text{ MHz} \leq \Delta f < 0.5 \text{ MHz}$               | $0.5 \text{ MHz} \leq f_{\text{offset}} < 1 \text{ MHz}$                     | $10 - 20(f_{\text{offset}}/\text{MHz}) \text{ dB}$        | 1 MHz                 |
| $0.5 \text{ MHz} \leq \Delta f < 9.5 \text{ MHz}$             | $1 \text{ MHz} \leq f_{\text{offset}} < 10 \text{ MHz}$                      | $-10 - 8/9(f_{\text{offset}}/\text{MHz} - 1) \text{ dB}$  | 1 MHz                 |
| $9.5 \text{ MHz} \leq \Delta f < 19.5 \text{ MHz}$            | $10 \text{ MHz} \leq f_{\text{offset}} < 20 \text{ MHz}$                     | $-28 - 1.2(f_{\text{offset}}/\text{MHz} - 10) \text{ dB}$ | 1 MHz                 |
| $19.5 \text{ MHz} \leq \Delta f$                              | $20 \text{ MHz} \leq f_{\text{offset}}$                                      | -30   | 1 MHz                 |

NOTE 1: The measurement filter -3dB point is that closest to the channel edge.  
 NOTE 2: The requirement applies when the offset of the measurement filter centre frequency is such that both -3 dB points of the measurement filter are confined within any of the two frequency ranges 5150-5250 MHz and 5470-5725 MHz.

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.2.2.7 Minimum requirement (network signalled value "NS\_35")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_35" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.7-1.

**Table 6.6.2.2.7-1: Additional requirements**

| $\Delta f_{\text{OOB}}$ (MHz) | 5 MHz            | 10 MHz           | 15 MHz           | 20 MHz | Measurement bandwidth (unless otherwise stated) |
|-------------------------------|------------------|------------------|------------------|--------|---|
| $\pm 0-0.1$                   | -15              | -18              | -20              | -21    | 30 kHz  |
| $\pm 0.1-6$                   | -13              | -13              | -13              | -13    | 100 kHz   |
| $\pm 6-10$                    | -25 <sup>1</sup> | -13              | -13              | -13    | 100 kHz   |
| $\pm 10-15$                   |                  | -25 <sup>1</sup> | -13              | -13    | 100 kHz   |
| $\pm 15-20$                   |                  |                  | -25 <sup>1</sup> | -13    | 100 kHz   |
| $\pm 20-25$                   |                  |                  |                  | -25    | 1 MHz   |

Note 1: The measurement bandwidth shall be 1 MHz

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.2.2A Additional Spectrum Emission Mask for CA

This requirement is specified in terms of an "additional spectrum emission" requirement.

#### 6.6.2.2A.1 Minimum requirement (network signalled value "CA\_NS\_04")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "CA\_NS\_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2A.1-1.

**Table 6.6.2.2A.1-1: Additional requirements**

| Spectrum emission limit [dBm]/BW <sub>Channel_CA</sub> |                        |                         |                        |                     |                         |                         |                          |
|--|------------------------|-------------------------|------------------------|---------------------|-------------------------|-------------------------|--------------------------|
| $\Delta f_{\text{OoB}}$<br>(MHz)                       | 50+75RB<br>(24.75 MHz) | 25+100RB<br>(24.95 MHz) | 50+100RB<br>(29.9 MHz) | 75+75RB<br>(30 MHz) | 75+100RB<br>(34.85 MHz) | 100+100RB<br>(39.8 MHz) | Measurement<br>bandwidth |
| ± 0-1  | -22                    | -22                     | -22.5                  | -23                 | -23.5                   | -24                     | 30 kHz                   |
| ± 1-5  | -10                    | -10                     | -10                    | -10                 | -10                     | -10                     | 1 MHz                    |
| ± 5-22.95  | -13                    | -13                     | -13                    | -13                 | -13                     | -13                     | 1 MHz                    |
| ± 22.95-23.25  | -13                    | -25                     | -13                    | -13                 | -13                     | -13                     | 1 MHz                    |
| ± 23.25-27.9   | -25                    | -25                     | -13                    | -13                 | -13                     | -13                     | 1 MHz                    |
| ± 27.9-28.5  | -25                    | -25                     | -25                    | -13                 | -13                     | -13                     | 1 MHz                    |
| ± 28.5-29.75   | -25                    | -25                     | -25                    | -25                 | -13                     | -13                     | 1 MHz                    |
| ± 29.75-29.95  |                        | -25                     | -25                    | -25                 | -13                     | -13                     | 1 MHz                    |
| ± 29.95-32.85  |                        |                         | -25                    | -25                 | -13                     | -13                     | 1 MHz                    |
| ± 32.85-34.9   |                        |                         | -25                    | -25                 | -25                     | -13                     | 1 MHz                    |
| ± 34.9-35  |                        |                         |                        | -25                 | -25                     | -13                     | 1 MHz                    |
| ± 35-37.8  |                        |                         |                        |                     | -25                     | -13                     | 1 MHz                    |
| ± 37.8-39.85   |                        |                         |                        |                     | -25                     | -25                     | 1 MHz                    |
| ± 39.85-44.8   |                        |                         |                        |                     |                         | -25                     | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.6.2.2A.2 Minimum requirement CA\_66B (network signalled value "CA\_NS\_09")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "CA\_NS\_09" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2A.2-1.

**Table 6.6.2.2A.2-1: Additional requirements**

| $\Delta f_{\text{OoB}}$<br>(MHz) | 25RB+25RB<br>(9.8MHz) | 25RB+50RB<br>(14.95 MHz) | 25RB+75RB<br>(19.8MHz) | 50RB+50RB<br>(19.9 MHz) | Measurement<br>bandwidth |
|----------------------------------|-----------------------|--------------------------|------------------------|-------------------------|--------------------------|
| ± 0-1                            | -18                   | -20                      | -21                    | -21                     | 30 kHz                   |
| ± 1-5                            | -13                   | -13                      | -13                    | -13                     | 1 MHz                    |
| ± 5-9.8                          | -13                   | -13                      | -13                    | -13                     | 1 MHz                    |
| ± 9.8-14.8                       | -25                   | -13                      | -13                    | -13                     | 1 MHz                    |
| ± 14.8-14.95                     |                       | -13                      | -13                    | -13                     | 1 MHz                    |
| ± 14.95-19.80                    |                       | -25                      | -13                    | -13                     | 1 MHz                    |
| ± 19.80-19.90                    |                       | -25                      | -25                    | -13                     | 1 MHz                    |
| ± 19.90-19.95                    |                       | -25                      | -25                    | -25                     | 1 MHz                    |
| ± 19.95-24.80                    |                       |                          | -25                    | -25                     | 1 MHz                    |
| ± 24.80-24.90                    |                       |                          |                        | -25                     | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.2.2A.3 Minimum requirement CA\_66C (network signalled value "CA\_NS\_09")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "CA\_NS\_09" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2A.3-1.

**Table 6.6.2.2A.3-1: Additional requirements**

| Spectrum emission limit [dBm]/BW <sub>Channel_CA</sub> |                          |                          |                          |                       |                           |                           |                          |
|--|--------------------------|--------------------------|--------------------------|-----------------------|---------------------------|---------------------------|--------------------------|
| $\Delta f_{\text{OoB}}$<br>(MHz)                       | 25RB+100RB<br>(24.95MHz) | 50RB+75RB<br>(24.75 MHz) | 50RB+100RB<br>(29.9 MHz) | 75RB+75RB<br>(30 MHz) | 75RB+100RB<br>(34.85 MHz) | 100RB+100RB<br>(39.8 MHz) | Measurement<br>bandwidth |
| ± 0-1  | -22                      | -22                      | -22.5                    | -22.5                 | -23.5                     | -24                       | 30 kHz                   |
| ± 1-5  | -13                      | -13                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 5-24.75  | -13                      | -13                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 24.75-24.95  | -13                      | -25                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 24.95-29.75  | -25                      | -25                      | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 29.75-29.9   | -25                      |                          | -13                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 29.9-29.95   | -25                      |                          | -25                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 29.95-30   |                          |                          | -25                      | -13                   | -13                       | -13                       | 1 MHz                    |
| ± 30-34.85   |                          |                          | -25                      | -25                   | -13                       | -13                       | 1 MHz                    |
| ± 34.85-34.9   |                          |                          | -25                      | -25                   | -25                       | -13                       | 1 MHz                    |
| ± 34.9-35  |                          |                          |                          | -25                   | -25                       | -13                       | 1 MHz                    |
| ± 35-39.8  |                          |                          |                          |                       | -25                       | -13                       | 1 MHz                    |
| ± 39.8-39.85   |                          |                          |                          |                       | -25                       | -25                       | 1 MHz                    |
| ± 39.85-44.8   |                          |                          |                          |                       |                           | -25                       | 1 MHz                    |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.2.2A.4 Minimum requirement CA\_48B and CA\_48C (network signalled value "CA\_NS\_10")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "CA\_NS\_10" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2A.4-1.

**Table 6.6.2.2A.4-1: Additional requirements for "CA\_NS\_10"**

| $\Delta f_{\text{OoB}}$<br>MHz                                     | Spectrum emission limit (dBm) / measurement bandwidth<br>for each channel bandwidth |                          |                           |                            |                         | Measurement<br>bandwidth |
|--|---|--------------------------|---------------------------|----------------------------|-------------------------|--------------------------|
|  | 25+100RB<br>(24.95MHz)  | 50+50RB<br>(19.9<br>MHz) | 50+100RB<br>(29.9<br>MHz) | 75+100RB<br>(34.85<br>MHz) | 100+100RB<br>(39.8 MHz) |                          |
| ± 0 - 1  | -13   |                          |                           |                            |                         | 1 % channel bandwidth    |
| ± 1 - X  | -13   |                          |                           |                            |                         | 1 MHz                    |
| < - X or > X when<br>3540 MHz < $\Delta f_{\text{OoB}}$ < 3710 MHz | -25   |                          |                           |                            |                         |                          |
| NOTE: X is aggregated channel bandwidth as defined in clause 5.6A  |   |                          |                           |                            |                         |                          |

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.2.3 Adjacent Channel Leakage Ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. ACLR requirements for one E-UTRA carrier are specified for two scenarios for an adjacent E-UTRA and /or UTRA channel as shown in Figure 6.6.2.3-1.

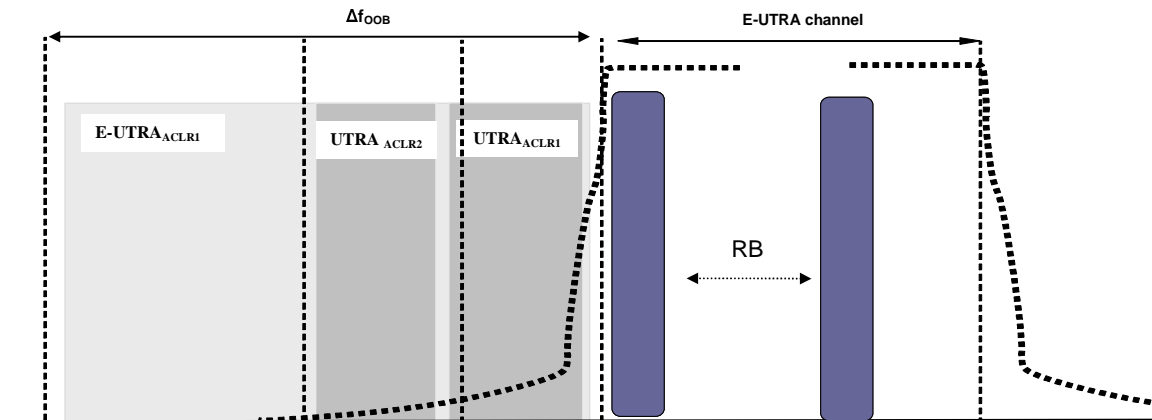


Figure 6.6.2.3-1: Adjacent Channel Leakage requirements for one E-UTRA carrier

#### 6.6.2.3.1 Minimum requirement E-UTRA

E-UTRA Adjacent Channel Leakage power Ratio ( $E-UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned E-UTRA channel power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.1-1, Table 6.6.2.3.1-2, and Table 6.6.2.3.1-3. If the measured adjacent channel power is greater than  $-50\text{dBm}$  then the  $E-UTRA_{ACLR}$  shall be higher than the value specified in Table 6.6.2.3.1-1, Table 6.6.2.3.1-2, and Table 6.6.2.3.1-3.

For a power class 2 capable UE operating on Band 41, when an IE  $P\text{-max}$  as defined in [7] of 23 dBm or lower is indicated in the cell or if the uplink/downlink configuration is 0 or 6, the requirements for power class 2 are not applicable, and the corresponding requirements for a power class 3 UE shall apply.

For each supported frequency band other than Band 14 and Band 41, the UE shall:

- if the UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:
  - if the band is a TDD band whose frame configuration is 0 or 6; or
  - if the IE  $P\text{-Max}$  as defined in TS 36.331 [7] is not provided; or
  - if the IE  $P\text{-Max}$  as defined in TS 36.331 [7] is provided and set to the maximum output power of the default power class or lower;
    - meet all requirements for the default power class of the operating band in which the UE is operating and set its configured transmitted power as specified in sub-clause 6.2.5;
- else (i.e the IE  $P\text{-Max}$  as defined in TS 36.331 [7] is provided and set to the higher value than the maximum output power of the default power class):
  - meet all requirements for the supported power class and set its configured transmitted power class as specified in sub-clause 6.2.5.



**Table 6.6.2.3.1-1: General requirements for E-UTRA<sub>ACLR</sub>**

|  | Channel bandwidth / E-UTRA <sub>ACLR1</sub> / Measurement bandwidth |             |         |           |           |           |
|--|---|-------------|---------|-----------|-----------|-----------|
|  | 1.4 MHz   | 3.0 MHz     | 5 MHz   | 10 MHz    | 15 MHz    | 20 MHz    |
| E-UTRA <sub>ACLR1</sub>                        | 30 dB   | 30 dB       | 30 dB   | 30 dB     | 30 dB     | 30 dB     |
| E-UTRA channel Measurement bandwidth           | 1.08 MHz  | 2.7 MHz     | 4.5 MHz | 9.0 MHz   | 13.5 MHz  | 18 MHz    |
| Adjacent channel centre frequency offset [MHz] | +1.4 / -1.4   | +3.0 / -3.0 | +5 / -5 | +10 / -10 | +15 / -15 | +20 / -20 |

**Table 6.6.2.3.1-2: Additional E-UTRA<sub>ACLR</sub> requirements for Power Class 1**

|  | Channel bandwidth / E-UTRA <sub>ACLR1</sub> / Measurement bandwidth |             |         |           |           |           |
|--|---|-------------|---------|-----------|-----------|-----------|
|  | 1.4 MHz   | 3.0 MHz     | 5 MHz   | 10 MHz    | 15 MHz    | 20 MHz    |
| E-UTRA <sub>ACLR1</sub>  | 37 dB   | 37 dB       | 37 dB   | 37 dB     | 37 dB     | 37 dB     |
| E-UTRA channel Measurement bandwidth                           | 1.08 MHz  | 2.7 MHz     | 4.5 MHz | 9.0 MHz   | 13.5 MHz  | 18 MHz    |
| Adjacent channel centre frequency offset [MHz]                 | +1.4 / -1.4   | +3.0 / -3.0 | +5 / -5 | +10 / -10 | +15 / -15 | +20 / -20 |
| NOTE 1: E-UTRA <sub>ACLR1</sub> shall be applicable for >23dBm |   |             |         |           |           |           |

**Table 6.6.2.3.1-3: Additional E-UTRA<sub>ACLR</sub> requirements for Power Class 2**

|  | Channel bandwidth / E-UTRA <sub>ACLR1</sub> / Measurement bandwidth |         |         |           |           |           |
|--|---|---------|---------|-----------|-----------|-----------|
|  | 1.4 MHz   | 3.0 MHz | 5 MHz   | 10 MHz    | 15 MHz    | 20 MHz    |
| E-UTRA <sub>ACLR1</sub>                        | N/A   | N/A     | 31 dB   | 31 dB     | 31 dB     | 31 dB     |
| E-UTRA channel Measurement bandwidth           | N/A   | N/A     | 4.5 MHz | 9.0 MHz   | 13.5 MHz  | 18 MHz    |
| Adjacent channel centre frequency offset [MHz] | N/A   | N/A     | +5 / -5 | +10 / -10 | +15 / -15 | +20 / -20 |

**6.6.2.3.1a Additional minimum requirement for E-UTRA (network signalled value “NS\_29”)**

When "NS\_29" is indicated in the cell, the UE emission shall meet the additional requirements specified in Table 6.6.2.3.1a-1 for E-UTRA channels assigned within the frequency ranges 5150-5350 MHz and 5470-5725 MHz. The assigned E-UTRA channel power and alternative adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.1a-1. If the measured alternative adjacent channel power is greater than -50dBm then the E-UTRA<sub>ACLR2</sub> shall be higher than the value specified in Table 6.6.2.3.1a-1.

**Table 6.6.2.3.1a-1: Additional E-UTRA<sub>ACLR</sub> requirement**

|   | Channel bandwidth / E-UTRA <sub>ACLR2</sub> / Measurement bandwidth |
|---|---|
|   | 20 MHz  |
| E-UTRA <sub>ACLR2</sub>   | 40 dBc  |
| E-UTRA channel Measurement bandwidth  | NOTE 1  |
| Adjacent channel centre frequency offset [MHz]  | +40 / -40   |
| NOTE 1: 18 MHz for E-UTRA channels assigned within 5150-5350 MHz; 19 MHz for E-UTRA channels assigned within 5470-5725 MHz. |   |

6.6.2.3.1A Void

6.6.2.3.1Aa Void

### 6.6.2.3.2 Minimum requirements UTRA

UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the assigned E-UTRA channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel ( $UTRA_{ACLR1}$ ) and the 2<sup>nd</sup> UTRA adjacent channel ( $UTRA_{ACLR2}$ ). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor  $\alpha = 0.22$ . The assigned E-UTRA channel power is measured with a rectangular filter with measurement bandwidth specified in Table 6.6.2.3.2-1. If the measured UTRA channel power is greater than  $-50\text{dBm}$  then the  $UTRA_{ACLR}$  shall be higher than the value specified in Table 6.6.2.3.2-1.

$UTRA_{ACLR}$  is not applicable to the power class 3 UE operating in Band 7, 12, 13, 17, 20, 24, 27, 30, 33, 35, 36, 37, 38, 40, 43, 44, 45, 47, 48, 50, 51, 52, 68, 70, 71, 85 and Scell operation in Band 46, 49.

$UTRA_{ACLR}$  is not applicable to the power class 2 UE operating in Band 38, 40, 41, 42 or 47 and Scell operation in Band 46.

$UTRA_{ACLR}$  is not applicable to the power class 1 UE operating in Band 3, 20, 28, 31 or 72.

**Table 6.6.2.3.2-1: Requirements for  $UTRA_{ACLR1/2}$**

|  | Channel bandwidth / $UTRA_{ACLR1/2}$ / Measurement bandwidth |                        |                           |                         |                           |                          |
|--|--|------------------------|---------------------------|-------------------------|---------------------------|--------------------------|
|  | 1.4 MHz  | 3.0 MHz                | 5 MHz                     | 10 MHz                  | 15 MHz                    | 20 MHz                   |
| $UTRA_{ACLR1}$   | 33 dB  | 33 dB                  | 33 dB                     | 33 dB                   | 33 dB                     | 33 dB                    |
| Adjacent channel centre frequency offset [MHz]                                     | $0.7+BW_{UTRA}/2$<br>/                                       | $1.5+BW_{UTRA}/2$<br>/ | $+2.5+BW_{UTRA}/2$<br>/   | $+5+BW_{UTRA}/2$<br>/   | $+7.5+BW_{UTRA}/2$<br>/   | $+10+BW_{UTRA}/2$<br>/   |
|  | $-0.7-BW_{UTRA}/2$   | $-1.5-BW_{UTRA}/2$     | $-2.5-BW_{UTRA}/2$        | $-5-BW_{UTRA}/2$        | $-7.5-BW_{UTRA}/2$        | $-10-BW_{UTRA}/2$        |
| $UTRA_{ACLR2}$   | -  | -                      | 36 dB                     | 36 dB                   | 36 dB                     | 36 dB                    |
| Adjacent channel centre frequency offset [MHz]                                     | -  | -                      | $+2.5+3*BW_{UTRA}/2$<br>/ | $+5+3*BW_{UTRA}/2$<br>/ | $+7.5+3*BW_{UTRA}/2$<br>/ | $+10+3*BW_{UTRA}/2$<br>/ |
|  |  |                        | $-2.5-3*BW_{UTRA}/2$      | $-5-3*BW_{UTRA}/2$      | $-7.5-3*BW_{UTRA}/2$      | $-10-3*BW_{UTRA}/2$      |
| E-UTRA channel Measurement bandwidth   | 1.08 MHz   | 2.7 MHz                | 4.5 MHz                   | 9.0 MHz                 | 13.5 MHz                  | 18 MHz                   |
| UTRA 5MHz channel Measurement bandwidth (NOTE 1)                                   | 3.84 MHz   | 3.84 MHz               | 3.84 MHz                  | 3.84 MHz                | 3.84 MHz                  | 3.84 MHz                 |
| UTRA 1.6MHz channel measurement bandwidth (NOTE 2)                                 | 1.28 MHz   | 1.28 MHz               | 1.28 MHz                  | 1.28MHz                 | 1.28MHz                   | 1.28MHz                  |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.   |  |                        |                           |                         |                           |                          |
| NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. |  |                        |                           |                         |                           |                          |

### 6.6.2.3.2A Minimum requirement UTRA for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the assigned channel bandwidth on the component carrier to the filtered mean power centred on an adjacent channel

frequency. The UTRA Adjacent Channel Leakage power Ratio is defined per carrier and the requirement is specified in subclause 6.6.2.3.2.

For intra-band contiguous carrier aggregation the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

For intra-band non-contiguous carrier aggregation when all sub-blocks consist of one component carrier the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the sum of the filtered mean powers centered on the assigned sub-block frequencies to the filtered mean power centred on an adjacent(s) UTRA channel frequency.  $UTRA_{ACLR1/2}$  requirements are applicable for all sub-blocks and are specified in Table 6.6.2.3.2A-2.  $UTRA_{ACLR1}$  is required to be met in the sub-block gap when the gap bandwidth  $W_{gap}$  is  $5\text{MHz} \leq W_{gap} < 15\text{MHz}$ . Both  $UTRA_{ACLR1}$  and  $UTRA_{ACLR2}$  are required to be met in the sub-block gap when the gap bandwidth  $W_{gap}$  is  $15\text{MHz} \leq W_{gap}$ .

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is defined as follows. For the E-UTRA band supporting one component carrier, the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the assigned channel bandwidth of the component carrier to the filtered mean power centred on an adjacent(s) UTRA channel frequency and the requirements specified in subclause 6.6.2.3.2 apply. For the E-UTRA band supporting two contiguous component carriers the UTRA Adjacent Channel Leakage power Ratio ( $UTRA_{ACLR}$ ) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent(s) UTRA channel frequency and the requirements specified in subclause 6.6.2.3.2A apply.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel ( $UTRA_{ACLR1}$ ) and the 2<sup>nd</sup> UTRA adjacent channel ( $UTRA_{ACLR2}$ ). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor  $\alpha = 0.22$ . The assigned aggregated channel bandwidth power is measured with a rectangular filter with measurement bandwidth specified in Table 6.6.2.3.2A-1 for intraband contiguous carrier aggregation or 6.6.2.3.2A-2 for intraband non-contiguous carrier aggregation. If the measured UTRA channel power is greater than  $-50\text{dBm}$  then the  $UTRA_{ACLR}$  shall be higher than the value specified in Table 6.6.2.3.2A-1 for intraband contiguous carrier aggregation or 6.6.2.3.2A-2 for intraband non-contiguous carrier aggregation.

For carrier aggregation with one or two uplink component carriers, the  $UTRA_{ACLR}$  requirements for the PC3 UE are not applicable to the uplink component carrier(s) assigned to one of the E-UTRA band in Band 7, 12, 13, 17, 20, 24, 27, 30, 33, 35, 36, 37, 38, 40, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 68, 70, 71 or 85.

**Table 6.6.2.3.2A-1: Requirements for  $UTRA_{ACLR1/2}$**

|  | CA bandwidth class / $UTRA_{ACLR1/2}$ / measurement bandwidth                                   |
|--|---|
|  | CA bandwidth class B, C and D   |
| $UTRA_{ACLR1}$   | 33 dB   |
| Adjacent channel centre frequency offset (in MHz)                                  | $\frac{+ BW_{Channel\_CA} / 2 + BW_{UTRA} / 2}{- BW_{Channel\_CA} / 2 - BW_{UTRA} / 2}$         |
| $UTRA_{ACLR2}$   | 36 dB   |
| Adjacent channel centre frequency offset (in MHz)                                  | $\frac{+ BW_{Channel\_CA} / 2 + 3 * BW_{UTRA} / 2}{- BW_{Channel\_CA} / 2 - 3 * BW_{UTRA} / 2}$ |
| CA E-UTRA channel Measurement bandwidth  | $BW_{Channel\_CA} - 2 * BW_{GB}$  |
| UTRA 5MHz channel Measurement bandwidth (NOTE 1)                                   | 3.84 MHz  |
| UTRA 1.6MHz channel measurement bandwidth (NOTE 2)                                 | 1.28 MHz  |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.   |   |
| NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. |   |

**Table 6.6.2.3.2A-2: Requirements for intraband non-contiguous CA UTRA<sub>ACLR1/2</sub>**

|  | UTRA <sub>ACLR1/2</sub> / measurement bandwidth  |
|--|--|
| UTRA <sub>ACLR1</sub>  | 33 dB  |
| Adjacent channel centre frequency offset (in MHz)  | $\frac{+ F_{\text{edge,block,high}} + BW_{\text{UTRA}/2}}{- F_{\text{edge,block,low}} - BW_{\text{UTRA}/2}}$                 |
| UTRA <sub>ACLR2</sub>  | 36 dB  |
| Adjacent channel centre frequency offset (in MHz)  | $\frac{+ F_{\text{edge,block,high}} + 3 \cdot BW_{\text{UTRA}/2}}{- F_{\text{edge,block,low}} - 3 \cdot BW_{\text{UTRA}/2}}$ |
| Sub-block measurement bandwidth  | $BW_{\text{Channel,block}} - 2 \cdot BW_{\text{GB}}$   |
| UTRA 5 MHz channel Measurement bandwidth (NOTE 1)  | 3.84 MHz   |
| UTRA 1.6 MHz channel measurement bandwidth (NOTE 2)  | 1.28 MHz   |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.<br>NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. |  |

### 6.6.2.3.3A Minimum requirements for CA E-UTRA

For intra-band contiguous carrier aggregation the carrier aggregation E-UTRA Adjacent Channel Leakage power Ratio (CA E-UTRA<sub>ACLR</sub>) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent aggregated channel bandwidth at nominal channel spacing. The assigned aggregated channel bandwidth power and adjacent aggregated channel bandwidth power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.3A-1. If the measured adjacent channel power is greater than – 50dBm then the E-UTRA<sub>ACLR</sub> shall be higher than the value specified in Table 6.6.2.3.3A-1 and Table 6.6.2.3.3A-1a.

**Table 6.6.2.3.3A-1: General requirements for CA E-UTRA<sub>ACLR</sub>**

|   | CA bandwidth class / CA E-UTRA <sub>ACLR</sub> / Measurement bandwidth |
|---|--|
|   | CA bandwidth class B, C and D  |
| CA E-UTRA <sub>ACLR</sub>                         | 30 dB  |
| CA E-UTRA channel Measurement bandwidth           | $BW_{\text{Channel\_CA}} - 2 \cdot BW_{\text{GB}}$                     |
| Adjacent channel centre frequency offset (in MHz) | $\frac{+ BW_{\text{Channel\_CA}}}{- BW_{\text{Channel\_CA}}}$          |

**Table 6.6.2.3.3A-1a: Additional requirements for CA E-UTRA<sub>ACLR</sub> for UL CA\_41C Power Class 2**

|   | CA bandwidth class / CA E-UTRA <sub>ACLR</sub> / Measurement bandwidth |
|---|--|
|   | CA bandwidth class C   |
| CA E-UTRA <sub>ACLR</sub>                         | 31 dB  |
| CA E-UTRA channel Measurement bandwidth           | $BW_{\text{Channel\_CA}} - 2 \cdot BW_{\text{GB}}$                     |
| Adjacent channel centre frequency offset (in MHz) | $\frac{+ BW_{\text{Channel\_CA}}}{- BW_{\text{Channel\_CA}}}$          |

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA<sub>ACLR</sub>) is the ratio of the filtered mean power centred on the assigned channel bandwidth on a component carrier to the filtered mean power centred on an adjacent channel frequency. The E-UTRA Adjacent Channel Leakage power Ratio is defined per carrier and the requirement is specified in subclause 6.6.2.3.1.

For intra-band non-contiguous carrier aggregation when all sub-blocks consist of one component carrier the E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA<sub>ACL</sub>R) is the ratio of the sum of the filtered mean powers centred on the assigned sub-block frequencies to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. In case the sub-block gap bandwidth  $W_{gap}$  is smaller than of the sub-block bandwidth then for that sub-block no E-UTRA<sub>ACL</sub>R requirement is set for the gap. In case the sub-block gap bandwidth  $W_{gap}$  is smaller than either of the sub-block bandwidths then no E-UTRA<sub>ACL</sub>R requirement is set for the gap. The assigned E-UTRA sub-block power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.3A-2. If the measured adjacent channel power is greater than  $-50$  dBm then the E-UTRA<sub>ACL</sub>R shall be higher than the value specified in Table 6.6.2.3.3A-2.

**Table 6.6.2.3.3A-2: General requirements for non-contiguous intraband CA E-UTRA<sub>ACL</sub>R**

|   | CC and adjacent channel bandwidth / E-UTRA <sub>ACL</sub> R / Measurement bandwidth |       |       |        |        |        |
|---|---|-------|-------|--------|--------|--------|
|   | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| E-UTRA <sub>ACL</sub> R1                            | 30 dB   | 30 dB | 30 dB | 30 dB  | 30 dB  | 30 dB  |
| CC and adjacent channel measurement bandwidth [MHz] | 1.08  | 2.7   | 4.5   | 9      | 13.5   | 18     |
| Adjacent channel centre frequency offset [MHz]      | + 1.4   | + 3   | + 5   | + 10   | + 15   | + 20   |
|   | /   | /     | /     | /      | /      | /      |
|   | - 1.4   | - 3   | - 5   | - 10   | - 15   | - 20   |

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA<sub>ACL</sub>R) is defined as follows. For the E-UTRA band supporting one component carrier, the E-UTRA Adjacent Channel Leakage power Ratio (UTRA<sub>ACL</sub>R) is the ratio of the filtered mean power centred on the assigned channel bandwidth of the component carrier to the filtered mean power centred on an adjacent channel frequency and the requirements in subclause 6.6.2.3.1 apply. For the E-UTRA band supporting two contiguous component carriers the E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA<sub>ACL</sub>R) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent(s) aggregated channel bandwidth at nominal channel spacing and the requirements of CA E-UTRA<sub>ACL</sub>R specified in subclause 6.6.2.3.3A apply.

#### 6.6.2.4 Void

##### 6.6.2.4.1 Void

#### 6.6.2A Void

<reserved for future use>

#### 6.6.2B Out of band emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.6.2 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.6.3 apply.

#### 6.6.2C Void

<reserved for future use>

## 6.6.2D Out of band emission for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the requirements in subclause 6.6.2 apply.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the requirements in subclause 6.6.2 apply per E-UTRA ProSe sidelink and E-UTRA uplink transmission as specified for the corresponding inter-band aggregation with uplink assigned to two bands.

## 6.6.2F Out of band emission for category NB1 and NB2

### 6.6.2F.1 Spectrum emission mask

The spectrum emission mask of the category NB1 and NB2 UE applies to frequencies ( $\Delta f_{\text{OoB}}$ ) starting from the  $\pm$  edge of the assigned category NB1 or NB2 channel bandwidth. For frequencies greater than ( $\Delta f_{\text{OoB}}$ ) as specified in Table 6.6.2F.1-1 the spurious requirements in subclause 6.6.3 are applicable.

The power of any category NB1 or NB2 UE emission shall not exceed the levels specified in Table 6.6.2F.1-1. The spectrum emission limit between each  $\Delta f_{\text{OoB}}$  is linearly interpolated.

**Table 6.6.2F.1-1: category NB1 and NB2 UE spectrum emission mask**

| $\Delta f_{\text{OoB}}$ (kHz) | Emission limit (dBm) | Measurement bandwidth |
|-------------------------------|----------------------|-----------------------|
| $\pm 0$                       | 26                   | 30 kHz                |
| $\pm 100$                     | -5                   | 30 kHz                |
| $\pm 150$                     | -8                   | 30 kHz                |
| $\pm 300$                     | -29                  | 30 kHz                |
| $\pm 500-1700$                | -35                  | 30 kHz                |

In addition to the spectrum emission mask requirement in Table 6.6.2F.1-1 a category NB1 or NB2 UE shall also meet the applicable E-UTRA spectrum emission mask requirement in sub-clause 6.6.2. E-UTRA spectrum emission requirement applies for frequencies that are Foffset away from edge of NB1 or NB2 channel edge as defined in Table 6.6.2F.1-2.

**Table 6.6.2F.1-2: Foffset for category NB1 and NB2 UE spectrum emission mask**

| Channel BW (MHz) | Foffset [kHz] |
|------------------|---------------|
| 1.4              | 165           |
| 3                | 190           |
| 5                | 200           |
| 10               | 225           |
| 15               | 240           |
| 20               | 245           |

Note: Foffset in Table 6.6.2F.1-2 is used to guarantee co-existence for guard-band operation.

### 6.6.2F.2 Additional Spectrum Emission Mask for Category NB1 and NB2

This requirement is specified in terms of an "additional spectrum emission" requirement.

#### 6.6.2F.2.1 Minimum requirement (network signalled value "NS\_02")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell broadcast message.

When "NS\_02" is indicated in the cell, the NB-IoT channel is deployed in the lower guard-band of a 10MHz E-UTRA channel and the separation between the two channel centres is equal to 4.695 MHz. The power of any UE emission shall

not exceed the levels specified in Table 6.6.2.1.1-1 for the specified E-UTRA channel bandwidth and the levels specified in Table 6.6.2F.1-1 for the NB-IoT channel.

Note: UEs that meet the above emission requirement would automatically meet the E-UTRA additional spectrum emission masks as defined in 6.6.2.2 for the applicable operating bands.

### 6.6.2F.2.2 Minimum requirement (network signalled value "NS\_03")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell broadcast message.

When "NS\_03" is indicated in the cell, the NB-IoT channel is deployed in the upper guard-band of a 10MHz E-UTRA channel and the separation between the two channel centres is equal to 4.695 MHz. The power of any UE emission shall not exceed the levels specified in Table 6.6.2.1.1-1 for the specified E-UTRA channel bandwidth and the levels specified in Table 6.6.2F.1-1 for the NB-IoT channel.

Note: UEs that meet the above emission requirement would automatically meet the E-UTRA additional spectrum emission masks as defined in 6.6.2.2 for the applicable operating bands.

### 6.6.2F.3 Adjacent Channel Leakage Ratio for category NB1 and NB2

Adjacent Channel Leakage power Ratio is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. The assigned category NB1 or NB2 channel power and adjacent channel power are measured with filters and measurement bandwidths specified in Table 6.6.2F.3-1. If the measured adjacent channel power is greater than  $-50\text{dBm}$  then the category NB1 or NB2 UE ACLR shall be higher than the value specified in Table 6.6.2F.3-1.  $\text{GSM}_{\text{ACLR}}$  requirement is intended for protection of GSM system.  $\text{UTRA}_{\text{ACLR}}$  requirement is intended for protection of UTRA and E-UTRA systems.

**Table 6.6.2F.3-1: category NB1 and NB2 UE ACLR requirements**

|   | $\text{GSM}_{\text{ACLR}}$ | $\text{UTRA}_{\text{ACLR}}$ |
|---|----------------------------|-----------------------------|
| <b>ACLR</b>   | 20 dB                      | 37 dB                       |
| <b>Adjacent channel center frequency offset from category NB1 or NB2 Channel edge</b> | $\pm 200\text{ kHz}$       | $\pm 2.5\text{ MHz}$        |
| <b>Adjacent channel measurement bandwidth</b>   | 180 kHz                    | 3.84 MHz                    |
| <b>Measurement filter</b>   | Rectangular                | RRC-filter<br>$\alpha=0.22$ |
| <b>Category NB1 and NB2 channel measurement bandwidth</b>                             | 180 kHz                    | 180 kHz                     |
| <b>Category NB1 and NB2 channel Measurement filter</b>                                | Rectangular                | Rectangular                 |

### 6.6.2G Out of band emission for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the requirements in subclause 6.6.2 apply except for the ACLR requirements for power class 2 V2X UE.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.6.2 apply per V2X sidelink

transmission and E-UTRA uplink transmission as specified for the corresponding inter-band con-current operation with uplink assigned to two bands.

For intra-band contiguous multi-carrier operation, the general CA spectrum emission mask for CA Bandwidth Class B specified in subclause 6.6.2.1A shall apply for V2X Bandwidth Class B, the general CA spectrum emission mask for CA Bandwidth Class C specified in subclause 6.6.2.1A shall apply for V2X Bandwidth Class C and C<sub>1</sub>.

For intra-band contiguous multi-carrier operation, the E-UTRA ACLR requirement for CA Bandwidth Class B specified in subclause 6.6.2.3.3A shall apply for V2X Bandwidth Class B, the general CA spectrum emission mask for CA Bandwidth Class C specified in subclause 6.6.2.3.3A shall apply for V2X Bandwidth Class C and C<sub>1</sub>.

For power class 2 V2X UE, the assigned channel power and adjacent channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2G-1. If the measured adjacent channel power is greater than -50dBm then ACLR shall be higher than the value specified in Table 6.6.2G-1.

**Table 6.6.2G-1: ACLR requirements for power class 2 V2X Communication**

|  | Channel bandwidth / ACLR / Measurement bandwidth |                 |
|--|--|-----------------|
|  | 10 MHz   | 20 MHz          |
| ACLR   | 31 dB  | 31 dB           |
| E-UTRA channel Measurement bandwidth           | 9.0 MHz  | 18 MHz          |
| Adjacent channel centre frequency offset [MHz] | +10<br>/<br>-10                                  | +20<br>/<br>-20 |

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements specified for single carrier apply to each transmit antenna connector.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

## 6.6.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements inline with SM.329 [2] and E-UTRA operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

### 6.6.3.1 Minimum requirements

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.6.3.1-2 apply for all transmitter band configurations ( $N_{RB}$ ) and channel bandwidths.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

**Table 6.6.3.1-1: Boundary between E-UTRA out of band and spurious emission domain**

| Channel bandwidth            | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
|------------------------------|---------|---------|-------|--------|--------|--------|
| OOB boundary $F_{OOB}$ (MHz) | 2.8     | 6       | 10    | 15     | 20     | 25     |



**Table 6.6.3.1-2: Spurious emissions limits**

| Frequency Range   | Maximum Level | Measurement bandwidth | NOTE |
|---|---------------|-----------------------|------|
| $9 \text{ kHz} \leq f < 150 \text{ kHz}$  | -36 dBm       | 1 kHz                 |      |
| $150 \text{ kHz} \leq f < 30 \text{ MHz}$   | -36 dBm       | 10 kHz                |      |
| $30 \text{ MHz} \leq f < 1000 \text{ MHz}$  | -36 dBm       | 100 kHz               |      |
| $1 \text{ GHz} \leq f < 12.75 \text{ GHz}$  | -30 dBm       | 1 MHz                 |      |
| $12.75 \text{ GHz} \leq f < 5^{\text{th}}$<br>harmonic of the upper<br>frequency edge of the<br>UL operating band in<br>GHz | -30 dBm       | 1 MHz                 | 1    |
| $12.75 \text{ GHz} < f < 26 \text{ GHz}$  | -30 dBm       | 1 MHz                 | 2    |
| NOTE 1: Applies for Band 22, Band 42, Band 43 and Band 48.  |               |                       |      |
| NOTE 2: Applies for Band 46 and Band 47.  |               |                       |      |

### 6.6.3.1A Minimum requirements for CA

This clause specifies the spurious emission requirements for carrier aggregation.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the spurious emission requirement Table 6.6.3.1-2 apply for the frequency ranges that are more than  $F_{\text{OOB}}$  as defined in Table 6.6.3.1-1 away from edges of the assigned channel bandwidth on a component carrier. If for some frequency a spurious emission requirement of individual component carrier overlaps with the spectrum emission mask or channel bandwidth of another component carrier then it does not apply.

NOTE: For inter-band carrier aggregation with uplink assigned to two E-UTRA bands the requirements in Table 6.6.3.1-2 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.6.3.1-2 would be considered to be verified by the measurements verifying the one uplink inter-band CA spurious emission requirement.

For intra-band contiguous carrier aggregation the spurious emission limits apply for the frequency ranges that are more than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth (Table 5.6A-1). For frequencies  $\Delta f_{\text{OOB}}$  greater than  $F_{\text{OOB}}$  as specified in Table 6.6.3.1A-1 the spurious emission requirements in Table 6.6.3.1-2 are applicable.

**Table 6.6.3.1A-1: Boundary between E-UTRA out of band and spurious emission domain for intra-band contiguous carrier aggregation**

| CA Bandwidth Class | OOB boundary $F_{\text{OOB}}$ (MHz) |
|--------------------|-------------------------------------|
| A                  | Table 6.6.3.1-1                     |
| B                  | $BW_{\text{Channel\_CA}} + 5$       |
| C                  | $BW_{\text{Channel\_CA}} + 5$       |

For intra-band non-contiguous carrier aggregation transmission the spurious emission requirement is defined as a composite spurious emission requirement. Composite spurious emission requirement applies to frequency ranges that are more than  $F_{\text{OOB}}$  away from the edges of the sub-blocks. Composite spurious emission requirement is defined as follows

- Composite spurious emission requirement is a combination of individual sub-block spurious emission requirements

- b) In case the sub-block consist of one component carrier the sub-lock spurious emission requirement and  $F_{OOB}$  are defined in subclause 6.6.3.1
- c) If for some frequency an individual sub-block spurious emission requirement overlaps with the general spectrum emission mask or the sub-block bandwidth of another sub-block then it does not apply

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band), the spurious emission requirement is defined as follows. For the E-UTRA band supporting one component carrier the requirements in Table 6.6.3.1-2 apply for frequency ranges that are more than  $F_{OOB}$  (MHz) from the edges of assigned channel bandwidth as defined in Table 6.6.3.1-1. For the E-UTRA band supporting two contiguous component carriers the requirements in Table 6.6.3.1-2 apply for frequency ranges that are more than  $F_{OOB}$  (MHz) from the edges of assigned aggregated channel bandwidth as defined in Table 6.6.3.1A-1. If for some frequency a spurious emission requirement of a single component carrier or two contiguous component carriers overlap with the spurious emission requirement or channel bandwidth of another component carrier or two contiguously aggregated carriers then it does not apply.

### 6.6.3.2 Spurious emission band UE co-existence

This clause specifies the requirements for the specified E-UTRA band, for coexistence with protected bands.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus  $MBW/2$ . The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus  $MBW/2$ .  $MBW$  denotes the measurement bandwidth defined for the protected band.

**Table 6.6.3.2-1: Requirements**

| E-UTRA Band | Spurious emission   |                       |   |                     |           |      |                |
|-------------|---|-----------------------|---|---------------------|-----------|------|----------------|
|             | Protected band  | Frequency range (MHz) |   | Maximum Level (dBm) | MBW (MHz) | NOTE |                |
| 1           | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76, 87, 88<br>NR Band n78, n79 | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    |                |
|             | E-UTRA Band 34  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 15             |
|             | NR Band n77   | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 2              |
|             | Frequency range   | 1880                  | - | 1895                | -40       | 1    | 15, 27         |
|             | Frequency range   | 1895                  | - | 1915                | -15.5     | 5    | 15, 26, 27     |
|             | Frequency range   | 1915                  | - | 1920                | +1.6      | 5    | 15, 26, 27, 44 |
| 2           | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 50, 51, 53, 66, 70, 71, 74, 85  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    |                |
|             | E-UTRA Band 2, 25,  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 15             |
|             | E-UTRA Band 43, 48<br>NR Band n77   | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 2              |
| 3           | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 41, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76, 87, 88<br>NR Band n79     | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    |                |
|             | E-UTRA Band 3   | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 15             |
|             | E-UTRA Band 22, 42<br>NR Band n77, n78  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 2              |
|             | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3  |                |
| 4           | E-UTRA Band 2, 4, 5, 7, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 41, 43, 48, 50, 51, 53, 66, 70, 71, 74, 85  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    |                |
|             | E-UTRA Band 42,<br>NR Band n77  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    | 2              |
| 5           | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 24, 25, 28, 29, 30, 31, 34, 38, 40,  | $F_{DL\_low}$         | - | $F_{DL\_high}$      | -50       | 1    |                |

|                 |   |                     |        |                      |       |         |            |
|-----------------|---|---------------------|--------|----------------------|-------|---------|------------|
|                 | 42, 43, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85<br>NR Band n79   |                     |        |                      |       |         |            |
|                 | E-UTRA Band 26  | 859                 | -      | 869                  | -27   | 1       |            |
|                 | E-UTRA Band 41, 52, 53<br>NR Band n77, n78  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | E-UTRA Band 18, 19  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -40   | 1       | 39         |
|                 | E-UTRA Band 11, 21  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 39         |
|                 | Frequency range   | 1884.5              | -      | 1915.7               | -41   | 0.3     | 8, 39      |
| 6               | E-UTRA Band 1, 9, 11, 34  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | Frequency range   | 860                 | -      | 875                  | -37   | 1       |            |
|                 | Frequency range   | 875                 | -      | 895                  | -50   | 1       |            |
|                 | Frequency range   | 1884.5              | -      | 1919.6               | -41   | 0.3     | 7          |
| 1884.5          |   | -                   | 1915.7 | 8                    |       |         |            |
| 7               | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 20, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 66, 67, 68, 72, 74, 75, 76, 85, 87, 88<br>NR Band n77, n78 | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | NR Band n79   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | Frequency range   | 2570                | -      | 2575                 | +1.6  | 5       | 15, 21, 26 |
|                 | Frequency range   | 2575                | -      | 2595                 | -15.5 | 5       | 15, 21, 26 |
|                 | Frequency range   | 2595                | -      | 2620                 | -40   | 1       | 15, 21     |
| 8               | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76, 87, 88   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | E-UTRA band 3, 7, 22, 41, 42, 43<br>NR Band n77, n78, n79   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | E-UTRA Band 8   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 15         |
|                 | E-UTRA Band 11, 21  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 23         |
|                 | Frequency range   | 860                 | -      | 890                  | -40   | 1       | 15, 23     |
|                 | Frequency range   | 1884.5              | -      | 1915.7               | -41   | 0.3     | 8, 23      |
| 9               | E-UTRA Band 1, 3, 11, 18, 19, 21, 26, 28, 34  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | E-UTRA Band 42  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | Frequency range   | 945                 | -      | 960                  | -50   | 1       |            |
|                 | Frequency range   | 1884.5              | -      | 1915.7               | -41   | 0.3     | 8          |
|                 | Frequency range   | 2545                | -      | 2575                 | -50   | 1       |            |
| Frequency range | 2595  | -                   | 2645   | -50                  | 1     |         |            |
| 10              | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 41, 43, 66, 70, 85   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | E-UTRA Band 22, 42,<br>NR Band n77  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
| 11              | E-UTRA Band 1, 3, 11, 18, 19, 21, 28, 34, 40, 42, 65<br>NR Band n77, n78, n79   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | Frequency range   | 945                 | -      | 960                  | -50   | 1       |            |
|                 | Frequency range   | 1884.5              | -      | 1915.7               | -41   | 0.3     | 8          |
|                 | Frequency range   | 2545                | -      | 2575                 | -50   | 1       |            |
|                 | Frequency range   | 2595                | -      | 2645                 | -50   | 1       |            |
| 12              | E-UTRA Band 2, 5, 13, 14, 17, 24, 25, 26, 27, 30, 41, 53, 70, 71, 74  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | E-UTRA Band 4, 48, 50, 51, 66<br>NR Band n77  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | E-UTRA Band 12, 85  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 15         |
| 13              | E-UTRA Band 2, 4, 5, 12, 13, 17, 25, 26, 27, 29, 41, 48, 50, 51, 53, 66, 70, 71, 74, 85   | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       |            |
|                 | E-UTRA Band 14  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 15         |
|                 | E-UTRA Band 24, 30,<br>NR Band n77  | F <sub>DL_low</sub> | -      | F <sub>DL_high</sub> | -50   | 1       | 2          |
|                 | Frequency range   | 769                 | -      | 775                  | -35   | 0.00625 | 15         |
|                 | Frequency range   | 799                 | -      | 805                  | -35   | 0.00625 | 15         |

|    |  |               |   |                |     |         |        |
|----|--|---------------|---|----------------|-----|---------|--------|
| 14 | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 23, 24, 25, 26, 27, 29, 30, 41, 48, 53, 66, 70, 71, 85  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | NR Band n77  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | Frequency range  | 769           | - | 775            | -35 | 0.00625 | 12, 15 |
|    | Frequency range  | 799           | - | 805            | -35 | 0.00625 | 12, 15 |
| 17 | E-UTRA Band 2, 5, 13, 14, 17, 24, 25, 26, 27, 30, 41, 70, 71, 74   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | E-UTRA Band 4, 48, 50, 51, 53, 66<br>NR Band n77   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | E-UTRA Band 12, 85   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 15     |
| 18 | E-UTRA Band 1, 3, 11, 21, 34, 40, 42, 65<br>NR Band n79  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | NR Band n77, n78   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | Frequency range  | 758           | - | 799            | -50 | 1       |        |
|    | Frequency range  | 799           | - | 803            | -40 | 1       | 15     |
|    | Frequency range  | 860           | - | 890            | -40 | 1       |        |
|    | Frequency range  | 945           | - | 960            | -50 | 1       |        |
|    | Frequency range  | 1884.5        | - | 1915.7         | -41 | 0.3     | 8      |
|    | Frequency range  | 2545          | - | 2575           | -50 | 1       |        |
| 19 | E-UTRA Band 1, 3, 11, 21, 28, 34, 40, 42, 65<br>NR Band n79  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | NR Band n77, n78   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | Frequency range  | 945           | - | 960            | -50 | 1       |        |
|    | Frequency range  | 1884.5        | - | 1915.7         | -41 | 0.3     | 8      |
|    | Frequency range  | 2545          | - | 2575           | -50 | 1       |        |
|    | Frequency range  | 2595          | - | 2645           | -50 | 1       |        |
| 20 | E-UTRA Band 1, 3, 7, 8, 22, 31, 32, 33, 34, 40, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76, 87, 88   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | E-UTRA Band 20   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 15     |
|    | E-UTRA Band 38, 42, 52, 69<br>NR Band n77, n78   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | Frequency range  | 758           | - | 788            | -50 | 1       |        |
| 21 | E-UTRA Band 1, 3, 18, 19, 28, 34, 40, 42, 65<br>NR Band n77, n78, n79  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | Frequency range  | 945           | - | 960            | -50 | 1       |        |
|    | Frequency range  | 1884.5        | - | 1915.7         | -41 | 0.3     | 8      |
|    | Frequency range  | 2545          | - | 2575           | -50 | 1       |        |
|    | Frequency range  | 2595          | - | 2645           | -50 | 1       |        |
| 22 | E-UTRA Band 1, 3, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 43, 65, 67, 68, 69, 72, 75, 76, 87, 88   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | Frequency range  | 3510          | - | 3525           | -40 | 1       | 15     |
|    | Frequency range  | 3525          | - | 3590           | -50 | 1       |        |
| 23 | E-UTRA Band 4, 5, 12, 13, 14, 17, 23, 24, 26, 27, 29, 30, 41, 66   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
| 24 | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | NR Band n77  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
| 25 | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 53, 66, 70, 71, 85   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | E-UTRA Band 2  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 15     |
|    | E-UTRA Band 25   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 15     |
|    | E-UTRA Band 43, 48<br>NR Band n77  | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
| 26 | E-UTRA Band 1, 2, 3, 4, 5, 11, 12, 13, 14, 17, 18, 19, 21, 24, 25, 26, 29, 30, 31, 34, 39, 40, 42, 43, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85<br>NR Band n79 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       |        |
|    | E-UTRA Band 41, 53<br>NR Band n77, n78   | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1       | 2      |
|    | Frequency range  | 703           | - | 799            | -50 | 1       |        |

|     |   |                     |   |                      |       |         |            |
|-----|---|---------------------|---|----------------------|-------|---------|------------|
|     | Frequency range   | 799                 | - | 803                  | -40   | 1       | 15         |
|     | Frequency range   | 945                 | - | 960                  | -50   | 1       |            |
|     | Frequency range   | 1884.5              | - | 1915.7               | -41   | 0.3     | 8          |
| 27  | E-UTRA Band 1, 2, 3, 4, 5, 7, 12, 13, 14, 17, 25, 26, 27, 29, 30, 31, 38, 40, 41, 42, 43, 65, 66, 73, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | E-UTRA Band 28  | F <sub>DL_low</sub> | - | 790                  | -50   | 1       |            |
|     | NR Band n77   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2          |
|     | Frequency range   | 799                 | - | 805                  | -35   | 0.00625 |            |
| 28  | E-UTRA Band 1, 4, 22, 32, 42, 43, 50, 51, 65, 66, 73, 74, 75, 76<br>NR Band n77, n78  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2          |
|     | E-UTRA Band 1   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 19, 25     |
|     | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 40, 41, 52, 72, 87, 88<br>NR Band n79  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | E-UTRA Band 11, 21  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 19, 24     |
|     | Frequency range   | 470                 | - | 694                  | -42   | 8       | 15, 35     |
|     | Frequency range   | 470                 | - | 710                  | -26.2 | 6       | 34         |
|     | Frequency range   | 662                 | - | 694                  | -26.2 | 6       | 15         |
|     | Frequency range   | 758                 | - | 773                  | -32   | 1       | 15         |
|     | Frequency range   | 773                 | - | 803                  | -50   | 1       |            |
|     | Frequency range   | 1884.5              | - | 1915.7               | -41   | 0.3     | 8, 19      |
| 30  | E-UTRA Band 2, 4, 5, 7, 12, 13, 14, 17, 24, 25, 26, 27, 29, 30, 38, 41, 48, 53, 66, 70, 71, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | NR Band n77   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
| 31  | E-UTRA Band 1, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 33, 34, 38, 40, 42, 43, 50, 51, 52, 65, 67, 68, 69, 74, 75, 76, 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | E-UTRA Band 3   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2          |
|     | Frequency range   | 470                 | - | 694                  | -42   | 8       |            |
| ... |   |                     |   |                      |       |         |            |
| 33  | E-UTRA Band 1, 7, 8, 20, 22, 28, 31, 32, 34, 38, 40, 42, 43, 52, 65, 67, 69, 72, 73, 75, 76, 87, 88   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 5          |
|     | E-UTRA Band 43  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2          |
|     | E-UTRA Band 3   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 15         |
| 34  | E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 26, 28, 31, 32, 33, 38, 39, 40, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 69, 72, 73, 74, 75, 76, 87, 88<br>NR Band n78, n79            | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 5          |
|     | NR Band n77   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2, 5       |
|     | Frequency range   | 1884.5              | - | 1915.7               | -41   | 0.3     | 8          |
| 35  |   |                     |   |                      |       |         |            |
| 36  |   |                     |   |                      |       |         |            |
| 37  |   |                     | - |                      |       |         |            |
| 38  | E-UTRA Band 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 66, 67, 68, 72, 74, 75, 76, 85, 87, 88<br>NR Band n77, n78, n79     | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | Frequency range   | 2620                | - | 2645                 | -15.5 | 5       | 15, 22, 26 |
|     | Frequency range   | 2645                | - | 2690                 | -40   | 1       | 15, 22     |
| 39  | E-UTRA Band 1, 8, 22, 26, 28, 34, 40, 41, 42, 44, 45, 50, 51, 52, 73, 74<br>NR Band n79   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |
|     | NR Band n77, n78  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       | 2          |
|     | Frequency range   | 1805                |   | 1855                 | -40   | 1       | 33         |
|     | Frequency range   | 1855                |   | 1880                 | -15.5 | 5       | 15, 26, 33 |
| 40  | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 33, 34, 38, 39, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76, 87, 88<br>NR Band n77, n78 | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50   | 1       |            |

|     |  |                     |   |                      |          |     |                |
|-----|--|---------------------|---|----------------------|----------|-----|----------------|
|     | NR Band n79  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
|     | Frequency range  | 1884.5              | - | 1915.7               | -41      | 0.3 | 8              |
| 41  | E-UTRA Band 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 34, 39, 40, 42, 44, 45, 48, 50, 51, 52, 65, 66, 70, 71, 73, 74, 85<br>NR Band n77, n78               | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | E-UTRA Band 9, 11, 18, 19, 21  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 30             |
|     | NR Band n79  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
|     | Frequency range  | 1884.5              | - | 1915.7               | -41      | 0.3 | 8, 30          |
| 42  | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 11, 18, 19, 20, 21, 25, 26, 27, 28, 31, 32, 33, 34, 38, 40, 41, 44, 45, 50, 51, 65, 66, 67, 68, 69, 72, 73, 74, 75, 76, 87, 88<br>NR Band n79 | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | Frequency range  | 1884.5              | - | 1915.7               | -41      | 0.3 | 8              |
| 43  | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 20, 25, 26, 27, 28, 31, 32, 33, 34, 38, 40, 50, 51, 65, 66, 67, 68, 69, 72, 73, 74, 75, 76, 85, 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 44  | E-UTRA Band 1, 40, 42, 45  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
|     | E-UTRA Band 3, 5, 8, 34, 39, 41, 73  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 45  | E-UTRA Band 1, 3, 5, 8, 34, 39, 40, 41, 42, 44, 52, 73   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| ... |  |                     |   |                      |          |     |                |
| 47  | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 65, 68, 72, 73<br>NR band n77, n78, n79   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | Frequency range  | 5925                | - | 5950                 | -30 EIRP | 1   | 38, 40, 43     |
|     | Frequency range  | 5815                | - | 5855                 | -30 EIRP | 1   | 38, 43, 45     |
| 48  | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 50, 51, 66, 70, 71, 74, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 50  | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 52, 65, 66, 67, 68, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 51  | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 52, 65, 66, 67, 68, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 52  | E-UTRA Band 1, 3, 5, 7, 8, 20, 28, 31, 33, 34, 38, 39, 40, 41, 45, 47, 50, 51, 68, 72, 73, 74, 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 53  | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 48, 66, 70, 71, 85,<br>NR Band n77  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
| 65  | E-UTRA Band 1, 3, 7, 8, 20, 22, 28, 31, 32, 38, 40, 42, 43, 50, 51, 65, 68, 69, 72, 74, 75, 76, 87, 88<br>NR Band n78, n79   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | NR Band n77  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
|     | E-UTRA Band 5, 11, 18, 19, 21, 26, 27, 41  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | E-UTRA Band 34   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 36             |
|     | Frequency range  | 1884.5              | - | 1915.7               | -41      | 0.3 | 37             |
|     | Frequency range  | 1900                | - | 1915                 | -15.5    | 5   | 15, 26, 27     |
|     | Frequency range  | 1915                | - | 1920                 | +1.6     | 5   | 15, 26, 27, 44 |
| 66  | E-UTRA Band 2, 4, 5, 7, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 38, 41, 43, 50, 51, 53, 66, 70, 71, 74, 85   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | E-UTRA Band 42, 48,<br>NR Band n77   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
| 68  | E-UTRA Band 3, 7, 8, 20, 28, 31, 38, 40, 47, 72, 74, 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |
|     | E-UTRA Band 1, 22, 42, 43, 50, 51, 52, 65  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   | 2              |
| ... |  |                     |   |                      |          |     |                |
| 70  | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 53, 66, 70, 71, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50      | 1   |                |

|   |   |                     |   |                      |     |     |        |  |
|---|---|---------------------|---|----------------------|-----|-----|--------|--|
|   | NR Band n77   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
| 71  | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 53, 66, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band 2, 25, 41, 70, NR Band n77  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
|   | E-UTRA Band 29  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -38 | 1   | 15     |  |
|   | E-UTRA Band 71  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 15     |  |
| 72  | E-UTRA Band 1, 7, 20, 22, 28, 31, 32, 33, 34, 38, 42, 43, 47, 52, 65, 68, 72, 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band 3, 8, 40  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
|   | Frequency range   | 470                 | - | 694                  | -42 | 8   |        |  |
| 73  | E-UTRA Band 1, 26, 28, 33, 34, 39, 41, 42, 43, 44, 45, 47, 52   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band 3, 5, 8, 27, 40   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
| 74  | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 52, 65, 66, 67, 68, 85 NR Band n77, n78  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | NR Band n79   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
|   | Frequency range   | 1884.5              | - | 1915.7               | -41 | 0.3 | 8      |  |
|   | Frequency range   | 1400                | - | 1427                 | -32 | 27  | 15, 41 |  |
|   | Frequency range   | 1475                | - | 1488                 | -50 | 1   | 42     |  |
| 85  | E-UTRA Band 2, 5, 13, 14, 17, 24, 25, 26, 27, 30, 41, 53, 70, 71, 74  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band 4, 48, 51, 66 NR Band n77, n78  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
|   | E-UTRA Band 12, 85  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 15     |  |
|   | E-UTRA Band 1, 3, 7, 8, 22, 28, 31, 32, 33, 34, 38, 40, 42, 43, 47, 52, 65, 68, 72  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band, 20   | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 2      |  |
| 87  | E-UTRA Band 87, 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 15     |  |
|   | Frequency range   | 470                 | - | 694                  | -42 | 8   |        |  |
|   | E-UTRA Band 1, 3, 7, 8, 20, 22, 28, 31, 32, 33, 34, 38, 40, 42, 43, 47, 52, 65, 68, 72  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   |        |  |
|   | E-UTRA Band 87  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -20 | 1   | 15     |  |
| 88  | E-UTRA Band 88  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1   | 15     |  |
|   | Frequency range   | 470                 | - | 694                  | -42 | 8   |        |  |
|   | NOTE 1: F <sub>DL_low</sub> and F <sub>DL_high</sub> refer to each E-UTRA frequency band specified in Table 5.5-1   |                     |   |                      |     |     |        |  |
|   | NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup> [or 5 <sup>th</sup> ] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L <sub>CRB</sub> x 180kHz), where N is 2, 3, 4, [5] for the 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup> [or 5 <sup>th</sup> ] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. |                     |   |                      |     |     |        |  |
| NOTE 3: N/A   |   |                     |   |                      |     |     |        |  |
| NOTE 4: N/A   |   |                     |   |                      |     |     |        |  |
| NOTE 5: For non synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band                                     |   |                     |   |                      |     |     |        |  |
| NOTE 6: N/A   |   |                     |   |                      |     |     |        |  |
| NOTE 7: Applicable when co-existence with PHS system operating in 1884.5-1919.6MHz.   |   |                     |   |                      |     |     |        |  |
| NOTE 8: Applicable when co-existence with PHS system operating in 1884.5-1915.7MHz.   |   |                     |   |                      |     |     |        |  |
| NOTE 9: N/A   |   |                     |   |                      |     |     |        |  |
| NOTE 10: N/A  |   |                     |   |                      |     |     |        |  |
| NOTE 11: Whether the applicable frequency range should be 793-805MHz instead of 799-805MHz is TBD   |   |                     |   |                      |     |     |        |  |
| NOTE 12: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB   |   |                     |   |                      |     |     |        |  |
| NOTE 13: N/A  |   |                     |   |                      |     |     |        |  |
| NOTE 14: N/A  |   |                     |   |                      |     |     |        |  |
| NOTE 15: These requirements also apply for the frequency ranges that are less than F <sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |   |                     |   |                      |     |     |        |  |
| NOTE 16: N/A  |   |                     |   |                      |     |     |        |  |
| NOTE 17: N/A  |   |                     |   |                      |     |     |        |  |

- NOTE 18: N/A
- NOTE 19: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. Applicable when the assigned E-UTRA carrier is confined within 715 MHz and 718 MHz and when the channel bandwidth used is 3 MHz.
- NOTE 20: N/A
- NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.
- NOTE 22: This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS\_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE *P-Max*.
- NOTE 23: This requirement is applicable only for the following cases:
- for carriers of 5 MHz channel bandwidth when carrier centre frequency ( $F_c$ ) is within the range  $902.5 \text{ MHz} \leq F_c < 907.5 \text{ MHz}$  with an uplink transmission bandwidth less than or equal to 20 RB
  - for carriers of 5 MHz channel bandwidth when carrier centre frequency ( $F_c$ ) is within the range  $907.5 \text{ MHz} \leq F_c \leq 912.5 \text{ MHz}$  without any restriction on uplink transmission bandwidth.
  - for carriers of 10 MHz channel bandwidth when carrier centre frequency ( $F_c$ ) is  $F_c = 910 \text{ MHz}$  with an uplink transmission bandwidth less than or equal to 32 RB with  $RB_{\text{start}} > 3$ .
- NOTE 24: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 2<sup>nd</sup> harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 2<sup>nd</sup> harmonic totally or partially overlaps the measurement bandwidth (MBW).
- NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3<sup>rd</sup> harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3<sup>rd</sup> harmonic totally or partially overlaps the measurement bandwidth (MBW).
- NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.
- NOTE 27: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.
- NOTE 28: N/A
- NOTE 29: N/A
- NOTE 30: This requirement applies when the E-UTRA carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz
- NOTE 31: N/A
- NOTE 32: Void
- NOTE 33: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.
- NOTE 34: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with  $RB_{\text{start}} > 1$  and  $RB_{\text{start}} < 48$ . Applicable when the assigned E-UTRA carrier is confined within 715 MHz and 718 MHz and when the channel bandwidth used is 3 MHz.
- NOTE 35: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.
- NOTE 36: This requirement is applicable for E-UTRA channel bandwidth allocated within 1920-1980 MHz.
- NOTE 37: Applicable when the upper edge of the channel bandwidth frequency is greater than 1980MHz.
- NOTE 38: Applicable when NS\_33 or NS\_34 is configured by the pre-configured radio parameters.
- NOTE 39: Applicable only when the assigned E-UTRA carrier is confined within 824 MHz and 849 MHz for UE category M1, M2 and UE category NB1 and NB2.



|  |
|--|
| NOTE 40: In the frequency range $x-5950\text{MHz}$ , SE requirement of $-30\text{dBm/MHz}$ should be applied; where $x = \max(5925, f_c + 15)$ , where $f_c$ is the channel centre frequency.  |
| NOTE 41: Applicable for all bandwidths, and when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is greater than or equal to $1427\text{ MHz} +$ the channel BW assigned for 1.4, 3, 5 and 10 MHz bandwidth, and when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is greater than or equal to $1440\text{ MHz}$ for 15 and 20 MHz bandwidth. This requirement shall be verified with UE transmission power configured as high as possible but no higher than 15 dBm. |
| NOTE 42: Applicable for 1.4, 3 and 5 MHz bandwidth, and when the upper edge of the assigned E-UTRA UL channel bandwidth frequency is less than or equal to $1467\text{ MHz}$ assigned for 10 MHz bandwidth, and when the upper edge of the assigned E-UTRA UL channel bandwidth frequency is less than or equal to $1463.8\text{ MHz}$ for 15 MHz bandwidth, and when the upper edge of the assigned E-UTRA UL channel bandwidth frequency is less than or equal to $1460.8\text{ MHz}$ for 20 MHz bandwidth.      |
| NOTE 43: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain $G_{\text{post connector}}$ declared by the UE following the principle described in annex I.   |
| NOTE 44: For category NB1 and NB2 UE when carrier centre frequency is $1920.1\text{ MHz}$ , in case of single-tone uplink transmission the requirement is applicable only for sub-carrier index $> 2$ .  |
| NOTE 45: Resolution BW is 10% of the measurement BW and the result should be integrated to achieve the measurement bandwidth. The sweep time shall be set at least as $(\text{sweep points}) \times (\text{symbol length})$ to improve the measurement accuracy.   |

NOTE: The restriction on the maximum uplink transmission to 54 RB in Notes 21, 22, and 27 of Table 6.6.3.2-1 and the restriction on the single-tone uplink transmission to sub-carrier index  $> 2$  in Note 44 of Table 6.6.3.2-1 are intended for conformance testing and may be applied to network operation to facilitate coexistence when the aggressor and victim bands are deployed in the same geographical area. The applicable spurious emission requirement of  $-15.5\text{ dBm/5MHz}$  is a least restrictive technical condition for FDD/TDD coexistence and may have to be revised in the future.

When "NS\_33" or "NS 34" is configured from pre-configured radio parameters or the cell and the indication from upper layers has indicated that the UE is within the protection zone of CEN DSRC devices or HDR DSRC devices, the power of any V2X UE emission shall fulfil either one of the two set of conditions.

|             | Maximum Transmission Power (dBm EIRP) | Emission Limit in Frequency Range 5795-5815 (dBm/MHz EIRP) |
|-------------|---------------------------------------|--|
| Condition 1 | 10                                    | -65  |
| Condition 2 | 10                                    | -45  |

### 6.6.3.2A Spurious emission band UE co-existence for CA

This clause specifies the additional requirements for inter-band uplink carrier aggregation configurations with the single CC uplink assigned to two E-UTRA bands for coexistence with protected bands for the specified uplink carrier aggregation configurations in Table 6.5A.3.2.3-1. The intersection of the requirements for the individual bands specified in clause 6.5.3.2 shall also apply for the specified uplink carrier aggregation configurations. Intersection of a requirement means that both UL constituent bands have the same protected band requirement specified and if one or both protected bands have note(s) associated those note(s) also apply.

As exceptions, the additional requirements in Table 6.6.3.2A-0 apply on each component carrier with all component carriers are active.

NOTE 1: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus  $\text{MBW}/2$ . The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus  $\text{MBW}/2$ . MBW denotes the measurement bandwidth defined for the protected band.

NOTE 2: For inter-band carrier aggregation with uplink assigned to two E-UTRA bands the requirements in Table 6.6A.3.2.3-1 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.6A.3.2.3-1 and in clause 6.6.3.2 would be considered to be verified by the measurements verifying the one uplink inter-band CA UE to UE co-existence requirements.

Table 6.6.3.2A-0: Requirements for uplink inter-band carrier aggregation (two bands)

| E-UTRA CA Configuration | Spurious emission |                       |   |                     |           |         |         |
|-------------------------|-------------------|-----------------------|---|---------------------|-----------|---------|---------|
|                         | Protected band    | Frequency range (MHz) |   | Maximum Level (dBm) | MBW (MHz) | NOTE    |         |
| CA_1-5                  | Frequency range   | 859                   | - | 869                 | -27       | 1       |         |
| CA_1-8                  | Frequency range   | 860                   | - | 890                 | -40       | 1       | 3, 11   |
| CA_1-11                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
|                         | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
| CA_1-18                 | Frequency range   | 758                   | - | 799                 | -50       | 1       |         |
|                         | Frequency range   | 799                   | - | 803                 | -40       | 1       | 3       |
|                         | Frequency range   | 860                   | - | 890                 | -40       | 1       |         |
|                         | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
| CA_1-19                 | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
|                         | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
| CA_1-20                 | Frequency range   | 758                   | - | 788                 | -50       | 1       |         |
| CA_1-21                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
|                         | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
| CA_1-26                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 703                   | - | 799                 | -50       | 1       |         |
|                         |                   | 799                   | - | 803                 | -40       | 1       | 3       |
| CA_1-28                 | Frequency range   | 470                   | - | 694                 | -42       | 8       | 3, 22   |
|                         | Frequency range   | 470                   | - | 710                 | -26.2     | 6       | 23      |
|                         | Frequency range   | 758                   | - | 773                 | -32       | 1       | 3       |
|                         | Frequency range   | 773                   | - | 803                 | -50       | 1       |         |
|                         | Frequency range   | 662                   | - | 694                 | -26.2     | 6       | 3       |
| CA_2-5                  | Frequency range   | 859                   | - | 869                 | -27       | 1       |         |
| CA_2-13                 | Frequency range   | 769                   | - | 775                 | -35       | 0.00625 | 3       |
|                         | Frequency range   | 799                   | - | 805                 | -35       | 0.00625 | 3       |
| CA_2-14                 | Frequency range   | 769                   | - | 775                 | -35       | 0.00625 | 3       |
|                         | Frequency range   | 799                   | - | 805                 | -35       | 0.00625 | 3       |
| CA_3-5                  | Frequency range   | 859                   | - | 869                 | -27       | 1       |         |
| CA_3-8                  | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 4, 11   |
|                         | Frequency range   | 860                   | - | 890                 | -40       | 1       | 3,11,17 |
| CA_3-11                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 4       |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
|                         | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
| CA_3-18                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 4       |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
|                         | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
| CA_3-19                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 3, 4    |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
| CA_3-20                 | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
|                         | Frequency range   | 758                   | - | 788                 | -50       | 1       |         |
| CA_3-21                 | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |
|                         | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 4       |
|                         | Frequency range   | 2545                  | - | 2575                | -50       | 1       |         |
|                         | Frequency range   | 2595                  | - | 2645                | -50       | 1       |         |
| CA_3-26                 | Frequency range   | 1884.5                | - | 1915.7              | -41       | 0.3     | 4       |
|                         | Frequency range   | 703                   | - | 799                 | -50       | 1       |         |
|                         |                   | 799                   | - | 803                 | -40       | 1       | 3       |
|                         | Frequency range   | 945                   | - | 960                 | -50       | 1       |         |

|          |                 |        |   |        |       |         |       |
|----------|-----------------|--------|---|--------|-------|---------|-------|
| CA_3-28  | Frequency range | 470    | - | 710    | -26.2 | 6       | 23    |
|          | Frequency range | 758    | - | 773    | -32   | 1       | 3     |
|          | Frequency range | 773    | - | 803    | -50   | 1       |       |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4, 5  |
| CA_3-40  | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     |       |
| CA_3-41  | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4, 18 |
| CA_3-42  | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
| CA_4-5   | Frequency range | 859    | - | 869    | -27   | 1       |       |
| CA_4-13  | Frequency range | 769    | - | 775    | -35   | 0.00625 | 3     |
|          | Frequency range | 799    | - | 805    | -35   | 0.00625 | 3     |
| CA_4-28  | Frequency range | 470    | - | 710    | -26.2 | 6       | 23    |
|          | Frequency range | 758    | - | 773    | -32   | 1       | 3     |
|          | Frequency range | 773    | - | 803    | -50   | 1       |       |
| CA_5-7   | Frequency range | 859    | - | 869    | -27   | 1       |       |
| CA_5-12  | Frequency range | 859    | - | 869    | -27   | 1       |       |
| CA_5-17  | Frequency range | 859    | - | 869    | -27   | 1       |       |
| CA_5-40  | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
| CA_7-26  | Frequency range | 703    | - | 799    | -50   | 1       |       |
|          | Frequency range | 799    | - | 803    | -40   | 1       | 3     |
|          | Frequency range | 945    | - | 960    | -50   | 1       |       |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     |       |
| CA_7-28  | Frequency range | 758    | - | 773    | -32   | 1       | 3     |
|          | Frequency range | 773    | - | 803    | -50   | 1       |       |
| CA_8-41  | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4, 11 |
| CA_11-18 | Frequency range | 860    | - | 890    | -40   | 1       | 3     |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
|          | Frequency range | 2545   | - | 2575   | -50   | 1       |       |
|          | Frequency range | 2595   | - | 2645   | -50   | 1       |       |
|          | Frequency range | 945    | - | 960    | -50   | 1       |       |
| CA_11-26 | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
|          | Frequency range | 2545   | - | 2575   | -50   | 1       | 2     |
|          | Frequency range | 2595   | - | 2645   | -50   | 1       |       |
|          | Frequency range | 945    | - | 960    | -50   | 1       |       |
| CA_13-66 | Frequency range | 769    | - | 775    | -35   | 0.00625 | 3     |
|          | Frequency range | 799    | - | 805    | -35   | 0.00625 | 3     |
| CA_14-30 | Frequency range | 769    | - | 775    | -35   | 0.00625 | 3     |
|          | Frequency range | 799    | - | 805    | -35   | 0.00625 | 3     |
| CA_14-66 | Frequency range | 769    | - | 775    | -35   | 0.00625 | 3     |
|          | Frequency range | 799    | - | 805    | -35   | 0.00625 | 3     |
| CA_18-28 | Frequency range | 470    | - | 710    | -26.2 | 6       | 23    |
|          | Frequency range | 758    | - | 773    | -32   | 1       | 3     |
|          | Frequency range | 773    | - | 799    | -50   | 1       |       |
|          | Frequency range | 799    | - | 803    | -40   | 1       | 3     |
|          | Frequency range | 860    | - | 890    | -40   | 1       |       |
|          | Frequency range | 945    | - | 960    | -50   | 1       | 3     |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
|          | Frequency range | 2545   | - | 2575   | -50   | 1       |       |
|          | Frequency range | 2595   | - | 2645   | -50   | 1       |       |
| CA_19-21 | Frequency range | 945    | - | 960    | -50   | 1       |       |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
|          | Frequency range | 2545   | - | 2575   | -50   | 1       |       |
|          | Frequency range | 2595   | - | 2645   | -50   | 1       |       |
| CA_19-42 | Frequency range | 945    | - | 960    | -50   | 1       |       |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4     |
|          | Frequency range | 2545   | - | 2575   | -50   | 1       |       |
|          | Frequency range | 2595   | - | 2645   | -50   | 1       |       |
| CA_21-28 | Frequency range | 470    | - | 710    | -26.2 | 6       | 23    |
|          | Frequency range | 773    | - | 803    | -50   | 1       |       |
|          | Frequency range | 945    | - | 960    | -50   | 1       |       |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3     | 4, 5  |

|          |                 |        |   |        |       |     |          |
|----------|-----------------|--------|---|--------|-------|-----|----------|
|          | Frequency range | 2545   | - | 2575   | -50   | 1   |          |
|          | Frequency range | 2595   | - | 2645   | -50   | 1   |          |
| CA_21-42 | Frequency range | 945    | - | 960    | -50   | 1   |          |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 4        |
|          | Frequency range | 2545   | - | 2575   | -50   | 1   |          |
|          | Frequency range | 2595   | - | 2645   | -50   | 1   |          |
|          | Frequency range | 703    | - | 799    | -50   | 1   |          |
| CA_26-46 | Frequency range | 799    | - | 803    | -40   | 1   | 2        |
|          | Frequency range | 945    | - | 960    | -50   | 1   |          |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 3        |
|          | Frequency range | 703    | - | 799    | -50   | 1   |          |
| CA_26-48 | Frequency range | 799    | - | 803    | -40   | 1   | 2        |
|          | Frequency range | 945    | - | 960    | -50   | 1   |          |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 3        |
|          | Frequency range | 470    | - | 694    | -42   | 8   | 3, 22    |
| CA_28-41 | Frequency range | 470    | - | 710    | -26.2 | 6   | 23       |
|          | Frequency range | 662    | - | 694    | -26.2 | 6   | 3        |
|          | Frequency range | 758    | - | 773    | -32   | 1   | 3        |
|          | Frequency range | 773    | - | 803    | -50   | 1   |          |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 4, 5, 18 |
|          | Frequency range | 470    | - | 710    | -26.2 | 6   | 23       |
| CA_28-42 | Frequency range | 758    | - | 773    | -32   | 1   | 3        |
|          | Frequency range | 773    | - | 803    | -50   | 1   |          |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 4, 5     |
|          | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 8        |
| CA_40-42 | Frequency range | 1884.5 | - | 1915.7 | -41   | 0.3 | 8        |
| CA_41-42 | Frequency range | 1884.5 |   | 1915.7 | -41   | 0.3 | 4, 18    |

NOTE 1: Void

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> [or 5<sup>th</sup>] harmonic spurious emissions. In case the exceptions are allowed due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L<sub>CRB</sub> x 180kHz), where N is 2, 3 or 4 for the 2<sup>nd</sup>, 3<sup>rd</sup> or 4<sup>th</sup> harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: These requirements also apply for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

NOTE 4: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.

NOTE 5: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. Applicable when the assigned E-UTRA carrier is confined within 715 MHz and 718 MHz and when the channel bandwidth used is 3 MHz.

NOTE 6: Void

NOTE 7: Void

NOTE 8: Void

NOTE 9: Void

NOTE 10: Void

NOTE 11: This requirement is applicable only for the following cases:

- for carriers of 5 MHz channel bandwidth when carrier centre frequency (F<sub>c</sub>) is within the range 902.5 MHz ≤ F<sub>c</sub> < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB
- for carriers of 5 MHz channel bandwidth when carrier centre frequency (F<sub>c</sub>) is within the range 907.5 MHz ≤ F<sub>c</sub> ≤ 912.5 MHz without any restriction on uplink transmission bandwidth.
- for carriers of 10 MHz channel bandwidth when carrier centre frequency (F<sub>c</sub>) is F<sub>c</sub> = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RB<sub>start</sub> > 3.

NOTE 12: Void

NOTE 13: Void

NOTE 14: Void

NOTE 15: Void

NOTE 16: Void

NOTE 17: This requirement is applicable only when Band 3 transmission frequency is less than or equal to 1765 MHz.

NOTE 18: This requirement applies when the E-UTRA carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz

NOTE 19: Void

NOTE 20: Void

NOTE 21: Void

NOTE 22: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.

NOTE 23: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.NOTE 24: Void

NOTE 25: Void

**Table 6.6.3.2A-1: Requirements for intraband carrier aggregation**

| E-UTRA CA Configuration | Spurious emission  |                       |   |                      |           |      |    |
|-------------------------|--|-----------------------|---|----------------------|-----------|------|----|
|                         | Protected band   | Frequency range (MHz) |   | Maximum Level (dBm)  | MBW (MHz) | NOTE |    |
| CA_1                    | E-UTRA Band 1, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 44, 50, 51, 52, 65, 67, 72, 73, 74, 75, 76 NR Band n78, n79               | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | E-UTRA Band 3  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 10 |
|                         | NR Band n77  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_3                    | E-UTRA Band 1, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 40, 41, 43, 44, 50, 51, 65, 67, 72, 73, 74, 75, 76 NR Band n79  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | E-UTRA Band 3  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 10 |
|                         | E-UTRA Band 22, 42, 52 NR Band n77, n78  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_5                    | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 24, 25, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 65, 66, 70, 71, 85  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | E-UTRA band 52, 53 NR Band n77, n78, n79   | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_7                    | E-UTRA Band 1, 3, 7, 8, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 67, 72, 74, 75, 76 NR Band n77, n78                                | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
| CA_8                    | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 50, 51, 72, 73, 74, 75, 76  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | E-UTRA band 3  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
|                         | E-UTRA band 7  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
|                         | E-UTRA Band 8  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 10 |
|                         | E-UTRA Band 22, 41, 42, 43, 52 NR Band n77, n78, n79   | F <sub>DL_low</sub>   |   | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_38                   | E-UTRA Band 1,3, 8, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 67, 72, 74, 75, 76   | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
| CA_39                   | E-UTRA Band 22, 34, 40, 41, 42, 44, 50, 51, 52, 73, 74 NR Band n79   | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | NR Band n77, n78   | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_40                   | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 33, 34, 38, 39, 41, 42, 43, 44, 50, 51, 52, 65, 67, 72, 73, 74, 75, 76 NR Band n77, n78 | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | NR Band n79  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
|                         | Frequency range  | 1884.5                | - | 1915.7               | -41       | 0.3  | 15 |
| CA_41                   | E-UTRA Band 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 34, 39, 40, 42, 44, 50, 51, 52, 65, 66, 70, 71, 73, 74, 85 NR Band n77, n78          | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | NR Band n79  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2  |
| CA_42                   | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 11, 18, 19, 20, 21, 25, 26, 27, 28, 31, 32, 33, 34, 38, 40, 41, 44, 50, 51, 65, 66, 67, 72, 73, 74, 75, 76 NR Band n79        | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |    |
|                         | Frequency range  | 1884.5                | - | 1915.7               | -41       | 0.3  |    |

|  |  |                     |   |                      |     |   |   |
|--|--|---------------------|---|----------------------|-----|---|---|
| CA_48  | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 50, 51, 66, 70, 71, 74, 85                    | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1 |   |
| CA_66  | E-UTRA Band 2, 4, 5, 7, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 38, 41, 43, 50, 51, 66, 70, 71, 74, 85 | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1 |   |
|  | E-UTRA Band 42, 48<br>NR Band n77  | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1 | 2 |
| <p>NOTE 1: F<sub>DL_low</sub> and F<sub>DL_high</sub> refer to each E-UTRA frequency band specified in Table 5.5-1</p> <p>NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> [or 5<sup>th</sup>] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L<sub>CRB</sub> x 180kHz), where N is 2, 3, 4, [5] for the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> [or 5<sup>th</sup>] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval</p> <p>NOTE 3: To meet these requirements some restriction will be needed for either the operating band or protected band</p> <p>NOTE 4: N/A</p> <p>NOTE 5: N/A</p> <p>NOTE 6: N/A</p> <p>NOTE 7: N/A</p> <p>NOTE 8: N/A</p> <p>NOTE 9: N/A</p> <p>NOTE 10: The requirement also applies for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.</p> <p>NOTE 11: N/A</p> <p>NOTE 12: N/A</p> <p>NOTE 13: N/A</p> <p>NOTE 14: N/A</p> <p>NOTE 15: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.</p> |  |                     |   |                      |     |   |   |

**Table 6.6.3.2A-2: Requirements for intraband non-contiguous CA**

| E-UTRA CA Configuration  | Spurious emission   |                       |   |                      |           |      |   |
|--|---|-----------------------|---|----------------------|-----------|------|---|
|  | Protected band  | Frequency range (MHz) |   | Maximum Level (dBm)  | MBW (MHz) | NOTE |   |
| CA_4-4   | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 41, 43, 50, 51, 53, 66, 70, 71, 74, 85 | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    |   |
|  | E-UTRA Band 22, 42<br>NR Band n7  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50       | 1    | 2 |
| <p>NOTE 1: F<sub>DL_low</sub> and F<sub>DL_high</sub> refer to each E-UTRA frequency band specified in Table 5.5-1</p> <p>NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2<sup>nd</sup> or 3<sup>rd</sup> harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L<sub>CRB</sub> x 180kHz), where N is 2 or 3 for the 2<sup>nd</sup> or 3<sup>rd</sup> harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.</p> |   |                       |   |                      |           |      |   |

**6.6.3.3 Additional spurious emissions**

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

#### 6.6.3.3.1 Minimum requirement (network signalled value "NS\_05")

When "NS\_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.1-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.1-1: Additional requirements (PHS)**

| Frequency band (MHz)        | Channel bandwidth / Spectrum emission limit (dBm) |        |        |        | Measurement bandwidth | NOTE |
|-----------------------------|---|--------|--------|--------|-----------------------|------|
|                             | 5 MHz   | 10 MHz | 15 MHz | 20 MHz |                       |      |
| $1884.5 \leq f \leq 1915.7$ | -41   | -41    | -41    | -41    | 300 KHz               | 1    |

**Table 6.6.3.3.1-2: Void**

#### 6.6.3.3.2 Minimum requirement (network signalled value "NS\_07")

When "NS\_07" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.2-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.2-1: Additional requirements**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) |  | Measurement bandwidth |
|--|---|--|-----------------------|
|  | 10 MHz  |  |                       |
| $769 \leq f \leq 775$  | -57   |  | 6.25 kHz              |
| NOTE: The emissions measurement shall be sufficiently power averaged to ensure standard standard deviation < 0.5 dB. |   |  |                       |

#### 6.6.3.3.3 Minimum requirement (network signalled value "NS\_08")

When "NS\_08" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.3-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.3-1: Additional requirement**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) |       |       | Measurement bandwidth |
|-----------------------|---|-------|-------|-----------------------|
|                       | 5MHz  | 10MHz | 15MHz |                       |
| $860 \leq f \leq 890$ | -40   | -40   | -40   | 1 MHz                 |

#### 6.6.3.3.4 Minimum requirement (network signalled value "NS\_09")

When "NS\_09" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.4-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.4-1: Additional requirement**

| Frequency band (MHz)        | Channel bandwidth / Spectrum emission limit (dBm) |       |       | Measurement bandwidth |
|-----------------------------|---|-------|-------|-----------------------|
|                             | 5MHz  | 10MHz | 15MHz |                       |
| $1475.9 \leq f \leq 1510.9$ | -35   | -35   | -35   | 1 MHz                 |

NOTE 1: Void.

NOTE 2: To improve measurement accuracy, A-MPR values for NS\_09 specified in Table 6.2.4-1 in subclause 6.2.4 are derived based on 100 kHz RBW.

#### 6.6.3.3.5 Minimum requirement (network signalled value "NS\_12")

When "NS 12" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.5-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.5-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz             |                       |
| $806 \leq f \leq 813.5$   | -42   | 6.25 kHz              |
| NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 814.2 MHz.              |   |                       |
| NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. |   |                       |

#### 6.6.3.3.6 Minimum requirement (network signalled value "NS\_13")

When "NS 13" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.6-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.6-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 1.4, 3, 5 MHz                                     |                       |
| $806 \leq f \leq 816$   | -42   | 6.25 kHz              |
| NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 819 MHz.                |   |                       |
| NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. |   |                       |

#### 6.6.3.3.7 Minimum requirement (network signalled value "NS\_14")

When "NS 14" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.7-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.7-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-----------------------|---|-----------------------|
|                       | 10 MHz, 15 MHz                                    |                       |
| $806 \leq f \leq 816$ | -42   | 6.25 kHz              |



NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 824 MHz.  
 NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB.

#### 6.6.3.3.8 Minimum requirement (network signalled value “NS\_15”)

When “NS\_15” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.8-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.8-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz             |                       |
| $851 \leq f \leq 859$   | -53   | 6.25 kHz              |
| NOTE 1: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. |   |                       |

#### 6.6.3.3.9 Minimum requirement (network signalled value “NS\_16”)

When “NS\_16” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.9-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.9-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | NOTE |
|-----------------------|---|-----------------------|------|
|                       | 1.4, 3, 5, 10 MHz                                 |                       |      |
| $790 \leq f \leq 803$ | -32   | 1 MHz                 |      |

#### 6.6.3.3.10 Minimum requirement (network signalled value “NS\_17”)

When “NS\_17” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.10-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.10-1: Additional requirements**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | NOTE |
|--|---|-----------------------|------|
|  | 3, 5, 10 MHz                                      |                       |      |
| $470 \leq f \leq 710$  | -26.2   | 6 MHz                 | 1    |
| NOTE 1: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.<br>Applicable when the assigned E-UTRA carrier is confined within 715 MHz and 718 MHz and when the channel bandwidth used is 3 MHz. |   |                       |      |

#### 6.6.3.3.11 Minimum requirement (network signalled value “NS\_18”)

When “NS\_18” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.11-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.11-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | NOTE |
|----------------------|---|-----------------------|------|
|                      | 5, 10, 15, 20 MHz                                 |                       |      |
| 692-698              | -26.2   | 6 MHz                 |      |

#### 6.6.3.3.12 Minimum requirement (network signalled value “NS\_19”)

When “NS\_19” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.12-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.12-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | NOTE |
|-----------------------|---|-----------------------|------|
|                       | 3, 5, 10, 15, 20 MHz                              |                       |      |
| $662 \leq f \leq 694$ | -25   | 8 MHz                 |      |

#### 6.6.3.3.13 Minimum requirement (network signalled value “NS\_11”)

When “NS\_11” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.13-1. These requirements also apply for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.13-1: Additional requirements**

| Frequency band (MHz)    | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-------------------------|---|-----------------------|
|                         | 1.4, 3, 5, 10, 15, 20 MHz                         |                       |
| E-UTRA Band 2           | -50   | 1 MHz                 |
| $1998 \leq f \leq 1999$ | -21   | 1 MHz                 |
| $1997 \leq f < 1998$    | -27   | 1 MHz                 |
| $1996 \leq f < 1997$    | -32   | 1 MHz                 |
| $1995 \leq f < 1996$    | -37   | 1 MHz                 |
| $1990 \leq f < 1995$    | -40   | 1 MHz                 |

#### 6.6.3.3.14 Minimum requirement (network signalled value “NS\_20”)

When “NS\_20” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.14-1. These requirements also apply for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.14-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 5, 10, 15, 20 MHz                                 |                       |
| $1990 \leq f < 1999$  | -40   | 1 MHz                 |
| $1999 \leq f \leq 2000$   | -40   | NOTE 1                |
| NOTE 1: The measurement bandwidth is 1% of the applicable E-UTRA channel bandwidth. |   |                       |

### 6.6.3.3.15 Minimum requirement (network signalled value "NS\_21")

When "NS\_21" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.15-1. These requirements also apply for the frequency ranges that are less than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.15-1: Additional requirements**

| Frequency band (MHz)    | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-------------------------|---|-----------------------|
|                         | 5, 10 MHz   |                       |
| $2200 \leq f < 2288$    | -40   | 1 MHz                 |
| $2288 \leq f < 2292$    | -37   | 1 MHz                 |
| $2292 \leq f < 2296$    | -31   | 1 MHz                 |
| $2296 \leq f < 2300$    | -25   | 1 MHz                 |
| $2320 \leq f < 2324$    | -25   | 1 MHz                 |
| $2324 \leq f < 2328$    | -31   | 1 MHz                 |
| $2328 \leq f < 2332$    | -37   | 1 MHz                 |
| $2332 \leq f \leq 2395$ | -40   | 1 MHz                 |

### 6.6.3.3.16 Minimum requirement (network signalled value "NS\_22")

When "NS 22" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.16-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.16-1: Additional requirement**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | MBW   |
|---|---|-------|
|   | 5, 10, 15, 20 MHz                                 |       |
| $3400 \leq f \leq 3800$   | -23 (NOTE 1, NOTE 3)                              | 5 MHz |
|   | -40 (NOTE 2)                                      | 1 MHz |
| NOTE 1: This requirement applies within an offset between 5 MHz and 25 MHz from the lower and from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band. |   |       |
| NOTE 2: This requirement applies from 3400 MHz to 25 MHz below the lower E-UTRA channel edge and from 25 MHz above the upper E-UTRA channel edge to 3800 MHz.   |   |       |
| NOTE 3: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band   |   |       |

### 6.6.3.3.17 Minimum requirement (network signalled value "NS\_23")

When "NS 23" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.17-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.17-1: Additional requirement**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | MBW   |
|---|---|-------|
|   | 5, 10, 15, 20 MHz                                 |       |
| $3400 \leq f \leq 3800$   | -23 (NOTE 1, NOTE 4)                              | 5 MHz |
|   | -40 (NOTE 2)                                      | 1 MHz |
| NOTE 1: This requirement applies within an offset between 5 MHz + $F_{\text{offset\_NS\_23}}$ and 25 MHz + $F_{\text{offset\_NS\_23}}$ from the lower and from the upper edges of the |   |       |

channel bandwidth, whenever these frequencies overlap with the specified frequency band.

NOTE 2: This requirement applies from 3400 MHz to 25 MHz +  $F_{\text{offset\_NS\_23}}$  below the lower E-UTRA channel edge and from 25 MHz +  $F_{\text{offset\_NS\_23}}$  above the upper E-UTRA channel edge to 3800 MHz.

NOTE 3:  $F_{\text{offset\_NS\_23}}$  is:  
 0 MHz for 5 MHz channel BW,  
 5 MHz for 10 MHz channel BW,  
 9 MHz for 15 MHz channel BW and  
 12 MHz for 20 MHz channel BW.

NOTE 4: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band

6.6.3.3.18 Void

Table 6.6.3.3.18-1: Void

6.6.3.3.19 Minimum requirement (network signalled value "NS\_04")

When "NS\_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.19-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

Table 6.6.3.3.19-1: Additional requirements

| Frequency band            | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---------------------------|---|-----------------------|
|                           | 5, 10, 15, 20 MHz                                 |                       |
| 2490.5 MHz ≤ f < 2495 MHz | -13   | 1 MHz                 |
| 9 kHz < f < 2490.5 MHz    | -25   | 1 MHz                 |

6.6.3.3.20 Minimum requirement (network signalled value "NS\_24")

When "NS\_24" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.20-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

Table 6.6.3.3.20-1: Additional requirements

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 5 MHz, 10 MHz, 15 MHz, 20 MHz                     |                       |
| Band 34   | -50   | MHz                   |
| NOTE 1: This requirement applies at a frequency offset equal or larger than 5 MHz from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band. |   |                       |

6.6.3.3.21 Minimum requirement (network signalled value "NS\_25")

When "NS\_25" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.21-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.21-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 5 MHz, 10 MHz, 15 MHz, 20 MHz                     |                       |
| Band 34   | -40   | MHz                   |
| NOTE 1: This requirement applies at a frequency offset equal or larger than 5 MHz from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band. |   |                       |

#### 6.6.3.3.22 Minimum requirement (network signalled value "NS\_26")

When "NS\_26" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.22-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.22-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-----------------------|---|-----------------------|
|                       | 5 MHz, 10 MHz, 15 MHz                             |                       |
| $686 \leq f \leq 694$ | -25   | 8MHz                  |

#### 6.6.3.3.23 Minimum requirement (network signalled value "NS\_27" and "NS\_43")

When "NS\_27" or "NS\_43" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.23-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.23-1: Additional requirements**

| Frequency band   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|--|---|-----------------------|
|  | 5, 10, 15, 20 MHz                                 |                       |
| $9 \text{ kHz} \leq f \leq 3530 \text{ MHz}$   | -40   | 1 MHz                 |
| $3720 \text{ MHz} \leq f \leq 5^{\text{th}} \text{ harmonic of the upper frequency edge of the UL operating band}$ |   |                       |

#### 6.6.3.3.24 Minimum requirement (network signalled value "NS\_28")

When "NS\_28" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 5150-5350 MHz and 5470-5725 MHz shall not exceed the levels specified in Table 6.6.3.3.24-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.24-1: Additional requirements**

| Frequency band (MHz)     | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|--------------------------|---|-----------------------|
|                          | 20 MHz  |                       |
| $47 \leq f \leq 74$      | -54   | 100 kHz               |
| $87.5 \leq f \leq 118$   | -54   | 100 kHz               |
| $174 \leq f \leq 230$    | -54   | 100 kHz               |
| $470 \leq f \leq 862$    | -54   | 100 kHz               |
| $1000 \leq f \leq 5150$  | -30   | 1 MHz                 |
| $5350 \leq f \leq 5470$  | -30   | 1 MHz                 |
| $5725 \leq f \leq 26000$ | -30   | 1 MHz                 |

6.6.3.3.25 Minimum requirement (network signalled value “NS\_29”)

When "NS\_29" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 5150-5350 and 5470-5725 MHz shall not exceed the levels specified in Table 6.6.3.3.25-1. This requirement also applies for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.25-1: Additional requirements**

| Centre Frequency F <sub>c</sub> [MHz]                            | Protected range [MHz] | Frequency difference Δf between centre frequency –<br>5240 (for F <sub>c</sub> =5180, 5200, 5220, 5240)<br>5260 (for F <sub>c</sub> =5260, 5280, 5300, 5320)<br>(MHz) | Minimum requirement [dBm] | Measurement bandwidth |
|--|-----------------------|---|---------------------------|-----------------------|
| 5180, 5200, 5220, 5240   | 5135 ≤ f ≤ 5142       | -   | -26                       | 1 MHz                 |
|  | 5142 < f ≤ 5150       | -   | -18                       |                       |
|  | 5250 ≤ f < 5251       | ≥ 10 and < 11   | 10(10 - Δf)               |                       |
|  | 5251 ≤ f < 5260       | ≥ 11 and < 20   | -10 - 8/9(Δf - 11)        |                       |
|  | 5260 ≤ f < 5266.7     | ≥ 20 and < 26.7   | -18 - 1.2(Δf - 20)        |                       |
| 5266.7 ≤ f ≤ 5365  | -                     | -26   |                           |                       |
| 5260, 5280, 5300, 5320   | 5135 ≤ f ≤ 5233.3     | -   | -26                       |                       |
|  | 5233.3 < f ≤ 5240     | ≥ 20 and < 26.7   | -18 - 1.2(Δf - 20)        |                       |
|  | 5240 < f ≤ 5249       | ≥ 11 and < 20   | -10 - 8/9(Δf - 11)        |                       |
|  | 5249 < f ≤ 5250       | ≥ 10 and < 11   | 10(10 - Δf)               |                       |
|  | 5350 ≤ f ≤ 5365       | -   | -26                       |                       |
| 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5700 | 5455 ≤ f ≤ 5460       | -   | -26                       |                       |
|  | 5460 < f ≤ 5470       | -   | -19                       |                       |
|  | 5725 ≤ f < 5740       | -   | -19                       |                       |
|  | 5740 ≤ f ≤ 5745       | -   | -26                       |                       |

6.6.3.3.26 Minimum requirement (network signalled value “NS\_30”)

When "NS\_30" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 5150-5350 MHz, 5470-5725 MHz and 5725-5850 MHz shall not exceed the levels specified in Table 6.6.3.3.26-1, Table 6.6.3.3.26-2 and Table 6.6.3.3.26-3, respectively. These requirements also apply for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.26-1: Additional requirements for E-UTRA channels assigned within 5150-5350 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| 4500 ≤ f ≤ 5150      | -41   | 1 MHz                 |
| 5350 ≤ f ≤ 5460      | -41   |                       |

**Table 6.6.3.3.26-2: Additional requirements for E-UTRA channels assigned within 5470-5725 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| 4500 ≤ f ≤ 5150      | -41   | 1 MHz                 |
| 5350 ≤ f ≤ 5460      | -41   |                       |
| 5460 < f ≤ 5470      | -27   |                       |
| 5725 ≤ f             | -27   |                       |

**Table 6.6.3.3.26-3: Additional requirements for E-UTRA channels assigned within 5725-5850 MHz**

| Frequency offset of measurement filter -3dB point, $\Delta f$ | Frequency offset of measurement filter centre frequency, $f_{\text{offset}}$ | Minimum requirement [dBm]                         | Measurement bandwidth |
|---|--|---|-----------------------|
| $0 \text{ MHz} \leq \Delta f < 5 \text{ MHz}$                 | $0.5 \text{ MHz} \leq f_{\text{offset}} < 5.5 \text{ MHz}$                   | $27 - 2.28(f_{\text{offset}}/\text{MHz} - 0.5)$   | 1 MHz                 |
| $5 \text{ MHz} \leq \Delta f < 25 \text{ MHz}$                | $5.5 \text{ MHz} \leq f_{\text{offset}} < 25.5 \text{ MHz}$                  | $15.6 - 0.28(f_{\text{offset}}/\text{MHz} - 0.5)$ | 1 MHz                 |
| $25 \text{ MHz} \leq \Delta f < 75 \text{ MHz}$               | $25.5 \text{ MHz} \leq f_{\text{offset}} < 75.5 \text{ MHz}$                 | $10 - 0.74(f_{\text{offset}}/\text{MHz} - 0.5)$   | 1 MHz                 |
| $75 \text{ MHz} \leq \Delta f$                                | $75.5 \text{ MHz} \leq f_{\text{offset}}$                                    | -27   | 1 MHz                 |

NOTE 1: The frequency offset  $f_{\text{offset}}$  is below and above the range 5725-5850 MHz; the measurement filter -3dB point is that closest to the range 5725-5850 MHz

NOTE 2: The requirement applies when the offset of the measurement filter centre frequency is such that both -3 dB points of the measurement filter are confined within the frequency range 5725-5850 MHz.

### 6.6.3.3.27 Minimum requirement (network signalled value "NS\_31")

When "NS\_31" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 5150-5250 MHz, 5250-5350 MHz, 5470-5725 MHz and 5725-5850 MHz shall not exceed the levels specified in Table 6.6.3.3.27-1, Table 6.6.3.3.27-2, Table 6.6.3.3.27-3 and Table 6.6.3.3.27-4, respectively. These requirements also apply for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.27-1: Additional requirements for E-UTRA channels assigned within 5150-5250 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| $f \leq 5150$        | -27   | 1 MHz                 |
| $f \geq 5250$        | -27   |                       |

**Table 6.6.3.3.27-2: Additional requirements for E-UTRA channels assigned within 5250-5350 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| $f \leq 5250$        | -27   | 1 MHz                 |
| $f \geq 5350$        | -27   |                       |

**Table 6.6.3.3.27-3: Additional requirements for E-UTRA channels assigned within 5470-5725 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| $f \leq 5470$        | -27   | 1 MHz                 |
| $f \geq 5725$        | -27   |                       |

**Table 6.6.3.3.27-4: Additional requirements for E-UTRA channels assigned within 5725-5850 MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      | 20 MHz  |                       |
| $f \leq 5725$        | -27   | 1 MHz                 |
| $f \geq 5850$        | -27   |                       |

### 6.6.3.3.28 Minimum requirement (network signalled value "NS\_36")

When "NS\_36" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.28-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.28-1: Additional requirements**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|--|---|-----------------------|
|  | 5 MHz, 10 MHz and 15 MHz                          |                       |
| $470 \leq f \leq 694$  | -42   | 8MHz                  |
| NOTE: For a 5 MHz E-UTRA carrier confined within 698MHz and 703MHz, this requirement shall be met in normal conditions only. The requirement is relaxed to -30dBm in extreme conditions. |   |                       |

### 6.6.3.3.29 Minimum requirement (network signalled value "NS\_38")

When "NS\_38" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.29-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.29-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|-----------------------|
|   | 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz     |                       |
| $1400 \leq f \leq 1427$   | -32   | 27MHz                 |
| NOTE 1: This requirement shall be verified with UE transmission power configured as high as possible but no higher than 15 dBm. |   |                       |

### 6.6.3.3.30 Minimum requirement (network signalled value "NS\_39")

When "NS\_39" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.30-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.30-1: Additional requirements**

| Frequency band (MHz)    | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-------------------------|---|-----------------------|
|                         | 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz     |                       |
| $1475 \leq f \leq 1488$ | -28   | 1MHz                  |

### 6.6.3.3.31 Minimum requirement (network signalled value "NS\_40" and "NS\_41")

When "NS\_40" or "NS\_41" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 1427-1432MHz (B51) and 1432-1452MHz (B50) shall not exceed the levels specified in Table 6.6.3.3.31-1. These requirements also apply for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.31-1: Additional requirements for E-UTRA channels assigned within 1427-1452MHz**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|----------------------|---|-----------------------|
|                      |   |                       |



|   |                                 |        |
|---|---------------------------------|--------|
|   | <b>3, 5, 10, 15,<br/>20 MHz</b> |        |
| $1400 \leq f \leq 1427$   | -32                             | 27 MHz |
| NOTE 1: This requirement shall be verified with UE transmission power configured as high as possible but no higher than 15 dBm. |                                 |        |

#### 6.6.3.3.32 Minimum requirement (network signalled value "NS\_42")

When "NS\_42" is indicated in the cell, the power of any UE emission for E-UTRA channels assigned within 1492-1517 MHz (B50) shall not exceed the levels specified in Table 6.6.3.3.32-1. These requirements also apply for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.32-1: Additional requirements for E-UTRA channels assigned within 1492-1517 MHz**

| Frequency band (MHz)    | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-------------------------|---|-----------------------|
|                         | <b>3, 5, 10, 15,<br/>20 MHz</b>                   |                       |
| $1518 \leq f \leq 1559$ | -30   | 1 MHz                 |

#### 6.6.3.3.33 Minimum requirement (network signalled value "NS\_44")

When "NS\_44" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.33-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.33-1: Additional requirements**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | NOTE |
|--|---|-----------------------|------|
|  | <b>5, 10, 15, 20</b>                              |                       |      |
| 2620-2645  | -15.5   | 5MHz                  | 1    |
| 2645-2690  | -40   | 1MHz                  | 1    |
| Note 1: The E-UTRA carrier with channel bandwidth is confined within 2570 MHz and 2615 MHz |   |                       |      |

#### 6.6.3.3.34 Minimum requirement (network signalled value "NS\_45")

When "NS\_45" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Tables 6.6.3.3.35-1 and 6.6.3.3.35-2. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.34-1: Additional requirements for 1.4, 3 and 5 MHz channel bandwidths**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth   | NOTE |
|--|---|-------------------------|------|
|  | <b>1.4, 3, 5</b>                                  |                         |      |
| $0.009 < f \leq 2477.5$  | -25   | 1 MHz                   |      |
| $2477.5 < f \leq 2478.5$   | -13   | 1 MHz                   |      |
| $2478.5 < f \leq 2483.5$   | -10   | 1 MHz                   |      |
| $2495 \leq f < 2496$   | -13   | 1% of Channel Bandwidth |      |
| $2496 < f \leq 2501$   | -13   | 1 MHz                   |      |
| $2501 \leq f \leq 5^{\text{th}}$ harmonic of the upper frequency edge of the UL operating band | -25   | 1 MHz                   |      |

**Table 6.6.3.34-2: Additional requirements for 10 MHz channel bandwidth**

| Frequency band (MHz)   | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth   | NOTE |
|--|---|-------------------------|------|
|  | 10  |                         |      |
| $0.009 < f \leq 2473.5$  | -25   | 1 MHz                   |      |
| $2473.5 < f \leq 2478.5$   | -13   | 1 MHz                   |      |
| $2478.5 < f \leq 2483.5$   | -10   | 1 MHz                   |      |
| $2495 \leq f < 2496$   | -13   | 1% of Channel Bandwidth |      |
| $2496 < f \leq 2505$   | -13   | 1 MHz                   |      |
| $2505 \leq f \leq 5^{\text{th}}$ harmonic of the upper frequency edge of the UL operating band | -25   | 1 MHz                   |      |

### 6.6.3.3.35 Minimum requirement (network signalled value "NS\_56")

When "NS\_56" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.35-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.35-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit <sup>1</sup> (dBm) | Measurement bandwidth | NOTE   |
|---|--|-----------------------|--|
|   | 5 MHz, 10MHz   |                       |  |
| $1541 \leq f \leq 1559$   | -102   | 2kHz                  | Averaged over any 2 millisecond active transmission interval |
| $1559 \leq f \leq 1608$   | -85  | 700Hz                 |  |
| $1608 \leq f \leq 1610$   | $-85 + 5/2 (f-1608)$   | 700Hz                 |  |
| $1610 \leq f \leq 1625$   | $-80 + 66/15 (f-1610)$   | 700Hz                 |  |
| $1541 \leq f \leq 1608$   | -75  | 1MHz                  | Averaged over any 2 millisecond active transmission interval |
| $1608 \leq f \leq 1610$   | $-75 + 5/2 (f-1608)$   | 1MHz                  |  |
| $1610 \leq f \leq 1627.5$   | $-70 + 57/17.5 (f-1610)$                                       | 1MHz                  |  |
| 1627.5  | -37  | 4kHz                  |  |
| $1638.5 \leq f \leq 1645.5$   | -28  | 4kHz                  |  |
| $1657.5 \leq f \leq 1660.5$   | -28  | 4kHz                  |  |
| NOTE 1: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna. |  |                       |  |

### 6.6.3.3A Additional spurious emissions for CA

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell reconfiguration message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus  $MBW/2$ . The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus  $MBW/2$ . MBW denotes the measurement bandwidth defined for the protected band.

#### 6.6.3.3A.1 Minimum requirement for CA\_1C (network signalled value "CA\_NS\_01")

When "CA\_NS\_01" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.1-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OoB}}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.1-1: Additional requirements (PHS)**

| Protected band  | Frequency range (MHz) |   |          | Maximum Level (dBm) | MBW (MHz) | NOTE |
|---|-----------------------|---|----------|---------------------|-----------|------|
| E-UTRA band 34  | FDL_low               | - | FDL_high | -50                 | 1         |      |
| Frequency range   | 1884.5                | - | 1915.7   | -41                 | 0.3       | 1    |
| NOTE 1: Applicable when the aggregated channel bandwidth is confined within frequency range 1940 – 1980 MHz |                       |   |          |                     |           |      |

#### 6.6.3.3A.2 Minimum requirement for CA\_1C (network signalled value "CA\_NS\_02")

When "CA\_NS\_02" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.2-1. This requirement also applies for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.2-1: Additional requirements**

| Protected band  | Frequency range (MHz) |   |                      | Maximum Level (dBm) | MBW (MHz) | NOTE |
|---|-----------------------|---|----------------------|---------------------|-----------|------|
| E-UTRA band 34  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50                 | 1         |      |
| Frequency range   | 1900                  | - | 1915                 | -15.5               | 5         | 1, 2 |
| Frequency range   | 1915                  | - | 1920                 | +1.6                | 5         | 1, 2 |
| NOTE 1: The requirement also applies for the frequency ranges that are less than F <sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |                       |   |                      |                     |           |      |
| NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.                                       |                       |   |                      |                     |           |      |

#### 6.6.3.3A.3 Minimum requirement for CA\_1C (network signalled value "CA\_NS\_03")

When "CA\_NS\_03" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.3-1. This requirement also applies for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.3-1: Additional requirements**

| Protected band  | Frequency range (MHz) |   |                      | Maximum Level (dBm) | MBW (MHz) | NOTE |
|---|-----------------------|---|----------------------|---------------------|-----------|------|
| E-UTRA band 34  | F <sub>DL_low</sub>   | - | F <sub>DL_high</sub> | -50                 | 1         |      |
| Frequency range   | 1880                  | - | 1895                 | -40                 | 1         |      |
| Frequency range   | 1895                  | - | 1915                 | -15.5               | 5         | 1, 2 |
| Frequency range   | 1915                  | - | 1920                 | +1.6                | 5         | 1, 2 |
| NOTE 1: The requirement also applies for the frequency ranges that are less than F <sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |                       |   |                      |                     |           |      |
| NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.                                       |                       |   |                      |                     |           |      |

#### 6.6.3.3A.4 Minimum requirement for CA\_38C (network signalled value "CA\_NS\_05")

When "CA\_NS\_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.4-1. This requirement also applies for the frequency ranges that are less than F<sub>OOB</sub> (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth. This requirement is applicable for carriers with aggregated channel bandwidths confined in 2570 - 2615 MHz.

**Table 6.6.3.3A.4-1: Additional requirements**

| Protected band  | Frequency range (MHz) |   |      | Maximum Level (dBm) | MBW (MHz) | NOTE    |
|---|-----------------------|---|------|---------------------|-----------|---------|
| Frequency range   | 2620                  | - | 2645 | -15.5               | 5         | 1, 2, 3 |
| Frequency range   | 2645                  | - | 2690 | -40                 | 1         | 1, 3    |
| NOTE 1: The requirement also applies for the frequency ranges that are less than F <sub>OOB</sub> (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |                       |   |      |                     |           |         |

NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  
 NOTE 3: This requirement is applicable for carriers with aggregated channel bandwidths confined in 2570-2615 MHz.

#### 6.6.3.3A.5 Minimum requirement for CA\_7C (network signalled value "CA\_NS\_06")

When "CA\_NS\_06" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.5-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.5-1: Additional requirements**

| Protected band   | Frequency range (MHz) |   |      | Maximum Level (dBm) | MBW (MHz) | NOTE |
|--|-----------------------|---|------|---------------------|-----------|------|
| Frequency range  | 2570                  | - | 2575 | +1.6                | 5         | 1, 2 |
| Frequency range  | 2575                  | - | 2595 | -15.5               | 5         | 1, 2 |
| Frequency range  | 2595                  | - | 2620 | -40                 | 1         |      |
| NOTE 1: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |                       |   |      |                     |           |      |
| NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.                                |                       |   |      |                     |           |      |

#### 6.6.3.3A.6 Minimum requirement for CA\_39C and CA\_39C-41A (network signalled value "CA\_NS\_07")

When "CA\_NS\_07" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.6-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.6-1: Additional requirements**

| Protected band   | Frequency range (MHz) |   |      | Maximum Level (dBm) | MBW (MHz) | NOTE    |
|--|-----------------------|---|------|---------------------|-----------|---------|
| Frequency range  | 1805                  | - | 1855 | -40                 | 1         | 1       |
| Frequency range  | 1855                  | - | 1880 | -15.5               | 5         | 1, 2, 3 |
| NOTE 1: This requirement is applicable for carriers with aggregated channel bandwidths confined in 1885-1920 MHz.  |                       |   |      |                     |           |         |
| NOTE 2: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. |                       |   |      |                     |           |         |
| NOTE 3: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.                                |                       |   |      |                     |           |         |

#### 6.6.3.3A.7 Minimum requirement for CA\_42C (network signalled value "CA\_NS\_08")

When "CA\_NS\_08" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.7-1. This requirement also applies for the frequency ranges that are less than  $F_{OOB}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.7-1: Additional requirements**

| Frequency band (MHz)  | Aggregated bandwidth / Spectrum emission limit (dBm) | MBW   |
|---|--|-------|
|   | 25, 30, 35, 40 MHz (Note 1)                          |       |
| $3400 \leq f \leq 3800$   | -23 (Note 2, Note 4)                                 | 5 MHz |
|   | -40 (Note 3)   | 1 MHz |
| NOTE 1: Possible aggregated bandwidth for CA_42C as specified in Table 5.6A.1-1.  |  |       |
| NOTE 2: This requirement applies within an offset between 5 MHz and 25 MHz from the lower and from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band. |  |       |

NOTE 3: This requirement applies from 3400 MHz to 25 MHz below the lower E-UTRA channel edge and from 25 MHz above the upper E-UTRA channel edge to 3800 MHz.

NOTE 4: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band.

#### 6.6.3.3A.8 Minimum requirement for CA\_41C and CA\_41D (network signalled value "CA\_NS\_04")

When "CA\_NS\_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.8-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.8-1: Additional requirements**

| Frequency band                                 | Spectrum emission limit (dBm) | Measurement bandwidth |
|--|-------------------------------|-----------------------|
| $2490.5 \text{ MHz} \leq f < 2495 \text{ MHz}$ | -13                           | 1 MHz                 |
| $9 \text{ kHz} < f < 2490.5 \text{ MHz}$       | -25                           | 1 MHz                 |

#### 6.6.3.3A.9 Void

#### 6.6.3.3A.10 Minimum requirement for CA\_48B and CA\_48C (network signalled value "CA\_NS\_10")

When "CA\_NS\_10" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.10-1. This requirement also applies for the frequency ranges that are less than  $F_{\text{OOB}}$  (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.10-1: Additional requirements**

| Frequency range (MHz) | Aggregated bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-----------------------|--|-----------------------|
|                       | 5, 10, 15, 20, 40 MHz                                |                       |
| 9 kHz – 3530 MHz      | -40  | 1 MHz                 |
| 3530 MHz – 3540 MHz   | -25  |                       |
| 3710 MHz – 3720 MHz   | -25  |                       |
| 3720 MHz – 12.75 GHz  | -40  |                       |

### 6.6.3A Void

<reserved for future use>

### 6.6.3B Spurious emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Spurious emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.6.3 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-1.

If UE is configured for transmission on single-antenna port, the general requirements in subclause 6.6.3 apply.

### 6.6.3C Void

<reserved for future use>

### 6.6.3D Spurious emission for ProSe

When UE is configured for E-UTRA ProSe sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the requirements in subclause 6.6.3 apply.

When UE is configured for simultaneous E-UTRA ProSe sidelink and E-UTRA uplink transmissions for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, the UE co-existence requirements in Table 6.6.3.2A-0 in subclause 6.6.3.2A apply as specified for the corresponding inter-band aggregation with uplink assigned to two bands.

### 6.6.3F Spurious emission for category NB1 and NB2

When UE is configured for category NB1 or NB2 uplink transmissions the requirements in subclause 6.6.3 apply with an exception that boundary between category NB1 or NB2 out of band and spurious emission domain shall be  $F_{OOB} = 1.7$  MHz.

### 6.6.3G Spurious emission for V2X Communication

This clause specifies the additional requirements for inter-band con-current V2X operation with the single CC uplink assigned to two E-UTRA bands for coexistence with protected bands for the specified simultaneous transmission of the inter-band con-current V2X configurations in Table 6.6.3G-0. The intersection of the requirements for the individual bands specified in clause 6.6.3.2 shall also apply for the specified simultaneous transmission of the inter-band con-current V2X. Intersection of a requirement means that both UL or sidelink transmission constituent bands have the same protected band requirement specified and if one or both protected bands have note(s) associated those note(s) also apply.

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the requirements in subclause 6.6.3 apply.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the UE-coexistence requirements in Table 6.6.3G-0 in subclause 6.6.3G apply as as specified for the corresponding inter-band con-current operation with uplink assigned to two bands.

**NOTE:** For inter-band con-current V2X operation with uplink assigned to E-UTRA band and sidelink transmission assigned to E-UTRA V2X operating bands, the requirements in Table 6.6.3G-0 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.6.3G-0 and in clause 6.6.3.2 would be considered to be verified by the measurements verifying the one uplink inter-band con-current UE to UE co-existence requirements.

**Table 6.6.3G-0: Requirements for inter-band con-current V2X operation**

| V2X con-current band Configuration | Spurious emission |                       |   |      |                     |           |      |
|------------------------------------|-------------------|-----------------------|---|------|---------------------|-----------|------|
|                                    | Protected band    | Frequency range (MHz) |   |      | Maximum Level (dBm) | MBW (MHz) | NOTE |
| V2X_3A-47A                         | Frequency range   | 5925                  | - | 5950 | -30                 | 1         | 7,8  |
|                                    | Frequency range   | 5815                  | - | 5855 | -30                 | 1         | 7    |
| V2X_5A-47A                         | Frequency range   | 5925                  | - | 5950 | -30                 | 1         | 7, 8 |
|                                    | Frequency range   | 5815                  | - | 5855 | -30                 | 1         | 7    |
| V2X_7A-47A                         | Frequency range   | 5925                  | - | 5950 | -30                 | 1         | 7, 8 |
|                                    | Frequency range   | 5815                  | - | 5855 | -30                 | 1         | 7    |
| V2X_8A-47A                         | Frequency range   | 5925                  | - | 5950 | -30                 | 1         | 7, 8 |
|                                    | Frequency range   | 5815                  | - | 5855 | -30                 | 1         | 7    |
| V2X_20A-47A                        | Frequency range   | 758                   | - | 788  | -50                 | 1         |      |
|                                    | Frequency range   | 5925                  | - | 5950 | -30                 | 1         | 7, 8 |

|             |                 |      |   |      |         |   |         |
|-------------|-----------------|------|---|------|---------|---|---------|
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |
| V2X_28A-47A | Frequency range | 470  | - | 694  | -42     | 8 | 3, 12   |
|             | Frequency range | 470  | - | 710  | -26.2   | 6 | 13      |
|             | Frequency range | 662  | - | 694  | -26.2   | 6 | 3       |
|             | Frequency range | 758  | - | 773  | -32     | 1 | 3       |
|             | Frequency range | 773  | - | 803  | -50     | 1 |         |
|             | Frequency range | 5925 | - | 5950 | -30     | 1 | 7, 8    |
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |
| V2X_34A-47A | Frequency range | 5925 | - | 5950 | -30     | 1 | 7, 8    |
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |
| V2X_39A-47A | Frequency range | 1805 | - | 1855 | [-40]   | 1 | 5       |
|             | Frequency range | 1855 | - | 1880 | [-15.5] | 5 | 3, 4, 5 |
|             | Frequency range | 5925 | - | 5950 | -30     | 1 | 7, 8    |
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |
| V2X_41A-47A | Frequency range | 5925 | - | 5950 | -30     | 1 | 7, 8    |
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |
| V2X_71A-47A | Frequency range | 5925 | - | 5950 | -30     | 1 | 7, 8    |
|             | Frequency range | 5815 | - | 5855 | -30     | 1 | 7       |

NOTE 1: Void  
 NOTE 2: Void  
 NOTE 3: These requirements also apply for the frequency ranges that are less than  $F_{OoB}$  (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.  
 NOTE 4: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  
 NOTE 5: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.  
 NOTE 6: Void  
 NOTE 7: Applicable when NS\_33 or NS\_34 is configured by the pre-configured radio parameters.  
 NOTE 8: In the frequency range x-5950MHz, SE requirement of -30dBm/MHz should be applied; where  $x = \max(5925, fc + 15)$ , where  $fc$  is the channel centre frequency.  
 NOTE 9: Void  
 NOTE 10: Void  
 NOTE 11: Void  
 NOTE 12: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.  
 NOTE 13: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with  $RB_{start} > 1$  and  $RB_{start} < 48$ . Applicable when the assigned E-UTRA carrier is confined within 715 MHz and 718 MHz and when the channel bandwidth used is 3 MHz.

For intra-band contiguous multi-carrier operation, the boundary between E-UTRA out of band and spurious emission domain for intra-band contiguous carrier aggregation specified in Table 6.6.3.1A-1 shall apply.

For intra-band contiguous multi-carrier operation, the spurious emission requirements in Table 6.6.3G-1 shall apply for coexistence with protected bands.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus  $MBW/2$ . The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus  $MBW/2$ . MBW denotes the measurement bandwidth defined for the protected band.

**Table 6.6.3G-1: Requirements for intraband multi-carrier V2X operation**

| V2X multi-carrier | Spurious emission |                       |                     |           |      |
|-------------------|-------------------|-----------------------|---------------------|-----------|------|
|                   | Protected band    | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |

| Config uration |  |                     |   |                      |     |   |
|----------------|--|---------------------|---|----------------------|-----|---|
| V2X_47<br>B    | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 50, 51, 52, 65<br>NR band n77, n78, n79 | F <sub>DL_low</sub> | - | F <sub>DL_high</sub> | -50 | 1 |

For V2X UEs supporting Transmit Diversity, the requirements specified for single carrier shall apply to each transmit antenna connector.

If V2X UE is configured for transmission on single-antenna connector, the general requirements specified for single carrier shall apply to the active antenna connector.

## 6.6A Void

## 6.6B Void

## 6.7 Transmit intermodulation

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

### 6.7.1 Minimum requirement

User Equipment(s) transmitting in close vicinity of each other can produce intermodulation products, which can fall into the UE, or eNode B receive band as an unwanted interfering signal. The UE intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal at each of the transmitter antenna port with the other antenna port(s) if any is terminated. Both the wanted signal power and the intermodulation product power are measured through E-UTRA rectangular filter with measurement bandwidth shown in Table 6.7.1-1.

The requirement of transmitting intermodulation is prescribed in Table 6.7.1-1.

**Table 6.7.1-1: Transmit Intermodulation**

| BW Channel (UL)                      | 5MHz   |        | 10MHz  |        | 15MHz   |         | 20MHz  |        |
|--------------------------------------|--------|--------|--------|--------|---------|---------|--------|--------|
| Interference Signal Frequency Offset | 5MHz   | 10MHz  | 10MHz  | 20MHz  | 15MHz   | 30MHz   | 20MHz  | 40MHz  |
| Interference CW Signal Level         | -40dBc |        |        |        |         |         |        |        |
| Intermodulation Product              | -29dBc | -35dBc | -29dBc | -35dBc | -29dBc  | -35dBc  | -29dBc | -35dBc |
| Measurement bandwidth                | 4.5MHz | 4.5MHz | 9.0MHz | 9.0MHz | 13.5MHz | 13.5MHz | 18MHz  | 18MHz  |

### 6.7.1A Minimum requirement for CA

User Equipment(s) transmitting in close vicinity of each other can produce intermodulation products, which can fall into the UE, or eNode B receive band as an unwanted interfering signal. The UE intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product on both component carriers when an interfering CW signal is added at a level below the wanted signal at each of the transmitter antenna port with the other antenna port(s) if any is terminated. Both the wanted signal power and the intermodulation product power are measured through rectangular filter with measurement bandwidth shown in Table 6.7.1A-1.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the requirement is specified in Table 6.7.1-1 which shall apply on each component carrier with both component carriers active.



For intra-band contiguous carrier aggregation the requirement of transmitting intermodulation is specified in Table 6.7.1A-1.

**Table 6.7.1A-1: Transmit Intermodulation**

| CA bandwidth class(UL)               | B and C  |                                   |
|--------------------------------------|--|-----------------------------------|
| Interference Signal Frequency Offset | $BW_{\text{Channel\_CA}}$                          | $2 \cdot BW_{\text{Channel\_CA}}$ |
| Interference CW Signal Level         | -40dBc   |                                   |
| Intermodulation Product              | -29dBc   | -35dBc                            |
| Measurement bandwidth                | $BW_{\text{Channel\_CA}} - 2 \cdot BW_{\text{GB}}$ |                                   |

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per band) transmit intermodulations is defined as follows. For the E-UTRA band supporting one component carrier the requirement specified in Table 6.7.1-1 apply. For the E-UTRA band supporting two contiguous component carriers the requirements specified in Table 6.7.1A-1 apply.

### 6.7.1B Minimum requirement for UL-MIMO

For UE supporting UL-MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output power at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.7.1 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.7.1 apply.

### 6.7.1F Minimum requirement for category NB1 and NB2

The UE category NB1 and NB2 transmitter intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product as defined in Table 6.7.1F-1 when an interfering CW signal is added at a level below the wanted signal at the transmitter antenna port. Both the wanted signal power and the intermodulation product power are measured through rectangular filter with measurement bandwidth shown in Table 6.7.1F-1.

**Table 6.7.1F-1: UE category NB1 and NB2 transmitter IM requirement**

| Parameters for transmitter intermodulation |                                       |         |
|--|---------------------------------------|---------|
| BW Channel (UL)                            | 15 kHz (1 tone at sub-carrier 5 or 6) |         |
| Interference Signal Frequency Offset       | 180 kHz                               | 360 kHz |
| Interference CW Signal Level               | -40dBc                                |         |
| Intermodulation Product                    | -20 dBc                               | -39 dBc |
| Measurement bandwidth                      | 30 kHz                                | 30 kHz  |

### 6.7.1G Minimum requirement for V2X Communication

When UE is configured for E-UTRA V2X sidelink transmissions non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table Table 5.5G-1, the requirements in subclause 6.7.1 apply for E-UTRA V2X sidelink transmission.

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA uplink transmissions for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 6.7.1 apply for V2X sidelink transmission and the E-UTRA uplink transmission.

For intra-band contiguous multi-carrier operation, the transmit intermodulation requirement for CA Bandwidth Class B specified in subclause 6.7.1A shall apply for V2X Bandwidth Class B, the general CA spectrum emission mask for CA Bandwidth Class C specified in subclause 6.7.1A shall apply for V2X Bandwidth Class C and C<sub>1</sub>.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements specified for single carrier shall apply to each transmit antenna connector. If the UE transmits on one antenna connector, the requirements specified for single carrier shall apply to the active antenna connector.

## 6.8 Void

### 6.8A Void

### 6.8B Time alignment error for UL-MIMO

For UE(s) with multiple transmit antenna connectors supporting UL-MIMO, this requirement applies to frame timing differences between transmissions on multiple transmit antenna connectors in the closed-loop spatial multiplexing scheme.

The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors.

#### 6.8B.1 Minimum Requirements

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

### 6.8C Void

### 6.8D Void

### 6.8E Void

### 6.8F Void

### 6.8G Time alignment error

For V2X UE(s) with two transmit antenna connectors in Transmit Diversity scheme, this requirement applies to frame timing differences between transmissions on two transmit antenna connectors. The Time Alignment Error (TAE) shall not exceed [260] ns.

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## 7 Receiver characteristics

### 7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements,

assuming a 0 dBi gain antenna. For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective sections below.

With the exception of subclause 7.3, the requirements shall be verified with the network signalling value NS\_01 configured (Table 6.2.4-1).

All the parameters in clause 7 are defined using the UL reference measurement channels specified in Annexes A.2.2 and A.2.3, the DL reference measurement channels specified in Annex A.3.2 and using the set-up specified in Annex C.3.1.

For the additional requirements for intra-band non-contiguous carrier aggregation of two or more sub-blocks, an in-gap test refers to the case when the interfering signal is located at a negative offset with respect to the assigned lowest channel frequency of the highest sub-block and located at a positive offset with respect to the assigned highest channel frequency of the lowest sub-block.

For the additional requirements for intra-band non-contiguous carrier aggregation of two or more sub-blocks, an out-of-gap test refers to the case when the interfering signal(s) is (are) located at a positive offset with respect to the assigned channel frequency of the highest carrier frequency, or located at a negative offset with respect to the assigned channel frequency of the lowest carrier frequency.

For the additional requirements for intra-band non-contiguous carrier aggregation of two or more sub-blocks with channel bandwidth larger than or equal to 5 MHz, the existing adjacent channel selectivity requirements, in-band blocking requirements (for each case), and narrow band blocking requirements apply for in-gap tests only if the corresponding interferer frequency offsets with respect to the two measured carriers satisfy the following condition in relation to the sub-block gap size  $W_{\text{gap}}$  for at least one of these carriers  $j = 1, 2$ , so that the interferer frequency position does not change the nature of the core requirement tested:

$$W_{\text{gap}} \geq 2 \cdot |F_{\text{Interferer (offset),j}}| - BW_{\text{Channel}(j)}$$

where  $F_{\text{Interferer (offset),j}}$  for a sub-block with a single component carrier is the interferer frequency offset with respect to carrier  $j$  as specified in subclause 7.5.1, subclause 7.6.1 and subclause 7.6.3 for the respective requirement and  $BW_{\text{Channel}(j)}$  the channel bandwidth of carrier  $j$ .  $F_{\text{Interferer (offset),j}}$  for a sub-block with two or more contiguous component carriers is the interference frequency offset with respect to the carrier adjacent to the gap is specified in subclause 7.5.1A, 7.6.1A and 7.6.3A. The interferer frequency offsets for adjacent channel selectivity, each in-band blocking case and narrow-band blocking shall be tested separately with a single in-gap interferer at a time.

For a ProSe UE that supports both ProSe Direct Discovery and ProSe Direct Communication, the receiver characteristics specified in clause 7 for ProSe Direct Communication shall apply.

For ProSe Direct Discovery and ProSe Direct Communication on E-UTRA ProSe operating bands that correspond to TDD E-UTRA operating bands as specified in subclause 5.5D, the only additional requirement for ProSe specified in subclause 7.4.1D is applicable.

## 7.2 Diversity characteristics

The requirements in Section 7 assume that the receiver is equipped with two Rx port as a baseline. These requirements apply to all UE categories unless stated otherwise. Additional requirements apply for UE(s) equipped with four Rx ports. These additional requirements also apply for supported band combinations for which the UE can operate using up to four Rx ports while configured with carrier aggregation. With the exception of subclause 7.9 all requirements shall be verified by using both (all) antenna ports simultaneously.

NOTE: for an operating band in which the UE can operate using up to four Rx ports, it suffices to verify for conformance the additional requirements applicable for four Rx ports [except for REFSSENS].

NOTE: Implementation of 4 antenna ports for all operating bands supported by the UE is not mandated.

For a category 0, a category [M 1], category 1bis, category NB1 and NB2 UE the requirements in Section 7 assume that the receiver is equipped with single Rx port.

## 7.3 Reference sensitivity power level

The reference sensitivity power level REFSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories except category 0, category M1, category M2, and category 1bis, or to the single antenna port for UE category 0, UE category M1, category M2, and UE category 1bis, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

The throughput for the REFSENS test is measured based on the Transmission Mode 1 unless specified otherwise.

### 7.3.1 Minimum requirements (QPSK)

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1 and Table 7.3.1-2

**Table 7.3.1-1: Reference sensitivity QPSK  $P_{\text{REFSENS}}$**

| E-UTRA Band | Channel bandwidth |             |                    |                    |                    |              | Duplex Mode |
|-------------|-------------------|-------------|--------------------|--------------------|--------------------|--------------|-------------|
|             | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm)        | 10 MHz (dBm)       | 15 MHz (dBm)       | 20 MHz (dBm) |             |
| 1           |                   |             | -100               | -97                | -95.2              | -94          | FDD         |
| 2           | -102.7            | -99.7       | -98                | -95                | -93.2              | -92          | FDD         |
| 3           | -101.7            | -98.7       | -97                | -94                | -92.2              | -91          | FDD         |
| 4           | -104.7            | -101.7      | -100               | -97                | -95.2              | -94          | FDD         |
| 5           | -103.2            | -100.2      | -98                | -95                |                    |              | FDD         |
| 6           |                   |             | -100               | -97                |                    |              | FDD         |
| 7           |                   |             | -98                | -95                | -93.2              | -92          | FDD         |
| 8           | -102.2            | -99.2       | -97                | -94                |                    |              | FDD         |
| 9           |                   |             | -99                | -96                | -94.2              | -93          | FDD         |
| 10          |                   |             | -100               | -97                | -95.2              | -94          | FDD         |
| 11          |                   |             | -100               | -97                |                    |              | FDD         |
| 12          | -101.7            | -98.7       | -97                | -94                |                    |              | FDD         |
| 13          |                   |             | -97                | -94                |                    |              | FDD         |
| 14          |                   |             | -97                | -94                |                    |              | FDD         |
| ...         |                   |             |                    |                    |                    |              |             |
| 17          |                   |             | -97                | -94                |                    |              | FDD         |
| 18          |                   |             | -100 <sup>7</sup>  | -97 <sup>7</sup>   | -95.2 <sup>7</sup> |              | FDD         |
| 19          |                   |             | -100               | -97                | -95.2              |              | FDD         |
| 20          |                   |             | -97                | -94                | -91.2              | -90          | FDD         |
| 21          |                   |             | -100               | -97                | -95.2              |              | FDD         |
| 22          |                   |             | -97                | -94                | -92.2              | -91          | FDD         |
| 23          | -104.7            | -101.7      | -100               | -97                | -95.2              | -94          | FDD         |
| 24          |                   |             | -100               | -97                |                    |              | FDD         |
| 25          | -101.2            | -98.2       | -96.5              | -93.5              | -91.7              | -90.5        | FDD         |
| 26          | -102.7            | -99.7       | -97.5 <sup>6</sup> | -94.5 <sup>6</sup> | -92.7 <sup>6</sup> |              | FDD         |
| 27          | -103.2            | -100.2      | -98                | -95                |                    |              | FDD         |
| 28          |                   | -100.2      | -98.5              | -95.5              | -93.7              | -91          | FDD         |
| 30          |                   |             | -99                | -96                |                    |              | FDD         |
| 31          | -99.0             | -95.7       | -93.5              |                    |                    |              | FDD         |
| ...         |                   |             |                    |                    |                    |              |             |
| 33          |                   |             | -100               | -97                | -95.2              | -94          | TDD         |
| 34          |                   |             | -100               | -97                | -95.2              |              | TDD         |
| 35          | -106.2            | -102.2      | -100               | -97                | -95.2              | -94          | TDD         |
| 36          | -106.2            | -102.2      | -100               | -97                | -95.2              | -94          | TDD         |
| 37          |                   |             | -100               | -97                | -95.2              | -94          | TDD         |
| 38          |                   |             | -100               | -97                | -95.2              | -94          | TDD         |

|   |                     |                     |                    |                    |                    |                    |     |
|---|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|-----|
| 39  |                     |                     | -100               | -97                | -95.2              | -94                | TDD |
| 40  |                     |                     | -100               | -97                | -95.2              | -94                | TDD |
| 41  |                     |                     | -98                | -95                | -93.2              | -92                | TDD |
| 42  |                     |                     | -99                | -96                | -94.2              | -93                | TDD |
| 43  |                     |                     | -99                | -96                | -94.2              | -93                | TDD |
| 44  |                     | [-100.2]            | [-98]              | [-95]              | [-93.2]            | [-92]              | TDD |
| 45  |                     |                     | -100               | -97                | -95.2              | -94                | TDD |
| 48  |                     |                     | -99                | -96                | -94.2              | -93                | TDD |
| 50  |                     | -102.2              | -100               | -97                | -95.2              | -94                | TDD |
| 51  |                     | -102.2              | -100               |                    |                    |                    | TDD |
| 52  |                     |                     | -99                | -96                | -94.2              | -93                | TDD |
| 53  | -106.2              | -102.2              | -100               | -97                |                    |                    | TDD |
| ...   |                     |                     |                    |                    |                    |                    |     |
| 65  | -104.2              | -101.2              | -99.5              | -96.5              | -94.7              | -93.5              | FDD |
| 66  | -104.2              | -101.2              | -99.5              | -96.5              | -94.7              | -93.5              | FDD |
| 68  |                     |                     | -98.5              | -95.5              | -93.7              |                    | FDD |
| ...   |                     |                     |                    |                    |                    |                    |     |
| 70  |                     |                     | -100               | -97                | -95.2              | -94                | FDD |
| 71  |                     |                     | -97.2              | -94.2              | -92.0              | -87.5              | FDD |
| 72  | -99.0               | -95.7               | -93.5              |                    |                    |                    | FDD |
| 73  | -99.0               | -95.7               | -93.5              |                    |                    |                    | FDD |
| 74  | -104.7 <sup>8</sup> | -101.7 <sup>8</sup> | -99.5 <sup>8</sup> | -96.5 <sup>8</sup> | -94.7 <sup>8</sup> | -89.8 <sup>8</sup> | FDD |
| 85  |                     |                     | -97                | -94                |                    |                    | FDD |
| 87  | -99.0               | -95.7               | -93.5              |                    |                    |                    | FDD |
| 88  | -99.0               | -95.7               | -93.5              |                    |                    |                    | FDD |
| NOTE 1: The transmitter shall be set to P <sub>UMAX</sub> as defined in subclause 6.2.5   |                     |                     |                    |                    |                    |                    |     |
| NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1                                 |                     |                     |                    |                    |                    |                    |     |
| NOTE 3: The signal power is specified per port  |                     |                     |                    |                    |                    |                    |     |
| NOTE 4: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.  |                     |                     |                    |                    |                    |                    |     |
| NOTE 5: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.  |                     |                     |                    |                    |                    |                    |     |
| NOTE 6: <sup>6</sup> indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz. |                     |                     |                    |                    |                    |                    |     |
| NOTE 7: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.                    |                     |                     |                    |                    |                    |                    |     |
| NOTE 8: <sup>8</sup> indicates that the requirement is modified by -0.5 dB when the assigned E-UTRA channel bandwidth is confined within 1475.9-1510.9 MHz.           |                     |                     |                    |                    |                    |                    |     |

For UE(s) equipped with 4 antenna ports, the minimum requirement for reference sensitivity in Table 7.3.1-1 shall be modified by the amount given in ΔR<sub>IB,4R</sub> in Table 7.3.1-1a for the applicable E-UTRA bands.

**Table 7.3.1-1a: ΔR<sub>IB,4R</sub>**

| E-UTRA Band                                       | ΔR <sub>IB,4R</sub> [dB] |
|---|--------------------------|
| 1, 2, 3, 4, 7, 20, 21, 25, 30, 34, 39, 40, 41, 66 | - 2.7                    |
| 42, 43, 52  | - 2.2                    |

For UE(s) equipped with 8 antenna ports, the minimum requirement for reference sensitivity in Table 7.3.1-1 shall be modified by the amount given in ΔR<sub>IB,8R</sub> in Table 7.3.1-1aa for the applicable E-UTRA bands.

**Table 7.3.1-1aa: ΔR<sub>IB,8R</sub>**

| E-UTRA Band | ΔR <sub>IB,8R</sub> [dB] |
|-------------|--------------------------|
| 41, 42, 43  | - 4                      |

For UE(s) supporting power class 1 in any of the E-UTRA bands given in table 7.3.1-1b, the following exceptions due to the high power leakage or blocking issue shall apply. The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1b and Table 7.3.1-2.

**Table 7.3.1-1b: Reference sensitivity for power class 1 QPSK  $P_{\text{REFSENS}}$  (Exception due to high power issue)**

| Channel bandwidth   |               |             |             |              |              |              |             |
|---|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
| E-UTRA Band   | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex Mode |
| 20  |               |             | -92.8       | -90.9        | -89.5        | -88.5        | FDD         |
| NOTE 1: The transmitter shall be set to $P_{\text{UMAX}}$ as defined in subclause 6.2.5   |               |             |             |              |              |              |             |
| NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 |               |             |             |              |              |              |             |
| NOTE 3: The signal power is specified per port.   |               |             |             |              |              |              |             |

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.1-1 (two antenna ports) and Table 7.3.1-1a (four antenna ports) shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.1-2.

NOTE: Table 7.3.1-2 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex G (informative). For the UE which supports inter-band carrier aggregation configuration with the uplink in one or two E-UTRA bands, the minimum requirement for reference sensitivity in Table 7.3.1-1 and Table 7.3.1-1a shall be increased by the amount given in  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A, Table 7.3.1-1B and Table 7.3.1-1C for the applicable E-UTRA bands where unless otherwise stated, the same  $\Delta R_{\text{IB,c}}$  is applicable to E-UTRA band(s) part for CA configurations which have the same E-UTRA operating band combination.

**Table 7.3.1-1A:  $\Delta R_{\text{IB,c}}$  (two bands)**

| E-UTRA operating band combination      | E-UTRA Band | $\Delta R_{\text{IB,c}}$ [dB] |
|--|-------------|-------------------------------|
| CA_1-3, CA_1-1-3, CA_1-1-3-3, CA_1-3-3 | 1           | 0                             |
|  | 3           | 0                             |
| CA_1-5, CA_1-1-5                       | 1           | 0                             |
|  | 5           | 0                             |
| CA_1-7, CA_1-1-7, CA_1-7-7             | 1           | 0                             |
|  | 7           | 0                             |
| CA_1-8                                 | 1           | 0                             |
|  | 8           | 0                             |
| CA_1-11                                | 1           | 0                             |
|  | 11          | 0                             |
| CA_1-18                                | 1           | 0                             |
|  | 18          | 0                             |
| CA_1-19                                | 1           | 0                             |
|  | 19          | 0                             |
| CA_1-20                                | 1           | 0                             |
|  | 20          | 0                             |
| CA_1-21                                | 1           | 0                             |
|  | 21          | 0                             |
| CA_1-26                                | 1           | 0                             |
|  | 26          | 0                             |
| CA_1-28, CA_1-1-28                     | 1           | 0                             |
|  | 28          | 0.2                           |
| CA_1-32                                | 1           | 0                             |
|  | 32          | 0                             |
| CA_1-38                                | 1           | 0                             |
|  | 38          | 0                             |

|   |    |     |
|---|----|-----|
| CA_1-40   | 1  | 0   |
|   | 40 | 0   |
| CA_1-41 <sup>8</sup>  | 1  | 0   |
|   | 41 | 0   |
| CA_1-42,<br>CA_1-42-42  | 1  | 0   |
|   | 42 | 0.5 |
| CA_1-43   | 1  | 0   |
|   | 43 | 0.5 |
| CA_1-46   | 1  | 0   |
| CA_2-4, CA_2-<br>2-4, CA_2-4-4,<br>CA_2-2-4-4                           | 2  | 0.3 |
|   | 4  | 0.3 |
| CA_2-5, CA_2-<br>2-5  | 2  | 0   |
|   | 5  | 0   |
| CA_2-7, CA_2-<br>2-7, CA_2-7-7  | 2  | 0   |
|   | 7  | 0   |
| CA_2-12,<br>CA_2-2-12,<br>CA_2-12-12,<br>CA_2-2-12-12                   | 2  | 0   |
|   | 12 | 0   |
| CA_2-13,<br>CA_2-2-13   | 2  | 0   |
|   | 13 | 0   |
| CA_2-14,<br>CA_2-2-14   | 2  | 0   |
|   | 14 | 0   |
| CA_2-17   | 2  | 0   |
|   | 17 | 0.5 |
| CA_2-26   | 2  | 0   |
|   | 26 | 0   |
| CA_2-28   | 2  | 0   |
|   | 28 | 0   |
| CA_2-29,<br>CA_2-2-29   | 2  | 0   |
| CA_2-30,<br>CA_2-2-30   | 2  | 0.4 |
|   | 30 | 0.5 |
| CA_2-46,<br>CA_2-2-46   | 2  | 0   |
| CA_2-48,<br>CA_2-48-48  | 2  | 0.2 |
|   | 48 | 0.5 |
| CA_2-49   | 2  | 0.2 |
| CA_2-66,<br>CA_2-2-66,<br>CA_2-66-66,<br>CA_2-2-66-66,<br>CA_2-66-66-66 | 2  | 0.3 |
|   | 66 | 0.3 |
| CA_2-71,<br>CA_2-2-71   | 2  | 0   |
|   | 71 | 0   |
| CA_3-5,<br>CA_3-3-5   | 3  | 0   |
|   | 5  | 0   |
| CA_3-7, CA_3-<br>3-7, CA_3-7-7,<br>CA_3-3-7-7                           | 3  | 0   |
|   | 7  | 0   |
| CA_3-8, CA_3-<br>3-8  | 3  | 0   |
|   | 8  | 0   |
| CA_3-11   | 3  | 0.3 |
|   | 11 | 0.5 |
| CA_3-18   | 3  | 0   |
|   | 18 | 0   |
| CA_3-19,<br>CA_3-3-19   | 3  | 0   |
|   | 19 | 0   |
| CA_3-20,<br>CA_3-3-20   | 3  | 0   |
|   | 20 | 0   |
| CA_3-21,<br>CA_3-3-21   | 3  | 0.3 |
|   | 21 | 0.5 |
| CA_3-26   | 3  | 0   |
|   | 26 | 0   |
| CA_3-27   | 3  | 0   |

|   |    |                   |
|---|----|-------------------|
|   | 27 | 0                 |
| CA_3-28   | 3  | 0                 |
|   | 28 | 0                 |
| CA_3-31   | 3  | 0                 |
|   | 31 | 0.2               |
| CA_3-32   | 3  | 0                 |
|   | 32 | 0                 |
| CA_3-38   | 3  | 0                 |
|   | 38 | 0                 |
| CA_3-40,<br>CA_3-40-40                                | 3  | 0                 |
|   | 40 | 0                 |
| CA_3-41,<br>CA_3-3-41                                 | 3  | 0                 |
|   | 41 | 0 <sup>10</sup>   |
|   |    | 0.5 <sup>11</sup> |
| CA_3-42,<br>CA_3-3-42,<br>CA_3-42-42                  | 3  | 0.2               |
|   | 42 | 0.5               |
| CA_3-43   | 3  | 0                 |
|   | 43 | 0.5               |
| CA_3-46,<br>CA_3-3-46                                 | 3  | 0                 |
|   |    |                   |
| CA_4-5, CA_4-<br>4-5                                  | 4  | 0                 |
|   | 5  | 0                 |
| CA_4-7, CA_4-<br>4-7, CA_4-7-7                        | 4  | 0.5               |
|   | 7  | 0.5               |
| CA_4-12,<br>CA_4-4-12,<br>CA_4-12-12,<br>CA_4-4-12-12 | 4  | 0                 |
|   | 12 | 0.5               |
| CA_4-13,<br>CA_4-4-13                                 | 4  | 0                 |
|   | 13 | 0                 |
| CA_4-17   | 4  | 0                 |
|   | 17 | 0.5               |
| CA_4-27   | 4  | 0                 |
|   | 27 | 0                 |
| CA_4-28   | 4  | 0                 |
|   | 28 | 0.2               |
| CA_4-29,<br>CA_4-4-29                                 | 4  | 0                 |
| CA_4-30,<br>CA_4-4-30                                 | 4  | 0.4               |
|   | 30 | 0.5               |
| CA_4-46   | 4  | 0                 |
| CA_4-48   | 4  | 0                 |
|   | 48 | 0.5               |
| CA_4-71,<br>CA_4-4-71                                 | 4  | 0                 |
|   | 71 | 0                 |
| CA_5-7, CA_5-<br>7-7                                  | 5  | 0                 |
|   | 7  | 0                 |
| CA_5-12,<br>CA_5-12-12                                | 5  | 0.5               |
|   | 12 | 0.3               |
| CA_5-13   | 5  | 0                 |
|   | 13 | 0                 |
| CA_5-17   | 5  | 0.5               |
|   | 17 | 0.3               |
| CA_5-25   | 5  | 0                 |
|   | 25 | 0                 |
| CA_5-28   | 5  | 0                 |
|   | 28 | 0                 |
| CA_5-29   | 5  | 0                 |
| CA_5-30   | 5  | 0                 |
|   | 30 | 0                 |
| CA_5-38   | 5  | 0                 |
|   | 38 | 0                 |
| CA_5-40,<br>CA_5-5-40,<br>CA_5-40-40                  | 5  | 0                 |
|   | 40 | 0                 |



|   |    |     |
|---|----|-----|
| CA_5-41   | 5  | 0   |
|   | 41 | 0   |
| CA_5-48   | 5  | 0   |
|   | 48 | 0   |
| CA_5-66,<br>CA_5-5-66,<br>CA_5-66-66,<br>CA_5-5-66-66 | 5  | 0   |
|   | 66 | 0   |
| CA_7-8, CA_7-7-8                                      | 7  | 0   |
|   | 8  | 0.2 |
| CA_7-12   | 7  | 0   |
|   | 12 | 0   |
| CA_7-13   | 7  | 0   |
|   | 13 | 0   |
| CA_7-20,<br>CA_7-7-20                                 | 7  | 0   |
|   | 20 | 0   |
| CA_7-22   | 7  | 0   |
|   | 22 | 0.5 |
| CA_7-26,<br>CA_7-7-26                                 | 7  | 0   |
|   | 26 | 0   |
| CA_7-28,<br>CA_7-7-28                                 | 7  | 0   |
|   | 28 | 0   |
| CA_7-29,<br>CA_7-7-29                                 | 7  | 0   |
| CA_7-30   | 7  | 0.5 |
|   | 30 | 0.5 |
| CA_7-32   | 7  | 0   |
|   | 32 | 0   |
| CA_7-40   | 7  | 0   |
|   | 40 | 0.5 |
| CA_7-42,<br>CA_7-42-42                                | 7  | 0   |
|   | 42 | 0.5 |
| CA_7-46,<br>CA_7-7-46                                 | 7  | 0   |
| CA_7-66,<br>CA_7-7-66,<br>CA_7-66-66,<br>CA_7-7-66-66 | 7  | 0.5 |
|   | 66 | 0.5 |
| CA_8-11   | 8  | 0   |
|   | 11 | 0   |
| CA_8-20   | 8  | 0   |
|   | 20 | 0   |
| CA_8-27   | 8  | 0.3 |
|   | 27 | 0.3 |
| CA_8-28 <sup>13</sup>                                 | 8  | 0.2 |
|   | 28 | 0.1 |
| CA_8-32   | 8  | 0   |
|   | 32 | 0   |
| CA_8-38   | 8  | 0   |
|   | 38 | 0   |
| CA_8-39   | 8  | 0   |
|   | 39 | 0   |
| CA_8-40   | 8  | 0   |
|   | 40 | 0   |
| CA_8-41   | 8  | 0   |
|   | 41 | 0   |
| CA_8-42   | 8  | 0.2 |
|   | 42 | 0.5 |
| CA_8-46   | 8  | 0   |
| CA_11-18  | 11 | 0   |
|   | 18 | 0   |
| CA_11-26  | 11 | 0   |
|   | 26 | 0   |
| CA_11-28  | 11 | 0   |
|   | 28 | 0.2 |
| CA_11-41  | 11 | 0   |

|   |    |     |
|---|----|-----|
|   | 41 | 0   |
| CA_11-42  | 11 | 0   |
|   | 42 | 0.5 |
| CA_11-46  | 11 | 0   |
|   |    |     |
| CA_12-25  | 12 | 0   |
|   | 25 | 0   |
| CA_12-30  | 12 | 0   |
|   | 30 | 0   |
| CA_12-46  | 12 | 0   |
|   | 46 | 0   |
| CA_12-48  | 12 | 0   |
|   | 48 | 0   |
| CA_12-66,<br>CA_12-66-66                        | 12 | 0.5 |
|   | 66 | 0   |
| CA_13-46,<br>CA_13-46-46                        | 13 | 0   |
|   |    |     |
| CA_13-48,<br>CA_13-48-48                        | 13 | 0   |
|   | 48 | 0   |
| CA_13-66,<br>CA_13-66-66                        | 13 | 0   |
|   | 66 | 0   |
| CA_14-30  | 14 | 0   |
|   | 30 | 0   |
| CA_14-66,<br>CA_14-66-66,<br>CA_14-66-66-<br>66 | 14 | 0   |
|   | 66 | 0   |
| CA_18-28 <sup>9</sup>                           | 18 | 0   |
|   | 28 | 0   |
| CA_18-41  | 18 | 0   |
|   | 41 | 0   |
| CA_18-42  | 18 | 0   |
|   | 42 | 0.5 |
| CA_19-21  | 19 | 0   |
|   | 21 | 0   |
| CA_19-28 <sup>9</sup>                           | 19 | 0   |
|   | 28 | 0   |
| CA_19-42  | 19 | 0   |
|   | 42 | 0.5 |
| CA_19-46  | 19 | 0   |
| CA_20-28  | 20 | 0   |
|   | 28 | 0   |
| CA_20-31  | 20 | 0   |
|   | 31 | 0   |
| CA_20-32  | 20 | 0   |
| CA_20-38  | 20 | 0   |
|   | 38 | 0   |
| CA_20-40,<br>CA_20-40-40                        | 20 | 0   |
|   | 40 | 0   |
| CA_20-41  | 20 | 0   |
|   | 41 | 0   |
| CA_20-42,<br>CA_20-42-42                        | 20 | 0   |
|   | 42 | 0.5 |
| CA_20-43  | 20 | 0   |
|   | 43 | 0.5 |
| CA_20-67  | 20 | 0   |
| CA_20-75  | 20 | 0   |
| CA_20-76  | 20 | 0   |
| CA_21-28  | 21 | 0   |
|   | 28 | 0   |
| CA_21-42  | 21 | 0   |
|   | 42 | 0.5 |
| CA_21-46  | 21 | 0   |
| CA_23-29  | 23 | 0   |
| CA_25-26,<br>CA_25-25-26                        | 25 | 0   |
|   | 26 | 0   |

|                          |    |                   |
|--------------------------|----|-------------------|
| CA_25-41,<br>CA_25-25-41 | 25 | 0                 |
|                          | 41 | 0 <sup>10</sup>   |
|                          |    | 0.5 <sup>11</sup> |
| CA_25-46                 | 25 | 0                 |
|                          | 46 | 0                 |
| CA_26-41                 | 26 | 0                 |
|                          | 41 | 0                 |
| CA_26-46                 | 26 | 0                 |
| CA_26-48,<br>CA_26-48-48 | 26 | 0                 |
|                          | 48 | 0                 |
| CA_26-66                 | 26 | 0                 |
|                          | 66 | 0                 |
| CA_28-32                 | 28 | 0                 |
| CA_28-38                 | 28 | 0                 |
|                          | 38 | 0                 |
| CA_28-40                 | 28 | 0                 |
|                          | 40 | 0                 |
| CA_28-41                 | 28 | 0                 |
|                          | 41 | 0                 |
| CA_28-42,<br>CA_28-42-42 | 28 | 0.2               |
|                          | 42 | 0.5               |
| CA_28-46                 | 28 | 0                 |
| CA_28-66                 | 28 | 0.2               |
|                          | 66 | 0                 |
| CA_29-30                 | 30 | 0                 |
| CA_29-66,<br>CA_29-66-66 | 66 | 0                 |
| CA_29-70                 | 70 | 0                 |
| CA_30-66,<br>CA_30-66-66 | 30 | 0.5               |
|                          | 66 | 0.4               |
| CA_32-42                 | 42 | 0.5               |
| CA_32-43                 | 43 | 0.5               |
| CA_34-39                 | 34 | 0.2 <sup>1</sup>  |
|                          | 39 | 0.2 <sup>1</sup>  |
| CA_34-41                 | 34 | 0.2 <sup>1</sup>  |
|                          | 41 | 0.2 <sup>1</sup>  |
| CA_38-40,<br>CA_38-40-40 | 38 | 0.5 <sup>4</sup>  |
|                          | 40 | 0.5 <sup>4</sup>  |
| CA_39-40                 | 39 | 0.3 <sup>4</sup>  |
|                          | 40 | 0.3 <sup>4</sup>  |
| CA_39-41                 | 39 | 0.2 <sup>4</sup>  |
|                          | 41 | 0.2 <sup>4</sup>  |
| CA_39-41                 | 39 | 0.2 <sup>7</sup>  |
|                          | 41 | 0.2 <sup>7</sup>  |
| CA_39-42                 | 39 | 0 <sup>4</sup>    |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_39-46                 | 39 | 0                 |
| CA_40-41                 | 40 | 0 <sup>4</sup>    |
|                          | 41 | 0 <sup>4</sup>    |
| CA_40-42                 | 40 | 0.4 <sup>4</sup>  |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_40-43                 | 40 | 0.4 <sup>4</sup>  |
|                          | 43 | 0.5 <sup>4</sup>  |
| CA_40-46                 | 40 | 0                 |
| CA_41-42,<br>CA_41-42-42 | 41 | 0.4 <sup>4</sup>  |
|                          | 42 | 0.5 <sup>4</sup>  |
| CA_41-42,<br>CA_41-42-42 | 41 | 0 <sup>7</sup>    |
|                          | 42 | 0.5 <sup>7</sup>  |
| CA_41-46                 | 41 | 0                 |
| CA_41-48                 | 41 | 0 <sup>4</sup>    |
|                          | 48 | 0.5 <sup>4</sup>  |
| CA_42-43                 | 42 | 0 <sup>4</sup>    |
|                          | 43 | 0 <sup>4</sup>    |
| CA_42-46                 | 42 | [0]               |

|  |    |     |
|--|----|-----|
| CA_46-48,<br>CA_46-48-48   | 48 | 0.5 |
| CA_46-66,<br>CA_46-66-66   | 66 | 0   |
| CA_46-70   | 70 | 0   |
| CA_46-71   | 71 | 0   |
| CA_48-66,<br>CA_48-48-66,<br>CA_48-66-66,<br>CA_48-48-66-<br>66  | 48 | 0.5 |
|  | 66 | 0.2 |
| CA_48-71,<br>CA_48-48-71   | 48 | 0   |
|  | 71 | 0   |
| CA_66-70,<br>CA_66-66-70   | 66 | 0   |
|  | 70 | 0   |
| CA_66-71,<br>CA_66-66-71   | 66 | 0   |
|  | 71 | 0   |
| CA_70-71   | 70 | 0   |
|  | 71 | 0   |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations</p> <p>NOTE 2: The above additional tolerances also apply in intra-band and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations</p> <p>NOTE 3: In case the UE supports more than one of the above 2DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 2DL inter-band carrier aggregation configurations then:</p> <ul style="list-style-type: none"> <li>- When the E-UTRA operating band frequency range is <math>\leq 1</math>GHz, the applicable additional tolerance shall be the average of the 2DL tolerances in Table 7.3.1-1A, truncated to one decimal place that would apply for that operating band among the supported 2DL CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 2DL carrier aggregation configurations involving such band shall be applied</li> <li>- When the E-UTRA operating band frequency range is <math>&gt;1</math>GHz, the applicable additional tolerance shall be the maximum 2DL tolerance in Table 7.3.1-1A that would apply for that operating band among the supported 2DL CA configurations</li> </ul> <p>NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx.</p> <p>NOTE 5: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:</p> <ul style="list-style-type: none"> <li>- When the E-UTRA operating band frequency range is <math>\leq 1</math>GHz and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied</li> <li>- When the E-UTRA operating band frequency range is <math>&gt;1</math>GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations.</li> </ul> <p>NOTE 6: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> <p>NOTE 7: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx.</p> <p>NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in the FDD band.</p> <p>NOTE 9: For Band 28, the requirements only apply for the restricted frequency range specified for this CA configuration (Table 5.5A-2).</p> <p>NOTE 10: The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.</p> |    |     |

NOTE 11: The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz.

NOTE 12: For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable  $\Delta R_{IB,c}$  in Band 42, 43, or 48 is the max(Band 42  $\Delta R_{IB,c}$ , Band 43  $\Delta R_{IB,c}$ , Band 48  $\Delta R_{IB,c}$ ).

NOTE 13: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8.

NOTE: To meet the  $\Delta R_{IB,c}$  requirements for CA\_20A-28A state-of-the-art filter combiner technology is needed.

**Table 7.3.1-1B:  $\Delta R_{IB,c}$  (three bands)**

| E-UTRA operating band combination                          | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|--|-------------|------------------------|
| CA_1-3-5, CA_1-1-3-5, CA_1-3-3-5                           | 1           | 0                      |
|  | 3           | 0                      |
|  | 5           | 0                      |
| CA_1-3-7, CA_1-1-3-7, CA_1-3-3-7, CA_1-3-7-7, CA_1-3-3-7-7 | 1           | 0                      |
|  | 3           | 0                      |
|  | 7           | 0                      |
| CA_1-3-8, CA_1-3-3-8                                       | 1           | 0                      |
|  | 3           | 0                      |
|  | 8           | 0                      |
| CA_1-3-11  | 1           | 0                      |
|  | 3           | 0.3                    |
|  | 11          | 0.5                    |
| CA_1-3-18  | 1           | 0                      |
|  | 3           | 0                      |
|  | 18          | 0                      |
| CA_1-3-19, CA_1-3-3-19                                     | 1           | 0                      |
|  | 3           | 0                      |
|  | 19          | 0                      |
| CA_1-3-20, CA_1-3-3-20                                     | 1           | 0                      |
|  | 3           | 0                      |
|  | 20          | 0                      |
| CA_1-3-21, CA_1-3-3-21                                     | 1           | 0                      |
|  | 3           | 0.3                    |
|  | 21          | 0.5                    |
| CA_1-3-26  | 1           | 0                      |
|  | 3           | 0                      |
|  | 26          | 0                      |
| CA_1-3-28, CA_1-1-3-28, CA_1-3-3-28, CA_1-1-3-28           | 1           | 0                      |
|  | 3           | 0                      |
|  | 28          | 0.2                    |
| CA_1-3-32  | 1           | 0                      |
|  | 3           | 0                      |
|  | 32          | 0                      |
| CA_1-3-38  | 1           | 0                      |
|  | 3           | 0                      |
|  | 38          | 0                      |
| CA_1-3-40  | 1           | 0                      |
|  | 3           | 0                      |
|  | 40          | 0                      |
| CA_1-3-41  | 1           | 0                      |
|  | 3           | 0                      |
|  | 41          | $0^5/0.5^6$            |
| CA_1-3-42, CA_1-3-3-42                                     | 1           | 0.2                    |
|  | 3           | 0.2                    |
|  | 42          | 0.5                    |
| CA_1-3-43  | 1           | 0                      |
|  | 3           | 0                      |
|  | 43          | 0.5                    |
| CA_1-3-46  | 1           | 0                      |
|  | 3           | 0                      |
|  | 1           | 0                      |

|                         |    |     |
|-------------------------|----|-----|
| CA_1-5-7, CA_1-5-7-7    | 5  | 0   |
|                         | 7  | 0   |
| CA_1-5-28               | 1  | 0   |
|                         | 5  | 0   |
|                         | 28 | 0,2 |
| CA_1-5-40               | 1  | 0   |
|                         | 5  | 0   |
|                         | 40 | 0   |
| CA_1-5-41               | 1  | 0   |
|                         | 5  | 0   |
|                         | 41 | 0   |
| CA_1-5-46               | 1  | 0   |
|                         | 5  | 0   |
| CA_1-7-8, CA_1-7-7-8    | 1  | 0   |
|                         | 7  | 0   |
|                         | 8  | 0,2 |
| CA_1-7-20, CA_1-7-7-20  | 1  | 0   |
|                         | 7  | 0   |
|                         | 20 | 0   |
| CA_1-7-26, CA_1-7-7-26  | 1  | 0   |
|                         | 7  | 0   |
|                         | 26 | 0   |
| CA_1-7-28               | 1  | 0   |
|                         | 7  | 0   |
|                         | 28 | 0,2 |
| CA_1-7-32               | 1  | 0   |
|                         | 7  | 0   |
|                         | 32 | 0   |
| CA_1-7-38               | 1  | 0   |
|                         | 7  | 0   |
|                         | 38 | 0,2 |
| CA_1-7-40               | 1  | 0   |
|                         | 7  | 0,3 |
|                         | 40 | 0,8 |
| CA_1-7-42               | 1  | 0,2 |
|                         | 7  | 0,2 |
|                         | 42 | 0,5 |
| CA_1-7-46               | 1  | 0   |
|                         | 7  | 0   |
| CA_1-8-11               | 1  | 0   |
|                         | 8  | 0   |
|                         | 11 | 0   |
| CA_1-8-20               | 1  | 0   |
|                         | 8  | 0   |
|                         | 20 | 0   |
| CA_1-8-28 <sup>10</sup> | 1  | 0   |
|                         | 8  | 0,2 |
|                         | 28 | 0,2 |
| CA_1-8-38               | 1  | 0   |
|                         | 8  | 0   |
|                         | 38 | 0   |
| CA_1-8-40               | 1  | 0   |
|                         | 8  | 0   |
|                         | 40 | 0   |
| CA_1-8-42               | 1  | 0   |
|                         | 8  | 0,2 |
|                         | 42 | 0,5 |
| CA_1-11-18              | 1  | 0   |
|                         | 11 | 0   |
|                         | 18 | 0   |
| CA_1-11-28              | 1  | 0   |
|                         | 11 | 0   |
|                         | 28 | 0,2 |
| CA_1-11-42              | 1  | 0   |
|                         | 11 | 0   |

|   |    |     |
|---|----|-----|
|   | 42 | 0.5 |
| CA_1-18-28  | 1  | 0   |
|   | 18 | 0   |
|   | 28 | 0   |
| CA_1-18-41  | 1  | 0   |
|   | 18 | 0   |
|   | 41 | 0   |
| CA_1-18-42  | 1  | 0   |
|   | 18 | 0   |
|   | 42 | 0.5 |
| CA_1-19-21  | 1  | 0   |
|   | 19 | 0   |
|   | 21 | 0   |
| CA_1-19-28  | 1  | 0   |
|   | 19 | 0   |
|   | 28 | 0   |
| CA_1-19-42  | 1  | 0   |
|   | 19 | 0   |
|   | 42 | 0.5 |
| CA_1-20-28  | 1  | 0   |
|   | 20 | 0.2 |
|   | 28 | 0.2 |
| CA_1-20-32  | 1  | 0   |
|   | 20 | 0   |
|   | 32 | 0   |
| CA_1-20-38  | 1  | 0   |
|   | 20 | 0   |
|   | 38 | 0   |
| CA_1-20-42  | 1  | 0   |
|   | 20 | 0   |
|   | 42 | 0.5 |
| CA_1-20-43  | 1  | 0   |
|   | 20 | 0   |
|   | 43 | 0.5 |
| CA_1-21-28  | 1  | 0   |
|   | 21 | 0   |
|   | 28 | 0.2 |
| CA_1-21-42  | 1  | 0   |
|   | 21 | 0   |
|   | 42 | 0.5 |
| CA_1-28-40  | 1  | 0   |
|   | 28 | 0.2 |
|   | 40 | 0   |
| CA_1-28-42  | 1  | 0   |
|   | 28 | 0.2 |
|   | 42 | 0.5 |
| CA_1-32-42  | 1  | 0   |
|   | 42 | 0.5 |
| CA_1-32-43  | 1  | 0   |
|   | 43 | 0.5 |
| CA_1-41-42 <sup>7, 12</sup>                       | 1  | 0   |
|   | 41 | 0   |
|   | 42 | 0.5 |
| CA_1-42-43 <sup>13</sup>                          | 1  | 0   |
|   | 42 | 0.5 |
|   | 43 | 0.5 |
| CA_2-4-5, CA_2-2-4-5, CA_2-4-4-5                  | 2  | 0.3 |
|   | 4  | 0.3 |
|   | 5  | 0   |
| CA_2-4-7, CA_2-4-7-7                              | 2  | 0.3 |
|   | 4  | 0.5 |
|   | 7  | 0.5 |
| CA_2-4-12, CA_2-2-4-12, CA_2-4-4-12, CA_2-4-12-12 | 2  | 0.3 |
|   | 4  | 0.3 |
|   | 12 | 0.5 |

|  |    |     |
|--|----|-----|
| CA_2-4-13  | 2  | 0.3 |
|  | 4  | 0.3 |
|  | 13 | 0   |
| CA_2-4-28  | 2  | 0.3 |
|  | 4  | 0.3 |
|  | 28 | 0.5 |
| CA_2-4-29  | 2  | 0.3 |
|  | 4  | 0.3 |
| CA_2-4-30  | 2  | 0.4 |
|  | 4  | 0.4 |
|  | 30 | 0.5 |
| CA_2-4-71,<br>CA_2-2-4-71  | 2  | 0.3 |
|  | 4  | 0.3 |
|  | 71 | 0   |
| CA_2-5-12, CA_2-2-<br>5-12, CA_2-5-12-12                         | 2  | 0   |
|  | 5  | 0.5 |
|  | 12 | 0.3 |
| CA_2-5-7   | 2  | 0   |
|  | 5  | 0   |
|  | 7  | 0   |
| CA_2-5-13  | 2  | 0   |
|  | 5  | 0   |
|  | 13 | 0   |
| CA_2-5-28  | 2  | 0   |
|  | 5  | 0.5 |
|  | 28 | 0.3 |
| CA_2-5-29  | 2  | 0   |
|  | 5  | 0   |
| CA_2-5-30, CA_2-2-<br>5-30                                       | 2  | 0.4 |
|  | 5  | 0   |
|  | 30 | 0.5 |
| CA_2-5-46  | 2  | 0   |
|  | 5  | 0   |
| CA_2-5-66, CA_2-2-<br>5-66, CA_2-5-66-66,<br>CA_2-2-5-66-66      | 2  | 0.3 |
|  | 5  | 0   |
|  | 66 | 0.3 |
| CA_2-7-12, CA_2-2-<br>7-12                                       | 2  | 0   |
|  | 7  | 0   |
|  | 12 | 0   |
| CA_2-7-13, CA_2-7-<br>7-13                                       | 2  | 0   |
|  | 7  | 0   |
|  | 13 | 0   |
| CA_2-7-26  | 2  | 0   |
|  | 7  | 0   |
|  | 26 | 0   |
| CA_2-7-28  | 2  | 0   |
|  | 7  | 0   |
| CA_2-7-29, CA_2-7-<br>7-29                                       | 2  | 0   |
|  | 7  | 0   |
| CA_2-7-30  | 2  | 0.4 |
|  | 7  | 0   |
|  | 30 | 0.5 |
| CA_2-7-46  | 2  | 0   |
|  | 7  | 0   |
| CA_2-7-66, CA_2-2-<br>7-66, CA_2-7-7-66,<br>CA_2-7-66-66         | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 66 | 0.5 |
| CA_2-12-30, CA_2-2-<br>12-30                                     | 2  | 0.4 |
|  | 12 | 0   |
|  | 30 | 0.5 |
| CA_2-12-66, CA_2-2-<br>12-66, CA_2-2-12-66-<br>66, CA_2-12-66-66 | 2  | 0.3 |
|  | 12 | 0.5 |
|  | 66 | 0.3 |
| CA_2-13-46   | 2  | 0   |



|   |    |                                    |
|---|----|------------------------------------|
|   | 13 | 0                                  |
| CA_2-13-48, CA_2-13-48-48                                   | 2  | 0.2                                |
|   | 13 | 0                                  |
|   | 48 | 0.5                                |
| CA_2-13-66, CA_2-2-13-66, CA_2-13-66-66                     | 2  | 0.3                                |
|   | 13 | 0                                  |
|   | 66 | 0.3                                |
| CA_2-14-30, CA_2-2-14-30                                    | 2  | 0.3                                |
|   | 14 | 0                                  |
|   | 30 | 0.3                                |
| CA_2-14-66, CA_2-2-14-66, CA_2-2-14-66-66, CA_2-14-66-66-66 | 2  | 0.3                                |
|   | 14 | 0                                  |
|   | 66 | 0.3                                |
| CA_2-26-66  | 2  | 0                                  |
|   | 26 | 0                                  |
|   | 66 | 0                                  |
| CA_2-28-66  | 2  | 0.3                                |
|   | 28 | 0.2                                |
|   | 66 | 0.3                                |
| CA_2-29-30, CA_2-2-29-30                                    | 2  | 0.4                                |
|   | 30 | 0.5                                |
| CA_2-29-66  | 2  | 0.3                                |
|   | 66 | 0.3                                |
| CA_2-30-66, CA_2-2-30-66, CA_2-30-66-66                     | 2  | 0.4                                |
|   | 30 | 0.5                                |
|   | 66 | 0.4                                |
| CA_2-46-48  | 2  | 0.3                                |
|   | 48 | 0.5                                |
| CA_2-46-66, CA_2-46-46-66, CA_2-46-66-66                    | 2  | 0                                  |
|   | 66 | 0                                  |
| CA_2-48-66, CA_2-48-48-66                                   | 2  | 0.3                                |
|   | 48 | 0.5                                |
|   | 66 | 0.3                                |
| CA_2-66-71, CA_2-2-66-71, CA_2-66-66-71                     | 2  | 0.3                                |
|   | 66 | 0.3                                |
|   | 71 | 0                                  |
| CA_3-5-7, CA_3-5-7-7, CA_3-3-5-7                            | 3  | 0                                  |
|   | 5  | 0                                  |
|   | 7  | 0                                  |
| CA_3-5-28<br>CA_3-3-5-28                                    | 3  | 0                                  |
|   | 5  | 0.1                                |
|   | 28 | 0.1                                |
| CA_3-5-40, CA_3-5-40-40                                     | 3  | 0                                  |
|   | 5  | 0                                  |
|   | 40 | 0                                  |
| CA_3-5-41   | 3  | 0                                  |
|   | 5  | 0                                  |
|   | 41 | 0 <sup>5</sup><br>0.5 <sup>6</sup> |
| CA_3-7-8, CA_3-3-7-8, CA_3-7-7-8, CA_3-3-7-7-8,             | 3  | 0                                  |
|   | 7  | 0                                  |
|   | 8  | 0.2                                |
| CA_3-7-20, CA_3-3-7-20, CA_3-7-7-20                         | 3  | 0                                  |
|   | 7  | 0                                  |
|   | 20 | 0                                  |
| CA_3-7-26   | 3  | 0                                  |
|   | 7  | 0                                  |
|   | 26 | 0                                  |
| CA_3-7-28, CA_3-3-7-28                                      | 3  | 0                                  |
|   | 7  | 0                                  |
|   | 28 | 0                                  |
| CA_3-7-32   | 3  | 0                                  |
|   | 7  | 0                                  |
| CA_3-7-38   | 3  | 0                                  |

|                             |    |     |
|-----------------------------|----|-----|
|                             | 7  | 0   |
|                             | 38 | 0.2 |
| CA_3-7-40                   | 3  | 0   |
|                             | 7  | 0.3 |
|                             | 40 | 0.8 |
| CA_3-7-42                   | 3  | 0.2 |
|                             | 7  | 0.2 |
|                             | 42 | 0.5 |
| CA_3-7-46                   | 3  | 0   |
|                             | 7  | 0   |
| CA_3-8-11                   | 3  | 0.3 |
|                             | 8  | 0   |
|                             | 11 | 0.5 |
| CA_3-8-20                   | 3  | 0   |
|                             | 8  | 0   |
|                             | 20 | 0   |
| CA_3-8-28 <sup>11</sup>     | 3  | 0   |
|                             | 8  | 0.2 |
|                             | 28 | 0.1 |
| CA_3-8-32                   | 3  | 0.3 |
|                             | 8  | 0   |
|                             | 32 | 0.5 |
| CA_3-8-38                   | 3  | 0   |
|                             | 8  | 0   |
|                             | 38 | 0   |
| CA_3-8-40                   | 3  | 0   |
|                             | 8  | 0   |
|                             | 40 | 0   |
| CA_3-8-42                   | 3  | 0.2 |
|                             | 8  | 0.2 |
|                             | 42 | 0.5 |
| CA_3-11-18                  | 3  | 0.3 |
|                             | 11 | 0.5 |
|                             | 18 | 0   |
| CA_3-11-26                  | 3  | 0.3 |
|                             | 11 | 0.5 |
|                             | 26 | 0   |
| CA_3-11-28                  | 3  | 0.3 |
|                             | 11 | 0.5 |
|                             | 28 | 0.2 |
| CA_3-18-42                  | 3  | 0.2 |
|                             | 18 | 0   |
|                             | 42 | 0.5 |
| CA_3-19-21                  | 3  | 0.3 |
|                             | 19 | 0   |
|                             | 21 | 0.5 |
| CA_3-19-42                  | 3  | 0.2 |
|                             | 19 | 0   |
|                             | 42 | 0.5 |
| CA_3-20-28,<br>CA_3-3-20-28 | 3  | 0   |
|                             | 20 | 0.1 |
|                             | 28 | 0.1 |
| CA_3-20-32                  | 3  | 0   |
|                             | 20 | 0   |
|                             | 32 | 0   |
| CA_3-20-42                  | 3  | 0.2 |
|                             | 20 | 0   |
|                             | 42 | 0.5 |
| CA_3-20-43                  | 3  | 0   |
|                             | 20 | 0   |
|                             | 43 | 0.5 |
| CA_3-21-28                  | 3  | 0.3 |
|                             | 21 | 0.5 |
|                             | 28 | 0   |
| CA_3-21-42                  | 3  | 0.3 |

|   |    |                                  |
|---|----|----------------------------------|
|   | 21 | 0.5                              |
|   | 42 | 0.5                              |
| CA_3-28-38                                | 3  | 0                                |
|   | 28 | 0                                |
|   | 38 | 0.2                              |
|   | 3  | 0                                |
| CA_3-28-40                                | 28 | 0                                |
|   | 40 | 0                                |
|   | 3  | 0                                |
| CA_3-28-41                                | 28 | 0                                |
|   | 41 | 0 <sup>5</sup> /0.5 <sup>6</sup> |
|   | 3  | 0.2                              |
| CA_3-28-42, CA_3-28-42-42                 | 28 | 0.2                              |
|   | 42 | 0.5                              |
|   | 3  | 0.2                              |
| CA_3-32-42                                | 32 | 0                                |
|   | 42 | 0.5                              |
|   | 3  | 0                                |
| CA_3-32-43                                | 32 | 0                                |
|   | 43 | 0.5                              |
|   | 3  | 0                                |
| CA_3-32-46                                | 32 | 0                                |
|   | 3  | 0.5                              |
| CA_3-41-42 <sup>13</sup><br>CA_3-41-42-42 | 41 | 0 <sup>5</sup> /0.5 <sup>6</sup> |
|   | 42 | 0.5                              |
|   | 3  | 0.2                              |
| CA_3-42-43 <sup>13</sup>                  | 42 | 0.5                              |
|   | 43 | 0.5                              |
|   | 4  | 0                                |
| CA_4-5-12, CA_4-4-5-12, CA_4-5-12-12      | 5  | 0.5                              |
|   | 12 | 0.5                              |
|   | 4  | 0                                |
| CA_4-5-13                                 | 5  | 0                                |
|   | 13 | 0                                |
|   | 4  | 0                                |
| CA_4-5-29                                 | 5  | 0                                |
|   | 4  | 0                                |
| CA_4-5-30, CA_4-4-5-30                    | 5  | 0                                |
|   | 30 | 0.5                              |
|   | 4  | 0.5                              |
| CA_4-7-12                                 | 7  | 0.5                              |
|   | 12 | 0.5                              |
|   | 4  | 0.5                              |
| CA_4-7-28                                 | 7  | 0.5                              |
|   | 28 | 0.2                              |
|   | 4  | 0.4                              |
| CA_4-12-30, CA_4-4-12-30                  | 12 | 0.5                              |
|   | 30 | 0.5                              |
|   | 4  | 0.4                              |
| CA_4-29-30, CA_4-4-29-30                  | 30 | 0.5                              |
|   | 5  | 0                                |
| CA_5-7-28                                 | 7  | 0                                |
|   | 28 | 0                                |
|   | 5  | 0                                |
| CA_5-7-46                                 | 7  | 0                                |
|   | 5  | 0                                |
| CA_5-7-66                                 | 7  | 0.5                              |
|   | 66 | 0.5                              |
|   | 5  | 0.5                              |
| CA_5-12-46                                | 12 | 0.3                              |
|   | 5  | 0.5                              |
| CA_5-12-48                                | 12 | 0.3                              |
|   | 48 | 0                                |
|   | 5  | 0                                |
| CA_5-12-66                                | 12 | 0.5                              |

|                           |    |       |
|---------------------------|----|-------|
|                           | 66 | 0.5   |
| CA_5-30-66, CA_5-30-66-66 | 5  | 0     |
|                           | 30 | 0.5   |
|                           | 66 | 0.4   |
| CA_5-40-41                | 5  | 0     |
|                           | 40 | 0     |
|                           | 41 | 0     |
| CA_5-46-66, CA_5-46-66-66 | 5  | 0     |
|                           | 66 | 0     |
| CA_5-48-66                | 5  | 0     |
|                           | 48 | 0.5   |
|                           | 66 | 0.2   |
| CA_7-8-20                 | 7  | 0     |
|                           | 8  | 0.2   |
|                           | 20 | [0.2] |
| CA_7-8-38                 | 7  | 0     |
|                           | 8  | 0     |
|                           | 38 | 0.2   |
| CA_7-8-40                 | 7  | 0     |
|                           | 8  | 0.2   |
|                           | 40 | 0.5   |
| CA_7-12-66                | 7  | 0.5   |
|                           | 12 | 0.5   |
|                           | 66 | 0.5   |
| CA_7-13-66                | 7  | 0.5   |
|                           | 13 | 0     |
|                           | 66 | 0.5   |
| CA_7-20-28                | 7  | 0     |
|                           | 20 | 0.2   |
|                           | 28 | 0.2   |
| CA_7-20-32                | 7  | 0     |
|                           | 20 | 0     |
|                           | 32 | 0     |
| CA_7-20-38                | 7  | 0     |
|                           | 20 | 0     |
|                           | 38 | 0.2   |
| CA_7-20-42                | 7  | 0     |
|                           | 20 | 0     |
|                           | 42 | 0.5   |
| CA_7-26-66                | 7  | 0     |
|                           | 26 | 0     |
|                           | 66 | 0     |
| CA_7-28-38                | 7  | 0     |
|                           | 28 | 0     |
|                           | 38 | 0.2   |
| CA_7-28-40                | 7  | 0     |
|                           | 28 | 0     |
|                           | 40 | 0.5   |
| CA_7-29-66                | 7  | 0.5   |
|                           | 66 | 0.5   |
|                           |    | 0.5   |
| CA_7-30-66                | 7  | 0.5   |
|                           | 30 | 0.5   |
|                           | 66 | 0.5   |
| CA_7-32-46                | 7  | 0     |
|                           | 32 | 0     |
| CA_7-46-66                | 7  | 0.5   |
|                           | 66 | 0.5   |
| CA_8-11-28 <sup>16</sup>  | 8  | 0.2   |
|                           | 11 | 0     |
|                           | 28 | 0.2   |
| CA_8-11-42                | 8  | 0.2   |
|                           | 11 | 0     |
|                           | 42 | 0.5   |
| CA_8-20-28                | 8  | 0     |
|                           | 20 | 0     |

|   |    |                   |
|---|----|-------------------|
|   | 28 | 0                 |
| CA_8-28-41 <sup>14</sup>  | 8  | 0.2               |
|   | 28 | 0.1               |
|   | 41 | 0                 |
| CA_8-39-41  | 8  | 0                 |
|   | 39 | 0.2 <sup>17</sup> |
|   | 41 | 0.2 <sup>17</sup> |
| CA_12-30-66,<br>CA_12-30-66-66  | 12 | 0.5               |
|   | 30 | 0.5               |
|   | 66 | 0.4               |
| CA_13-46-66   | 13 | 0                 |
|   | 66 | 0                 |
| CA_13-48-66,<br>CA_13-48-48-66  | 13 | 0                 |
|   | 48 | 0.5               |
|   | 66 | 0.2               |
| CA_14-30-66,<br>CA_14-30-66-66  | 14 | 0                 |
|   | 30 | 0.5               |
|   | 66 | 0.4               |
| CA_19-21-42   | 19 | 0                 |
|   | 21 | 0                 |
|   | 42 | 0.5               |
| CA_20-32-42   | 20 | 0                 |
|   | 32 | 0                 |
|   | 42 | 0.5               |
| CA_20-32-43   | 20 | 0                 |
|   | 32 | 0                 |
|   | 43 | 0.5               |
| CA_20-38-40,<br>CA_20-38-40-40 <sup>18</sup>  | 20 | 0                 |
|   | 38 | 0.5               |
|   | 40 | 0.5               |
| CA_21-28-42   | 21 | 0                 |
|   | 28 | 0.2               |
|   | 42 | 0.5               |
| CA_25-26-41,<br>CA_25-25-26-41  | 25 | 0                 |
|   | 26 | 0                 |
|   | 41 | 0.5               |
| CA_28-41-42 <sup>9</sup> ,<br>CA_28-41-42-42 <sup>9</sup>   | 28 | 0.2               |
|   | 41 | 0.4 <sup>1</sup>  |
|   | 42 | 0.5 <sup>1</sup>  |
| CA_29-30-66,<br>CA_29-30-66-66  | 30 | 0.5               |
|   | 66 | 0.4               |
| CA_29-46-66   | 66 | 0                 |
| CA_29-66-70,<br>CA_29-66-66-70  | 66 | 0                 |
|   | 70 | 0                 |
| CA_32-42-43 <sup>13</sup>   | 32 | 0                 |
|   | 42 | 0.5               |
|   | 43 | 0.5               |
| CA_46-48-66   | 48 | 0.5               |
|   | 66 | 0.3               |
| CA_46-48-71,<br>CA_46-48-48-71  | 46 | 0                 |
|   | 48 | 0.5               |
|   | 71 | 0                 |
| CA_66-70-71,<br>CA_66-66-70-71  | 66 | 0                 |
|   | 70 | 0                 |
|   | 71 | 0                 |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.  |    |                   |
| NOTE 2: The above additional tolerances also apply in intra-band and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.                                    |    |                   |
| NOTE 3: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then: |    |                   |

- When the E-UTRA operating band frequency range is  $\leq 1$ GHz and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied
  - When the E-UTRA operating band frequency range is  $>1$ GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations.
- NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.
- NOTE 5: The requirement is specified for the frequency range of 2545-2690MHz.
- NOTE 6: The requirement is specified for the frequency range of 2496-2545MHz.
- NOTE 7: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1 or Band 42.
- NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx on Band 41 and Band 42.
- NOTE 9: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 10: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1 or Band 8.
- NOTE 11: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 3 or Band 8.
- NOTE 12: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 13: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.
- NOTE 14: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8 or Band 41.
- NOTE 15: For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable  $\Delta R_{IB,c}$  in Band 42, 43, or 48 is the  $\max(\text{Band 42 } \Delta R_{IB,c}, \text{Band 43 } \Delta R_{IB,c}, \text{Band 48 } \Delta R_{IB,c})$ .
- NOTE 16: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 8 or Band 11.
- NOTE 17: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRAN band and without simultaneous Rx/Tx on Band 39 and Band 41.
- NOTE 18: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx among TDD bands.

**Table 7.3.1-1C:  $\Delta R_{IB,c}$  (four bands)**

| E-UTRA operating band combination      | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|--|-------------|------------------------|
| CA_1-3-5-7, CA_1-3-3-5-7, CA_1-3-5-7-7 | 1           | 0                      |
|  | 3           | 0                      |
|  | 5           | 0                      |
|  | 7           | 0                      |
| CA_1-3-5-28                            | 1           | 0                      |
|  | 3           | 0                      |
|  | 5           | 0.1                    |
|  | 28          | 0.2                    |
| CA_1-3-5-40                            | 1           | 0                      |
|  | 3           | 0                      |
|  | 5           | 0                      |
|  | 40          | 0                      |
| CA_1-3-5-41                            | 1           | 0                      |
|  | 3           | 0                      |
|  | 5           | 0                      |
|  | 41          | 0 <sup>6</sup>         |
|  |             | 0.5 <sup>7</sup>       |

|   |    |     |
|---|----|-----|
| CA_1-3-7-8, CA_1-3-3-7-8, CA_1-3-7-7-8, CA_1-3-3-7-7-8                    | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 8  | 0.2 |
| CA_1-3-7-20, CA_1-3-3-7-20, CA_1-3-7-7-20                                 | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 20 | 0   |
| CA_1-3-7-26, CA_1-3-7-7-26  | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 26 | 0   |
| CA_1-3-7-28, CA_1-1-3-7-28, CA_1-1-3-3-7-28, CA_1-3-3-7-28, CA_1-3-7-7-28 | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 28 | 0.2 |
| CA_1-3-7-32   | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 32 | 0   |
| CA_1-3-7-38   | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 38 | 0   |
| CA_1-3-7-40   | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0.3 |
|   | 40 | 0.8 |
| CA_1-3-7-42   | 1  | 0.3 |
|   | 3  | 0.3 |
|   | 7  | 0.3 |
|   | 42 | 0.5 |
| CA_1-3-7-46   | 1  | 0   |
|   | 3  | 0   |
|   | 7  | 0   |
|   | 46 | 0   |
| CA_1-3-8-11   | 1  | 0   |
|   | 3  | 0.3 |
|   | 8  | 0   |
|   | 11 | 0.5 |
| CA_1-3-8-20   | 1  | 0   |
|   | 3  | 0   |
|   | 8  | 0   |
|   | 20 | 0   |
| CA_1-3-8-28 <sup>8</sup>  | 1  | 0   |
|   | 3  | 0   |
|   | 8  | 0.2 |
|   | 28 | 0.2 |
| CA_1-3-8-38   | 1  | 0   |
|   | 3  | 0   |
|   | 8  | 0   |
|   | 38 | 0   |
| CA_1-3-11-28  | 1  | 0   |
|   | 3  | 0.3 |
|   | 11 | 0.5 |
|   | 28 | 0.2 |
| CA_1-3-8-40   | 1  | 0   |
|   | 3  | 0   |
|   | 8  | 0   |
|   | 40 | 0   |
| CA_1-3-8-42   | 1  | 0.2 |
|   | 3  | 0.2 |
|   | 8  | 0.2 |
|   | 42 | 0.5 |
| CA_1-3-18-42  | 1  | 0.2 |

|                              |    |     |
|------------------------------|----|-----|
|                              | 3  | 0.2 |
|                              | 18 | 0   |
|                              | 42 | 0.5 |
| CA_1-3-19-21                 | 1  | 0   |
|                              | 3  | 0.3 |
|                              | 19 | 0   |
|                              | 21 | 0.5 |
| CA_1-3-19-42, CA_1-3-3-19-21 | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 19 | 0   |
|                              | 42 | 0.5 |
| CA_1-3-20-28, CA_1-3-3-20-28 | 1  | 0   |
|                              | 3  | 0   |
|                              | 20 | 0.2 |
|                              | 28 | 0.2 |
| CA_1-3-20-32                 | 1  | 0   |
|                              | 3  | 0   |
|                              | 20 | 0   |
|                              | 32 | 0   |
| CA_1-3-20-42                 | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 20 | 0   |
|                              | 42 | 0.5 |
| CA_1-3-20-43                 | 1  | 0   |
|                              | 3  | 0   |
|                              | 20 | 0   |
|                              | 43 | 0.5 |
| CA_1-3-21-28                 | 1  | 0   |
|                              | 3  | 0.3 |
|                              | 21 | 0.5 |
|                              | 28 | 0.2 |
| CA_1-3-21-42                 | 1  | 0.2 |
|                              | 3  | 0.3 |
|                              | 21 | 0.5 |
|                              | 42 | 0.5 |
| CA_1-3-28-40                 | 1  | 0   |
|                              | 3  | 0   |
|                              | 28 | 0.2 |
|                              | 40 | 0   |
| CA_1-3-28-42                 | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 28 | 0.2 |
|                              | 42 | 0.5 |
| CA_1-3-32-42                 | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 32 | 0   |
|                              | 42 | 0.5 |
| CA_1-3-32-43                 | 1  | 0   |
|                              | 3  | 0   |
|                              | 32 | 0   |
|                              | 43 | 0.5 |
| CA_1-3-41-42                 | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 41 | 0   |
|                              | 42 | 0.5 |
| CA_1-3-42-43 <sup>11</sup>   | 1  | 0.2 |
|                              | 3  | 0.2 |
|                              | 42 | 0.5 |
|                              | 43 | 0.5 |
| CA_1-5-7-28                  | 1  | 0   |
|                              | 5  | 0.1 |
|                              | 7  | 0   |
|                              | 28 | 0.2 |
| CA_1-5-7-46                  | 1  | 0   |
|                              | 5  | 0   |



|                             |    |     |
|-----------------------------|----|-----|
|                             | 7  | 0   |
| CA_1-7-8-20                 | 1  | 0   |
|                             | 7  | 0   |
|                             | 8  | 0.2 |
|                             | 20 | 0.2 |
| CA_1-7-8-40                 | 1  | 0   |
|                             | 7  | 0.3 |
|                             | 8  | 0.2 |
| CA_1-7-20-28                | 40 | 0.8 |
|                             | 1  | 0   |
|                             | 7  | 0   |
| CA_1-7-20-32                | 20 | 0.2 |
|                             | 28 | 0.2 |
|                             | 1  | 0   |
|                             | 7  | 0   |
| CA_1-7-20-42                | 20 | 0   |
|                             | 32 | 0   |
|                             | 1  | 0.2 |
|                             | 7  | 0.2 |
| CA_1-7-28-40                | 20 | 0.2 |
|                             | 42 | 0.5 |
|                             | 1  | 0   |
|                             | 7  | 0.3 |
| CA_1-7-28-40                | 28 | 0.2 |
|                             | 40 | 0.8 |
|                             | 1  | 0   |
|                             | 8  | 0.2 |
| CA_1-8-11-28 <sup>9</sup>   | 11 | 0   |
|                             | 28 | 0.2 |
|                             | 1  | 0   |
| CA_1-8-11-42                | 8  | 0.2 |
|                             | 11 | 0   |
|                             | 42 | 0.5 |
|                             | 1  | 0   |
| CA_1-8-20-28                | 8  | 0.2 |
|                             | 20 | 0.2 |
|                             | 28 | 0.2 |
|                             | 1  | 0   |
| CA_1-19-21-42               | 19 | 0   |
|                             | 21 | 0   |
|                             | 42 | 0.5 |
|                             | 1  | 0   |
| CA_1-20-32-42               | 20 | 0   |
|                             | 32 | 0   |
|                             | 42 | 0.5 |
|                             | 1  | 0   |
| CA_1-20-32-43               | 20 | 0   |
|                             | 32 | 0   |
|                             | 43 | 0.5 |
|                             | 1  | 0   |
| CA_1-21-28-42               | 21 | 0   |
|                             | 28 | 0.2 |
|                             | 42 | 0.5 |
|                             | 1  | 0   |
| CA_1-32-42-43 <sup>11</sup> | 32 | 0   |
|                             | 42 | 0.5 |
|                             | 43 | 0.5 |
|                             | 2  | 0.3 |
| CA_2-4-5-12                 | 4  | 0.3 |
|                             | 5  | 0.5 |
|                             | 12 | 0.5 |
|                             | 2  | 0.3 |
| CA_2-4-5-29                 | 4  | 0.3 |
|                             | 5  | 0   |
|                             | 2  | 0.4 |
| CA_2-4-5-30                 | 2  | 0.4 |

|  |    |     |
|--|----|-----|
|  | 4  | 0.4 |
|  | 5  | 0   |
|  | 30 | 0.5 |
| CA_2-4-7-12                                      | 2  | 0.3 |
|  | 4  | 0.3 |
|  | 7  | 0.5 |
|  | 12 | 0.5 |
| CA_2-4-12-30                                     | 2  | 0.4 |
|  | 4  | 0.4 |
|  | 12 | 0.5 |
|  | 30 | 0.5 |
| CA_2-4-29-30                                     | 2  | 0.4 |
|  | 4  | 0.4 |
|  | 30 | 0.5 |
| CA_2-5-7-28                                      | 2  | 0   |
|  | 5  | 0.2 |
|  | 7  | 0   |
|  | 28 | 0.2 |
| CA_2-5-12-66, CA_2-2-5-12-66                     | 2  | 0.3 |
|  | 5  | 0.5 |
|  | 12 | 0.5 |
|  | 66 | 0.3 |
| CA_2-5-30-66, CA_2-2-5-30-66, CA_2-5-30-66-66    | 2  | 0.4 |
|  | 5  | 0   |
|  | 30 | 0.5 |
|  | 66 | 0.4 |
| CA_2-5-46-66, CA_2-5-46-66-66                    | 2  | 0.3 |
|  | 5  | 0   |
|  | 66 | 0.3 |
| CA_2-7-12-66, CA_2-2-7-12-66                     | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 12 | 0.5 |
|  | 66 | 0.3 |
| CA_2-7-13-66                                     | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 13 | 0   |
|  | 66 | 0.5 |
| CA_2-7-26-66                                     | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 26 | 0   |
|  | 66 | 0.5 |
| CA_2-7-29-66, CA_2-7-7-29-66                     | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 66 | 0.5 |
| CA_2-7-46-66                                     | 2  | 0.3 |
|  | 7  | 0.5 |
|  | 46 | 0   |
|  | 66 | 0.5 |
| CA_2-12-30-66, CA_2-2-12-30-66, CA_2-12-30-66-66 | 2  | 0.4 |
|  | 12 | 0.5 |
|  | 30 | 0.5 |
|  | 66 | 0.4 |
| CA_2-13-46-66, CA_2-13-46-66-66                  | 2  | 0.3 |
|  | 13 | 0   |
|  | 66 | 0.3 |
| CA_2-13-48-66, CA_2-13-48-48-66                  | 2  | 0.3 |
|  | 13 | 0   |
|  | 48 | 0.5 |
|  | 66 | 0.3 |
| CA_2-14-30-66, CA_2-2-14-30-66, CA_2-14-30-66-66 | 2  | 0.4 |
|  | 14 | 0   |
|  | 30 | 0.5 |
|  | 66 | 0.4 |
| CA_2-29-30-66                                    | 2  | 0.4 |
|  | 30 | 0.5 |

|                            |    |     |
|----------------------------|----|-----|
|                            | 66 | 0.4 |
| CA_2-46-48-66              | 2  | 0.3 |
|                            | 48 | 0.5 |
|                            | 66 | 0.3 |
|                            | 3  | 0   |
| CA_3-5-7-28, CA_3-3-5-7-28 | 5  | 0.1 |
|                            | 7  | 0   |
|                            | 28 | 0.1 |
|                            | 3  | 0   |
| CA_3-7-8-20                | 7  | 0   |
|                            | 8  | 0   |
|                            | 20 | 0   |
|                            | 3  | 0   |
| CA_3-7-8-38                | 7  | 0   |
|                            | 8  | 0   |
|                            | 38 | 0.2 |
|                            | 3  | 0   |
| CA_3-7-8-40                | 7  | 0.3 |
|                            | 8  | 0.2 |
|                            | 40 | 0.8 |
|                            | 3  | 0   |
| CA_3-7-20-28               | 7  | 0   |
|                            | 20 | 0.2 |
|                            | 28 | 0.1 |
|                            | 3  | 0   |
| CA_3-7-20-32               | 7  | 0   |
|                            | 20 | 0   |
|                            | 32 | 0   |
|                            | 3  | 0.2 |
| CA_3-7-20-42               | 7  | 0.2 |
|                            | 20 | 0   |
|                            | 42 | 0.5 |
|                            | 3  | 0   |
| CA_3-7-28-38               | 7  | 0   |
|                            | 28 | 0   |
|                            | 38 | 0.2 |
|                            | 3  | 0   |
| CA_3-7-28-40               | 7  | 0.3 |
|                            | 28 | 0   |
|                            | 40 | 0.8 |
|                            | 3  | 0   |
| CA_3-7-32-46               | 7  | 0   |
|                            | 32 | 0   |
|                            | 3  | 0.3 |
|                            | 8  | 0.2 |
| CA_3-8-11-28 <sup>10</sup> | 11 | 0.5 |
|                            | 28 | 0.2 |
|                            | 3  | 0   |
|                            | 8  | 0.2 |
| CA_3-8-20-28               | 20 | 0.1 |
|                            | 28 | 0.1 |
|                            | 3  | 0.3 |
|                            | 19 | 0   |
| CA_3-19-21-42              | 21 | 0.5 |
|                            | 42 | 0.5 |
|                            | 3  | 0.2 |
|                            | 20 | 0   |
| CA_3-20-32-42              | 32 | 0   |
|                            | 42 | 0.5 |
|                            | 3  | 0   |
|                            | 20 | 0   |
| CA_3-20-32-43              | 32 | 0   |
|                            | 43 | 0.5 |
|                            | 3  | 0.3 |
|                            | 21 | 0.5 |
| CA_3-21-28-42              |    |     |

|   |    |                                    |
|---|----|------------------------------------|
|   | 28 | 0.2                                |
|   | 42 | 0.5                                |
| CA_3-28-41-42   | 3  | 0.5                                |
|   | 28 | 0.2                                |
|   | 41 | 0.4 <sup>6</sup> /0.5 <sup>7</sup> |
|   | 42 | 0.5                                |
| CA_3-32-42-43 <sup>11</sup>   | 3  | 0.2                                |
|   | 32 | 0                                  |
|   | 42 | 0.5                                |
|   | 43 | 0.5                                |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 2: The above additional tolerances also apply in intra-band and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 3: Tolerances for a UE supporting multiple 4DL inter-band CA configurations are FFS.</p> <p>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> <p>NOTE 5: For UE supporting E-UTRA band 42, 43 or 48 and CA configurations including Band 42, 43 or 48, the applicable <math>\Delta R_{IB,c}</math> in Band 42, 43, or 48 is the max(Band 42 <math>\Delta R_{IB,c}</math>, Band 43 <math>\Delta R_{IB,c}</math>, Band 48 <math>\Delta R_{IB,c}</math>).</p> <p>NOTE 6: The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.</p> <p>NOTE 7: The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz.</p> <p>NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1, Band 3 or Band 8.</p> <p>NOTE 9: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 1, Band 8 or Band 11.</p> <p>NOTE 10: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in Band 3, Band 8 or Band 11.</p> <p>NOTE 11: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among TDD bands.</p> |    |                                    |

Table 7.3.1-1D:  $\Delta R_{IB,c}$  (five bands)

| E-UTRA operating band combination | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|-----------------------------------|-------------|------------------------|
| CA_1-3-5-7-28                     | 1           | 0                      |
|                                   | 3           | 0                      |
|                                   | 5           | 0.1                    |
|                                   | 7           | 0                      |
|                                   | 28          | 0.2                    |
| CA_1-3-7-8-20                     | 1           | 0                      |
|                                   | 3           | 0                      |
|                                   | 7           | 0                      |
|                                   | 8           | 0.2                    |
|                                   | 20          | 0.2                    |
| CA_1-3-7-20-28                    | 1           | 0                      |
|                                   | 3           | 0                      |
|                                   | 7           | 0                      |
|                                   | 20          | 0.2                    |
|                                   | 28          | 0.2                    |
| CA_1-3-7-20-32                    | 1           | 0                      |
|                                   | 3           | 0                      |
|                                   | 7           | 0                      |
|                                   | 20          | 0                      |
|                                   | 32          | 0                      |
| CA_1-3-7-20-42                    | 1           | 0.2                    |
|                                   | 3           | 0.2                    |
|                                   | 7           | 0.2                    |

|   |    |     |
|---|----|-----|
|   | 20 | 0   |
|   | 42 | 0.5 |
| CA_1-3-8-11-28  | 1  | 0   |
|   | 3  | 0.3 |
|   | 8  | 0.2 |
|   | 11 | 0.5 |
|   | 28 | 0.2 |
| CA_1-3-20-32-42   | 1  | 0.2 |
|   | 3  | 0.2 |
|   | 20 | 0   |
|   | 32 | 0   |
|   | 42 | 0.5 |
| CA_1-3-20-32-43   | 1  | 0   |
|   | 3  | 0   |
|   | 20 | 0   |
|   | 32 | 0   |
|   | 43 | 0.5 |
| CA_1-3-32-42-43   | 1  | 0.2 |
|   | 3  | 0.2 |
|   | 32 | 0   |
|   | 42 | 0.5 |
|   | 43 | 0.5 |
| <p>NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 2: The above additional tolerances also apply in intra-band and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.</p> <p>NOTE 3: Tolerances for a UE supporting multiple 5DL inter-band CA configurations are FFS.</p> <p>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.</p> |    |     |

NOTE : The above additional tolerances do not apply to supported UTRA operating bands with frequency range below 1 GHz that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations when such bands are belonging only to band combination(s) where one band is <1GHz and other bands are >1.7GHz and there is no harmonic relationship between the low band UL and high band DL. Otherwise the above additional tolerances also apply to supported UTRA operating bands that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.

**Table 7.3.1-2: Uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |         |       |                 |                 |                 |                 |             |
|---|---------|-------|-----------------|-----------------|-----------------|-----------------|-------------|
| E-UTRA Band   | 1.4 MHz | 3 MHz | 5 MHz           | 10 MHz          | 15 MHz          | 20 MHz          | Duplex Mode |
| 1   |         |       | 25              | 50              | 75              | 100             | FDD         |
| 2   | 6       | 15    | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| 3   | 6       | 15    | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| 4   | 6       | 15    | 25              | 50              | 75              | 100             | FDD         |
| 5   | 6       | 15    | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 6   |         |       | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 7   |         |       | 25              | 50              | 75              | 75 <sup>1</sup> | FDD         |
| 8   | 6       | 15    | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 9   |         |       | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| 10  |         |       | 25              | 50              | 75              | 100             | FDD         |
| 11  |         |       | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 12  | 6       | 15    | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD         |
| 13  |         |       | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD         |

|     |   |                |                 |                 |                 |                 |     |
|-----|---|----------------|-----------------|-----------------|-----------------|-----------------|-----|
| 14  |   |                | 15 <sup>1</sup> | 15 <sup>1</sup> |                 |                 | FDD |
| ... |   |                |                 |                 |                 |                 |     |
| 17  |   |                | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD |
| 18  |   |                | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD |
| 19  |   |                | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD |
| 20  |   |                | 25              | 20 <sup>1</sup> | 20 <sup>3</sup> | 20 <sup>3</sup> | FDD |
| 21  |   |                | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD |
| 22  |   |                | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| 23  | 6 | 15             | 25              | 50              | 75              | 100             | FDD |
| 24  |   |                | 25              | 50              |                 |                 | FDD |
| 25  | 6 | 15             | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| 26  | 6 | 15             | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD |
| 27  | 6 | 15             | 25              | 25 <sup>1</sup> |                 |                 | FDD |
| 28  |   | 15             | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
| 30  |   |                | 25              | 25 <sup>1</sup> |                 |                 | FDD |
| 31  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD |
| ... |   |                |                 |                 |                 |                 |     |
| 33  |   |                | 25              | 50              | 75              | 100             | TDD |
| 34  |   |                | 25              | 50              | 75              |                 | TDD |
| 35  | 6 | 15             | 25              | 50              | 75              | 100             | TDD |
| 36  | 6 | 15             | 25              | 50              | 75              | 100             | TDD |
| 37  |   |                | 25              | 50              | 75              | 100             | TDD |
| 38  |   |                | 25              | 50              | 75              | 100             | TDD |
| 39  |   |                | 25              | 50              | 75              | 100             | TDD |
| 40  |   |                | 25              | 50              | 75              | 100             | TDD |
| 41  |   |                | 25              | 50              | 75              | 100             | TDD |
| 42  |   |                | 25              | 50              | 75              | 100             | TDD |
| 43  |   |                | 25              | 50              | 75              | 100             | TDD |
| 44  |   | 15             | 25              | 50              | 75              | 100             | TDD |
| 45  |   |                | 25              | 50              | 75              | 100             | TDD |
| 48  |   |                | 25              | 50              | 75              | 100             | TDD |
| 50  |   | 15             | 25              | 50              | 75              | 100             | TDD |
| 51  |   | 15             | 25              |                 |                 |                 | TDD |
| 52  |   |                | 25              | 50              | 75              | 100             | TDD |
| 53  | 6 | 15             | 25              | 50              |                 |                 |     |
| ... |   |                |                 |                 |                 |                 |     |
| 65  | 6 | 15             | 25              | 50              | 75              | 100             | FDD |
| 66  | 6 | 15             | 25              | 50              | 75              | 100             | FDD |
| 68  |   |                | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD |
| ... |   |                |                 |                 |                 |                 |     |
| 70  |   |                | 25              | 50              | 75              |                 | FDD |
| 71  |   |                | 25              | 25 <sup>1</sup> | 20 <sup>1</sup> | 20 <sup>1</sup> | FDD |
| 72  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD |
| 73  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD |
| 74  | 6 | 15             | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
| 85  |   |                | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD |
| 87  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD |
| 88  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD |

NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).

NOTE 2: For the UE which supports both Band 11 and Band 21 the uplink configuration for reference sensitivity is FFS.

|         |   |
|---------|---|
| NOTE 3: | <sup>3</sup> refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB <sub>start</sub> 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB <sub>start</sub> 16                     |
| NOTE 4: | <sup>4</sup> refers to Bands 31, 72, 73, 87 and 88; in the case of 3 MHz channel bandwidth, the UL resource blocks shall be located at RB <sub>start</sub> 9 and in the case of 5 MHz channel bandwidth, the UL resource blocks shall be located at RB <sub>start</sub> 10. |

Unless given by Table 7.3.1-3, the minimum requirements specified in Tables 7.3.1-1, 7.3.1-1a and 7.3.1-2 shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

**Table 7.3.1-3: Network signalling value for reference sensitivity**

| E-UTRA Band | Network Signalling value |
|-------------|--------------------------|
| 2           | NS_03                    |
| 4           | NS_03                    |
| 10          | NS_03                    |
| 12          | NS_06                    |
| 13          | NS_06                    |
| 14          | NS_06                    |
| 17          | NS_06                    |
| 19          | NS_08                    |
| 21          | NS_09                    |
| 23          | NS_03                    |
| 25          | NS_03                    |
| 30          | NS_21                    |
| 48          | NS_27                    |
| 53          | NS_45                    |
| 66          | NS_03                    |
| 70          | NS_03                    |
| 71          | NS_35                    |
| 85          | NS_06                    |

### 7.3.1A Minimum requirements (QPSK) for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1, Table 7.3.1-1a and Table 7.3.1-2. The reference sensitivity is defined to be met with all downlink component carriers active and one of the uplink carriers active. The uplink resource blocks shall be located as close as possible to the primary downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). The primary downlink operating band is the downlink band of the active uplink operating band. The UE shall meet the requirements specified in subclause 7.3.1 with the following exceptions.

For the bands supporting 4 antenna ports which are in Table 7.3.1-1a, the minimum requirements for reference sensitivity in the reference sensitivity exception tables shall be modified by the amount given in  $\Delta R_{IB,4R}$  in Table 7.3.1-1a for the applicable E-UTRA bands unless otherwise specified.

For the bands supporting 8 antenna ports which are in Table 7.3.1-1aa, the minimum requirements for reference sensitivity in the reference sensitivity exception tables shall be modified by the amount given in  $\Delta R_{IB,8R}$  in Table 7.3.1-1aa for the applicable E-UTRA bands unless otherwise specified.

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0a, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by harmonic interference from the uplink transmission in a lower-frequency band of the same CA configuration. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0a and Table 7.3.1A-0b.

**Table 7.3.1A-0a: Reference sensitivity for carrier aggregation QPSK  $P_{\text{REFSENS, CA}}$  (exceptions due to harmonic issue)**

| EUTRA CA Configuration                | Channel bandwidth |               |             |             |              |              |              | Duplex mode |
|---------------------------------------|-------------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                                       | EUTRA band        | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| CA_1A-3A-5A-7A-28A <sup>5,6</sup>     | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-5A-28A <sup>5,6</sup>        | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-5A-41A <sup>8,19,28</sup>    | 5                 |               |             | N/A         | N/A          |              |              | FDD         |
|                                       | 41                |               |             | N/A         | N/A          | N/A          | N/A          | TDD         |
| CA_1A-3A-7A-8A <sup>4</sup>           | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-7A-8A <sup>4,5,6</sup>       | 7 <sup>33</sup>   |               |             | -88         | -87.4        | -87          | -86.7        | FDD         |
| CA_1A-3C-7A-8A <sup>4</sup>           | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3C-7A-8A <sup>5,6</sup>         | 7 <sup>33</sup>   |               |             | -88         | -87.4        | -87          | -86.7        | FDD         |
| CA_1A-3A-7A-8A-20A <sup>5,6</sup>     | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-7A-8A-20A <sup>5,6</sup>     | 7 <sup>33</sup>   |               |             | -88         | -87.4        | -87          | -86.7        | FDD         |
| CA_1A-3A-7A-20A-28A <sup>5,6</sup>    | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-7A-20A-42A <sup>9,10</sup>   | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-7A-20A-42A <sup>11</sup>     | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-7A-28A <sup>5,6</sup>        | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-7A-42A <sup>9,10</sup>       | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-7A-42A <sup>11</sup>         | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-8A <sup>4</sup>              | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-11A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-20A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-11A-28A <sup>4</sup>      | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-28A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-38A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-11A-28A <sup>5,6</sup>       | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-11A-28A <sup>9,10</sup>      | 11                |               |             | -75.2       | -75.2        |              |              | FDD         |
| CA_1A-3A-8A-40A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-42A <sup>4</sup>          | 3                 |               |             | N/A         | N/A          | N/A          | N/A          | FDD         |
| CA_1A-3A-8A-42A <sup>9,10</sup>       | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-8A-42A <sup>11</sup>         | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-8A-42A <sup>12,13</sup>      | 42 <sup>33</sup>  |               |             | -84.8       | -84.7        | -84.6        | -84.5        | TDD         |
| CA_1A-3A-18A-42A <sup>9,10</sup>      | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-18A-42A <sup>11</sup>        | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-19A-42A <sup>9,10</sup>      | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-19A-42A <sup>11</sup>        | 42                |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-20A-28A <sup>5,6</sup>       | 1 <sup>33</sup>   |               |             | -89.8       | -89.4        | -89          | -88.7        | FDD         |
| CA_1A-3A-20A-32A-42A <sup>9,10</sup>  | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-20A-32A-42A <sup>11</sup>    | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-20A-32A-42A <sup>12,13</sup> | 42 <sup>33</sup>  |               |             | -84.8       | -84.7        | -84.6        | -84.5        | TDD         |
| CA_1A-3A-21A-28A <sup>4,21</sup>      | 21                |               |             | N/A         | N/A          | N/A          |              | FDD         |
| CA_1A-3A-21A-42A <sup>22,23</sup>     | 42 <sup>33</sup>  |               |             | -71.7       | -71.7        | -71.7        | -71.7        | TDD         |
| CA_1A-3A-21A-42A <sup>24</sup>        | 42 <sup>33</sup>  |               |             | -97.1       | -94.7        | -93.2        | -92.5        | TDD         |
| CA_1A-3A-28A-40A <sup>15,16</sup>     | 28                |               |             | -60.7       | -60.7        | -60.7        | -60.7        | FDD         |



|  |                  |  |  |       |       |       |       |     |
|--|------------------|--|--|-------|-------|-------|-------|-----|
| CA_1A-3A-28A-42A <sup>22,23</sup>  | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-28A-42A <sup>24</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-28A <sup>5,6</sup><br>CA_1A-1A-3A-28A<br>CA_1A-1A-3C-28A<br>CA_1A-3A-3A-28A | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-3A-32A-42A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-32A-42A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42A-43A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42A-43A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-32A-42A-43A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-32A-42A-43A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-41A-42A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-41A-42A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-3A-42A <sup>9,10</sup>  | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-3A-42A <sup>11</sup>  | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42A-42A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42A-42A <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42A-42C <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42A-42C <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42C-42C <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42C-42C <sup>11</sup>   | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-5A-7A-28A <sup>5,6</sup>   | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-5A-28A <sup>5,6</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-5A-41A <sup>8,19</sup>   | 5                |  |  | N/A   | N/A   |       |       | FDD |
|  | 41               |  |  | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_1A-7A-8A <sup>5,6</sup> ,<br>CA_1A-7A-7A-8A <sup>5,6</sup>                        | 7 <sup>33</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_1A-7A-8A-20A  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-7A-8A-40A <sup>5,6</sup>   | 7 <sup>33</sup>  |  |  |       | -87.1 | -86.7 | -86.4 | FDD |
| CA_1A-7A-20A-28A <sup>5,6</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-7A-28A <sup>5,6</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-7A-28A-40A <sup>15,16</sup>  | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_1A-8A-20A-28A <sup>5,6</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-8A-42A <sup>12,13</sup><br>CA_1A-8A-42C <sup>12,13</sup>                       | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_1A-8A-11A-42A <sup>12,13</sup>  | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_1A-11A-28A <sup>5,6</sup>   | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-11A-28A <sup>9,10</sup>  | 11               |  |  | -75.2 | -75.2 |       |       | FDD |
| CA_1A-18A-28A <sup>14</sup>  | 1                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_1A-19A-28A <sup>14</sup>  | 1 <sup>33</sup>  |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_1A-20A-28A  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-20A-32A-42A <sup>12,13</sup>   | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_1A-21A-28A <sup>4,21</sup>  | 21               |  |  | N/A   | N/A   | N/A   |       | FDD |
| CA_1A-21A-28A-42A <sup>4,21</sup>  | 21               |  |  | N/A   | N/A   | N/A   |       | FDD |
| CA_1A-28A <sup>5,6,14</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-1A-28A <sup>5,6,14</sup>   | 1                |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-28A-40A <sup>15,16</sup><br>CA_1A-28A-40C <sup>15,16</sup>                     | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_1A-28A-40A <sup>5,6</sup><br>CA_1A-28A-40C <sup>5,6</sup>                         | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |

|   |                  |  |  |       |       |       |       |     |
|---|------------------|--|--|-------|-------|-------|-------|-----|
| CA_1A-28A-42A <sup>5,6,17,18</sup>  | 1 <sup>33</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
|   | 42 <sup>33</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_2A-46A <sup>15,16</sup>  | 2                |  |  | -70   | -67   | -65.2 | -64   | FDD |
| CA_2A-2A-46A <sup>15,16</sup>   | 2                |  |  | -70   | -67   | -65.2 | -64   | FDD |
| CA_2A-48A <sup>9,10</sup>   | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-71A <sup>36</sup>   | 2                |  |  | -93.4 | -94   | -92.5 | -91.4 | FDD |
| CA_2A-71A <sup>37</sup>   | 2                |  |  | -96.8 | -94   | -92.5 | -91.4 | FDD |
| CA_2A-71A <sup>15,16</sup>  | 71               |  |  | -70.4 | -70.4 | -70.4 | -70.4 | FDD |
| CA_2A-2A-71A <sup>36</sup>  | 2                |  |  | -93.4 | -94   | -92.5 | -91.4 | FDD |
| CA_2A-2A-71A <sup>37</sup>  | 2                |  |  | -96.8 | -94   | -92.5 | -91.4 | FDD |
| CA_2A-2A-71A <sup>15,16</sup>   | 71               |  |  | -70.4 | -70.4 | -70.4 | -70.4 | FDD |
| CA_2A-4A-12A <sup>5,6</sup>   | 4 <sup>33</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-28A <sup>5,6</sup>   | 4 <sup>33</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-71A <sup>36</sup> ,<br>CA_2A-2A-4A-71A <sup>36</sup>   | 2                |  |  | -93.1 | -93.7 | -92.2 | -91.1 | FDD |
| CA_2A-4A-71A <sup>37</sup> ,<br>CA_2A-2A-4A-71A <sup>37</sup>   | 2                |  |  | -96.5 | -93.7 | -92.2 | -91.1 | FDD |
| CA_2A-4A-71A <sup>15,16</sup> ,<br>CA_2A-2A-4A-71A <sup>15,16</sup>   | 71               |  |  | -70.4 | -70.4 | -70.4 | -70.4 | FDD |
| CA_2A-4A-5A-12A <sup>5,6</sup>  | 4 <sup>33</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-7A-12A <sup>5,6</sup>  | 4 <sup>33</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-12A-30A <sup>5,6</sup>   | 4 <sup>33</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-5A-12A-66A <sup>5,6</sup>   | 66               |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-7A-12A-66A <sup>5,6</sup>   | 66 <sup>33</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-12A-66A <sup>5,6</sup>  | 66 <sup>33</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-13A-48A <sup>9,10</sup>   | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48A <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-13A-48A-<br>66A <sup>9,10</sup>   | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48A-66A <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-28A-66A <sup>5,6</sup>  | 66               |  |  | -89.5 | -88.9 | -88.5 | -88.2 | FDD |
| CA_2A-48A-48A <sup>10,31</sup>  | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48A <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48A-48C <sup>10,31</sup>  | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48C <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48C <sup>9,10</sup>   | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48C <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48D <sup>9,10</sup>   | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48D <sup>11</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48A-66A <sup>10,32</sup> ,<br>CA_2A-48C-66A <sup>10,32</sup>  | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-66A <sup>11</sup> ,<br>CA_2A-48C-66A <sup>11</sup>  | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-66A-71A <sup>36</sup> ,<br>CA_2A-2A-66A-71A <sup>36</sup> ,<br>CA_2A-66A-66A-71A <sup>36</sup> ,<br>CA_2A-66C-71A <sup>36</sup>                     | 2                |  |  | -93.1 | -93.7 | -92.2 | -91.1 | FDD |
| CA_2A-66A-71A <sup>37</sup> ,<br>CA_2A-2A-66A-71A <sup>37</sup> ,<br>CA_2A-66A-66A-71A <sup>37</sup> ,<br>CA_2A-66C-71A <sup>37</sup>                     | 2                |  |  | -96.5 | -93.7 | -92.2 | -91.1 | FDD |
| CA_2A-66A-71A <sup>15,16</sup> ,<br>CA_2A-2A-66A-<br>71A <sup>15,16</sup> ,<br>CA_2A-66A-66A-<br>71A <sup>15,16</sup> ,<br>CA_2A-66C-71A <sup>15,16</sup> | 71               |  |  | -70.4 | -70.4 | -70.4 | -70.4 | FDD |
| CA_3A-5A-41A <sup>8,19,28</sup>   | 5                |  |  | N/A   | N/A   |       |       | FDD |
|   | 41               |  |  | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_3A-7A-8A <sup>4</sup>  | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-8A <sup>5,6</sup>  | 7 <sup>33</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |

|                                    |                  |  |  |       |       |       |       |     |
|------------------------------------|------------------|--|--|-------|-------|-------|-------|-----|
| CA_3C-7A-8A <sup>4</sup>           | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3C-7A-8A <sup>5,6</sup>         | 7 <sup>33</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_3A-7A-8A-20A <sup>4</sup>       | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-8A-20A <sup>5,6</sup>     | 7 <sup>33</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_1A-3A-8A-20A <sup>4</sup>       | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-8A-38A <sup>4</sup>       | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-8A-40A <sup>4</sup>       | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-8A-40A <sup>5,6</sup>     | 7 <sup>33</sup>  |  |  |       | -87.1 | -86.7 | -86.4 | FDD |
| CA_3A-7A-20A-42A <sup>9,10</sup>   | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-7A-20A-42A <sup>11</sup>     | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-7A-28A-40A <sup>15,16</sup>  | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_3A-7A-42A <sup>9,10</sup>       | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-7A-42A <sup>11</sup>         | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-8A <sup>4</sup>              | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-11A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-11A-28A <sup>4</sup>      | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-32A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-38A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3C-8A-38A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-40A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-40C <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-42A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-42C <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-8A-42A <sup>9,10</sup>       | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-8A-42C <sup>9,10</sup>       | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-8A-42A <sup>11</sup>         | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-8A-42C <sup>11</sup>         | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-8A-42A <sup>12,13</sup>      | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_3A-8A-42C <sup>12,13</sup>      | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_3A-11A-28A <sup>9,10</sup>      | 11               |  |  | -75.2 | -75.2 |       |       | FDD |
| CA_3A-18A-42A <sup>9,10</sup>      | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-18A-42C <sup>9,10</sup>      | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-18A-42A <sup>11</sup>        | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-18A-42C <sup>11</sup>        | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-19A-21A-42A <sup>25,26</sup> | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-19A-21A-42A <sup>27</sup>    | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-19A-21A-42C <sup>25,26</sup> | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-19A-21A-42C <sup>27</sup>    | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-19A-42A <sup>9,10</sup>      | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-19A-42A <sup>11</sup>        | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-20A-32A-42A <sup>9,10</sup>  | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-20A-32A-42A <sup>11</sup>    | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-20A-32A-42A <sup>12,13</sup> | 42 <sup>33</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_3A-20A-42A <sup>9,10</sup>      | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-20A-42A <sup>11</sup>        | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-21A-28A <sup>4,21</sup>      | 21               |  |  | N/A   | N/A   | N/A   |       | FDD |
| CA_3A-21A-28A-42A <sup>9,10</sup>  | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-21A-28A-42A <sup>11</sup>    | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-21A-28A-42C <sup>9,10</sup>  | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-21A-28A-42C <sup>11</sup>    | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-21A-42A <sup>9,10</sup>      | 42 <sup>33</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-21A-42A <sup>11</sup>        | 42 <sup>33</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-40A <sup>15,16</sup>     | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |

|                                       |                  |       |       |       |       |       |       |     |
|---------------------------------------|------------------|-------|-------|-------|-------|-------|-------|-----|
| CA_3A-28A-41A-42A <sup>9,10,29</sup>  | 41               |       |       |       | -94.5 | -92.7 | -91.5 | TDD |
|                                       | 42 <sup>33</sup> |       |       |       | -71.7 | -71.7 | -71.7 |     |
| CA_3A-28A-41A-42A <sup>11,29</sup>    | 41               |       |       |       | -94.5 | -92.7 | -91.5 | TDD |
|                                       | 42 <sup>33</sup> |       |       |       | -94.7 | -93.2 | -92.5 |     |
| CA_3A-28A-41A-42A <sup>17,18,29</sup> | 41               |       |       |       | -94.5 | -92.7 | -91.5 | TDD |
|                                       | 42 <sup>33</sup> |       |       |       | -85.4 | -85.1 | -84.9 |     |
| CA_3A-28A-42A <sup>9,10</sup>         | 42 <sup>33</sup> |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42A <sup>11</sup>           | 42 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42A <sup>17,18</sup>        | 42 <sup>33</sup> |       |       | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-31A <sup>12,13</sup>            | 3 <sup>33</sup>  |       |       | -86.9 | -86.4 | -86   | -85.6 | FDD |
| CA_3A-32A-42A <sup>9,10</sup>         | 42 <sup>33</sup> |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-32A-42A <sup>11</sup>           | 42 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42A <sup>9,10</sup>             | 42 <sup>33</sup> |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42A <sup>11</sup>               | 42 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42A-42A <sup>9,10</sup>         | 42 <sup>33</sup> |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42A-42A <sup>11</sup>           | 42 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-3A-42A <sup>11</sup>            | 42 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42A-43A <sup>9,10</sup>         | 42               |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42A-43A <sup>11</sup>           | 42               |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-32A-42A-43A <sup>9,10</sup>     | 42               |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-32A-42A-43A <sup>11</sup>       | 42               |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_4A-5A-12A <sup>5,6</sup>           | 4 <sup>33</sup>  |       |       | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-7A-12A <sup>5,6</sup>           | 4 <sup>33</sup>  |       |       | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-7A-28A <sup>5,6</sup>           | 4 <sup>33</sup>  |       |       | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_4A-12A <sup>5,6</sup>              | 4 <sup>33</sup>  | -89.2 | -89.2 | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-12A-30A <sup>5,6</sup>          | 4 <sup>33</sup>  |       |       | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-17A <sup>5,6</sup>              | 4 <sup>33</sup>  |       |       | -90   | -89.5 |       |       | FDD |
| CA_4A-28A <sup>5,6</sup>              | 4 <sup>33</sup>  |       |       | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_5A-12A-66A <sup>5,6</sup>          | 66 <sup>33</sup> |       |       | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_5A-38A <sup>8,19</sup>             | 5                |       |       | N/A   | N/A   |       |       | FDD |
| CA_5A-41A <sup>8,19</sup>             | 38,41            |       |       | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_5A-40A-41A <sup>8,19</sup>         |                  |       |       |       |       |       |       |     |
| CA_5A-48A-66A <sup>9,10</sup>         | 48 <sup>33</sup> |       |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_5A-48A-66A-66A <sup>9,10</sup>     |                  |       |       |       |       |       |       |     |
| CA_5A-48A-66A <sup>11</sup>           | 48 <sup>33</sup> |       |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_5A-48A-66A-66A <sup>11</sup>       |                  |       |       |       |       |       |       |     |
| CA_7A-8A <sup>5,6</sup>               | 7 <sup>33</sup>  |       |       | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_7A-8A-20A <sup>5,6</sup>           | 7 <sup>33</sup>  |       |       |       | -87.4 | -87   | -86.7 | FDD |
| CA_7A-12A-66A <sup>5,6</sup>          | 66 <sup>33</sup> |       |       | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_7A-12B-66A <sup>5,6</sup>          | 66 <sup>33</sup> |       |       | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_7A-20A-38A <sup>8</sup>            | 38               |       |       | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_7A-28A-40A <sup>15,16</sup>        | 28               |       |       | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_7A-28A-40C <sup>15,16</sup>        |                  |       |       |       |       |       |       |     |
| CA_8A-28A-41A <sup>28</sup>           | 41               |       |       | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_8A-39A-41A <sup>8</sup>            | 41               |       |       | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_8A-41A <sup>8</sup>                | 41               |       |       | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_8A-42A <sup>12,13</sup>            | 42 <sup>33</sup> |       |       | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_8A_11A_42A <sup>12,13</sup>        | 42 <sup>33</sup> |       |       | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_8A_11A_42C <sup>12,13</sup>        |                  |       |       |       |       |       |       |     |
| CA_11A-28A <sup>9,10</sup>            | 11 <sup>33</sup> |       |       | -75.2 | -75.2 |       |       | FDD |
| CA_12A-30A-66A <sup>5,6</sup>         | 66 <sup>33</sup> |       |       | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_12A-66A <sup>5,6</sup>             | 66 <sup>33</sup> | -88.7 | -88.7 | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_13A-48A-66A <sup>9,10</sup>        | 48 <sup>33</sup> |       |       |       |       |       |       | TDD |
| CA_13A-48A-66A-66A <sup>9,10</sup>    |                  |       |       |       |       |       |       |     |
| CA_13A-48A-66B <sup>9,10</sup>        |                  |       |       |       |       |       |       |     |
| CA_13A-48A-66C <sup>9,10</sup>        |                  |       |       |       |       |       |       |     |
| CA_13A-48A-48A-66A <sup>9,10</sup>    |                  |       |       |       |       |       |       |     |
| CA_13A-48C-66A <sup>9,10</sup>        |                  |       |       |       |       |       |       |     |
| CA_13A-48D-66A <sup>9,10</sup>        |                  |       |       |       |       |       |       |     |

|  |                  |  |  |            |            |            |            |            |
|--|------------------|--|--|------------|------------|------------|------------|------------|
| CA_13A-48A-48C-66A <sup>9,10</sup>   |                  |  |  |            |            |            |            |            |
| CA_13A-48A-66A <sup>11</sup><br>CA_13A-48A-66A-66A <sup>11</sup><br>CA_13A-48A-66B <sup>11</sup><br>CA_13A-48A-66C <sup>11</sup><br>CA_13A-48A-48A-66A <sup>11</sup><br>CA_13A-48C-66A <sup>11</sup><br>CA_13A-48D-66A <sup>11</sup><br>CA_13A-48A-48C-66A <sup>11</sup><br>CA_13A-48E-66A | 48 <sup>33</sup> |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_18A-41A <sup>19</sup><br>CA_18A-41C <sup>19</sup>   | 41               |  |  | N/A        | N/A        | N/A        | N/A        | TDD        |
| CA_20A-32A-42A <sup>12,13</sup>  | 20               |  |  | -97        |            |            |            | FDD        |
|  | 32               |  |  | -100       | -97        | -95.2      | -94        | FDD        |
|  | 42 <sup>33</sup> |  |  | -84.8      | -84.7      | -84.6      | -84.5      | TDD        |
| CA_20A-38A <sup>8</sup><br>CA_20A-38C <sup>8</sup>   | 20               |  |  | N/A        | N/A        | N/A        | N/A        | FDD        |
| CA_20A-38A-40D <sup>15,16</sup>  | 20               |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-40A <sup>15,16</sup>  | 20 <sup>33</sup> |  |  | -60.7      | -60.7      | -60.7      | -60.7      | FDD        |
| CA_20A-40A-40A <sup>15,16</sup>  | 20 <sup>33</sup> |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-38A-40A <sup>15,16</sup>  | 20 <sup>33</sup> |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-40C <sup>15,16</sup>  | 20 <sup>33</sup> |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-40D <sup>15,16</sup>  | 20               |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-38A-40A-40A <sup>15,16</sup>  | 20               |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-38A-40C <sup>15,16</sup>  | 20               |  |  | -60.7      | -60.7      | -60.7      |            | FDD        |
| CA_20A-42A <sup>12,13</sup><br>CA_20A-42A-42A <sup>12,13</sup>   | 42 <sup>33</sup> |  |  | -84.8      | -84.7      | -84.6      | -84.5      | TDD        |
| CA_20A-41A <sup>5,6</sup><br>CA_20A-41C <sup>5,6</sup><br>CA_20A-41D <sup>5,6</sup>  | 41               |  |  | -85.1      | -84.7      | -84.8      | -84.6      | TDD        |
| CA_21A-28A <sup>4,21</sup>   | 21               |  |  | N/A        | N/A        | N/A        |            | FDD        |
| CA_21A-28A-42A <sup>4,21</sup>   | 21               |  |  | N/A        | N/A        | N/A        | N/A        | FDD        |
| CA_25A-26A-41A <sup>38</sup>   | 41               |  |  | N/A        | N/A        | N/A        | N/A        | TDD        |
| CA_26A-41A <sup>8,19</sup><br>CA_25A-25A-26A-41A <sup>8,19</sup><br>CA_25A-26A-41C <sup>8,19</sup>   | 26<br>41         |  |  | N/A<br>N/A | N/A<br>N/A | N/A<br>N/A | N/A<br>N/A | FDD<br>TDD |
| CA_28A-32A <sup>9,10</sup>   | 32               |  |  | -72.2      | -72.2      | -72.2      | -72.2      | FDD        |
| CA_28A-32A <sup>11</sup>   | 32               |  |  | -97.6      | -95.2      | -93.7      | -93.0      | FDD        |
| CA_28A-40A <sup>15,16</sup>  | 28               |  |  | -60.7      | -60.7      | -60.7      | -60.7      | FDD        |
| CA_28A-41A-42A <sup>17,18</sup>  | 42 <sup>33</sup> |  |  |            | -85.4      | -85.1      | -84.9      | TDD        |
| CA_28A-42A <sup>17,18</sup>  | 42 <sup>33</sup> |  |  | -85.7      | -85.4      | -85.1      | -84.9      | TDD        |
| CA_28A-66A <sup>5,6</sup>  | 66               |  |  | -89.5      | -88.9      | -88.5      | -88.2      | FDD        |
| CA_48A-66A <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-66A <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-66B <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-66B <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-66C <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-66C <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-48A-66A <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-48A-66A <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-66A-66A <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-66A-66A <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-48A-66A-66A <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-48A-66A-66A <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-48A-66B <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-48A-66B <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |
| CA_48A-48A-66C <sup>9,10</sup>   | 48               |  |  | -71.7      | -71.7      | -71.7      | -71.7      | TDD        |
| CA_48A-48A-66C <sup>11</sup>   | 48               |  |  | -97.1      | -94.7      | -93.2      | -92.5      | TDD        |

|                                      |    |  |  |       |       |       |       |     |
|--------------------------------------|----|--|--|-------|-------|-------|-------|-----|
| CA_48C-66A-66A <sup>9,10</sup>       | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
|                                      | 66 |  |  | -99.3 | -96.3 | -94.5 | -93.2 | FDD |
| CA_48C-66A-66A <sup>11</sup>         | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
|                                      | 66 |  |  | -99.3 | -96.3 | -94.5 | -93.2 | FDD |
| CA_48C-66B <sup>9,10</sup>           | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_48C-66B <sup>11</sup>             | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_48C-66C <sup>9,10</sup>           | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_48C-66C <sup>11</sup>             | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_48C-66A <sup>9,10</sup>           | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_48C-66A <sup>11</sup>             | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_48E-66A <sup>9,10</sup>           | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_48E-66A <sup>11</sup>             | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_66A-70A-71A <sup>5,6</sup>        | 70 |  |  | -90   | -89.5 | -89.2 |       | FDD |
| CA_66A-66A-70A-71A <sup>5,6</sup>    | 70 |  |  | -90   | -89.5 | -89.2 |       | FDD |
| CA_66A-70C-71A <sup>5,6,35</sup>     | 70 |  |  | -90   | -89.5 | -89.2 | -89   | FDD |
| CA_66A-66A-70C-71A <sup>5,6,35</sup> | 70 |  |  | -90   | -89.5 | -89.2 | -89   | FDD |
| CA_66C-70A-71A <sup>5,6</sup>        | 70 |  |  | -90   | -89.5 | -89.2 |       | FDD |
| CA_66C-70C-71A <sup>5,6,35</sup>     | 70 |  |  | -90   | -89.5 | -89.2 | -89   | FDD |
| CA_70A-71A <sup>5,6</sup>            | 70 |  |  | -90   | -89.5 | -89.2 |       | FDD |
| CA_70C-71A <sup>5,6,35</sup>         | 70 |  |  | -90   | -89.5 | -89.2 | -89   | FDD |

NOTE 1: The transmitter shall be set to  $P_{UMAX}$  as defined in subclause 6.2.5A.

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1.

NOTE 3: The signal power is specified per port

NOTE 4: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity for all active downlink component carriers is only verified when this is not the case (the requirements specified in clause 7.3.1 apply unless otherwise specified).

NOTE 5: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3<sup>rd</sup> transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 6: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.3 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.

NOTE 7: Void.

NOTE 8: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3<sup>rd</sup> transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).

NOTE 9: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_3A-42A, CA\_3A-3A-42A, CA\_3A-42A-42A, CA\_1A-3A-42A, CA\_2A-13A-48A-66A, CA\_2A-48A, CA\_2A-48C, CA\_2A-48D, CA\_48A-66A, CA\_3A-7A-42A, CA\_3A-19A-42A, CA\_3A-20A-42A, CA\_3A-28A-42A, CA\_1A-3A-7A-42A, CA\_5A-48A-66A, CA\_5A-48A-66A-66A, CA\_13A-48A-66A, CA\_13A-48A-66A-66A, CA\_13A-48A-66B, CA\_13A-48A-66C, CA\_13A-48A-48A-66A, CA\_13A-48C-66A, CA\_13A-48D-66A, CA\_13A-48A-48C-66A, CA\_28A-32A, CA\_48A-66A-66A, CA\_48A-66B, CA\_48A-66C, CA\_48A-48A-66A, CA\_48C-66A, CA\_48A-48A-66A-66A, CA\_48A-48A-66B, CA\_48A-48A-66C, CA\_48C-66B, CA\_48C-66C, CA\_48E-66A, CA\_1A-3A-18A-42A, CA\_1A-3A-19A-42A, CA\_1A-3A-32A-42A, CA\_1A-3A-41A-42A, CA\_3A-7A-20A-42A, CA\_3A-20A-32A-42A, CA\_3A-28A-41A-42A, CA\_3A-18A-42A, CA\_3A-18A-42C, CA\_3A-8A-42A and CA\_3A-8A-42C.  $\Delta F_{HD} = 0$  MHz for CA\_11A-28A, CA\_1A-11A-28A and CA\_3A-11A-28A.

NOTE 10: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.

NOTE 11: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher) band with  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

- NOTE 12: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 4<sup>th</sup> transmitter harmonic is within the downlink transmission bandwidth of a high band.
- NOTE 13: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \left\lfloor f_{DL}^{HB} / 0.4 \right\rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.
- NOTE 14: For the UE that supports CA\_1A-18A-28A or CA\_1A-19A-28A, no requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3<sup>rd</sup> transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity should only be verified when this is not the case (the requirements specified in clause 7.3.1 apply).
- NOTE 15: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3<sup>rd</sup> harmonic is within the uplink transmission bandwidth or the uplink adjacent channel's transmission bandwidth of an aggressor (higher) band.
- NOTE 16: The requirements should be verified for UL EARFCN of the aggressor (higher) band (superscript HB) such that  $f_{DL}^{LB} = \left\lfloor f_{UL}^{HB} / 0.3 \right\rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{LB}$  the carrier frequency in the victim (lower) band and  $BW_{Channel}^{HB}$  the channel bandwidth configured in the higher band.
- NOTE 17: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 5<sup>th</sup> transmitter harmonic is within the downlink transmission bandwidth of a high band.
- NOTE 18: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \left\lfloor f_{DL}^{HB} / 0.5 \right\rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.
- NOTE 19: No requirements apply for the case that there is at least one individual RE within the uplink transmission bandwidth of the relative higher band and when the frequency range of relative higher band's uplink channel bandwidth or uplink 1<sup>st</sup> adjacent channel bandwidth is fully or partially overlapped with the 3 times of the frequency range of the relative lower band's downlink channel bandwidth. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).
- NOTE 20: Void
- NOTE 21: No requirements apply when there is at least one individual RE on band 28 uplink outside frequencies 728 – 738 MHz. The reference sensitivity is only verified when all configured RE's are confined within frequencies 728 – 738 MHz (the requirements specified in clause 7.3.1 of [6] apply).
- NOTE 22: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_1A-3A-21A-42A.
- NOTE 23: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \left\lfloor f_{DL}^{HB} / 0.2 \right\rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 < f_{UL}^{LB} < F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.
- NOTE 24: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher band) with  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 < f_{UL}^{LB} < F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.
- NOTE 25: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_3A-19A-21A-42A.
- NOTE 26: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \left\lfloor f_{DL}^{HB} / 0.2 \right\rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 < f_{UL}^{LB} < F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.
- NOTE 27: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher band) with  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 < f_{UL}^{LB} < F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

- NOTE 28: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of either Band 5 or Band 8 for which the 3<sup>rd</sup> transmitter harmonic is within the downlink transmission bandwidth of Band 41. The reference sensitivity for all active downlink component carriers is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).
- NOTE 29: The B41 requirements are modified by -0.1dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2545-2690 MHz.
- NOTE 30: Void
- NOTE 31: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_2A-48A-48A and CA\_2A-48A-48C
- NOTE 32: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2<sup>nd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_2A-48A-66A, CA\_2A-48A-66A-66A and CA\_2A-48C-66A
- NOTE 33: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.
- NOTE 34: Void
- NOTE 35: These exceptions for the intra-band class C carriers should be verified one carrier at a time, according to note 6 frequency arrangements. No exceptions apply for the carrier which is not under RESENS exception test.
- NOTE 36: These requirements apply when the lower edge frequency of the 5 MHz uplink channel in Band 71 is located at or below 668 MHz and the downlink channel in Band 2 is located with its upper edge at 1990 MHz.
- NOTE 37: These requirements apply when the lower edge frequency of the 10 MHz, 15 MHz, or 20 MHz uplink channel in Band 71 is located at or below 668 MHz and the downlink channel in Band 2 is located with its upper edge at 1990 MHz.
- Note 38: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 3<sup>rd</sup> transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 15$  MHz for CA\_26A-41A, CA\_25A-26A-41A.

**Table 7.3.1A-0b: Uplink configuration for the low band (exceptions due to harmonic issue)**

| E-UTRA Band / Channel bandwidth of the high band / N <sub>RB</sub> / Duplex mode |         |         |       |       |        |        |        |             |
|--|---------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration   | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A-5A-7A-28A   | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-5A-28A  | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-7A-8A   | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3C-7A-8A   | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-7A-8A-20A   | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-7A-20A-28A  | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-7A-20A-42A  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-7A-28A  | 28      |         |       |       | 16     | 25     | 25     | FDD         |
| CA_1A-3A-7A-42A  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-8A-42A  | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-8A-42A  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-11A-28A <sup>4</sup>  | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-11A-28A <sup>5</sup>  | 28      |         |       | 12    | 25     |        |        | FDD         |
| CA_1A-3A-18A-42A   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-19A-42A   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-28A<br>CA_1A-1A-3A-28A<br>CA_1A-3A-3A-28A                               | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-42A   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-3A-42A  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |



|  |    |  |  |                 |                 |                 |                 |     |
|--|----|--|--|-----------------|-----------------|-----------------|-----------------|-----|
| CA_1A-3A-42A-42A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-42A-42C   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-42C-42C   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-20A-28A   | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-3A-21A-42A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-28A-40A   | 40 |  |  | 25              | 50              | 75              | 100             | TDD |
| CA_1A-3A-28A-42A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-41A-42A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-5A-7A-28A  | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-7A-8A  | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-3A-32A-42A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-3A-42A-43A   | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-7A-8A-20A<br>CA_1A-7A-7A-8A                        | 8  |  |  | 8               | 16              |                 |                 | FDD |
| CA_1A-7A-8A-40A  | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-7A-20A-28A   | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-7A-28A   | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-7A-28A-40A   | 40 |  |  | 25              | 50              | 75              | 100             | TDD |
| CA_1A-8A-20A-28A   | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-8A-42A<br>CA_1A-8A-42C                             | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-8A-11A-42A   | 8  |  |  | e               | 16              | 25              | 25              | FDD |
| CA_1A-11A-28A <sup>4</sup>                               | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-11A-28A <sup>5</sup>                               | 28 |  |  | 12              | 25              |                 |                 | FDD |
| CA_1A-20A-28A  | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-20A-32A-42A  | 20 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-3A-20A-32A-42A                                     | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
|  | 20 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-3A-32A-42A-43A                                     | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_1A-28A  | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-1A-28A   | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_1A-28A-40A  | 40 |  |  | 25              | 50              | 75              | 100             | TDD |
| CA_1A-28A-42A  | 28 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_2A-46A  | 46 |  |  |                 |                 |                 | 100             | TDD |
| CA_2A-2A-46A   | 46 |  |  |                 |                 |                 | 100             | TDD |
| CA_2A-71A  | 71 |  |  | 25              | 25 <sup>1</sup> | 20 <sup>1</sup> | 20 <sup>1</sup> | FDD |
| CA_2A-71A  | 2  |  |  | 25              | 50              | 50              | 50              | FDD |
| CA_2A-2A-71A   | 71 |  |  | 25              | 50              | 50              | 50              | FDD |
| CA_2A-4A-12A   | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-4A-28A   | 28 |  |  | 8               | 16              | 25              |                 | FDD |
| CA_2A-4A-71A<br>CA_2A-2A-4A-71A                          | 71 |  |  | 25              | 50              | 50              | 50              | FDD |
| CA_2A-4A-5A-12A  | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-4A-7A-12A  | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-4A-12A-30A   | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-5A-12A-66A   | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-7A-12A-66A   | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-12A-66A  | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-13A-48A  | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-13A-48A-66A  | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|  | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> |     |
| CA_2A-48A<br>CA_2A-48A-48A<br>CA_2A-48A-48C<br>CA_2A-48D | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |

|                   |    |   |   |                 |                 |                 |                 |     |
|-------------------|----|---|---|-----------------|-----------------|-----------------|-----------------|-----|
| CA_2A-48A-66A     | 2  |   |   | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48C-66A     | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48A-66A-66A |    |   |   |                 |                 |                 |                 |     |
| CA_2A-66A-71A     | 71 |   |   | 25              | 50              | 50              | 50              | FDD |
| CA_2A-2A-66A-71A  |    |   |   |                 |                 |                 |                 |     |
| CA_2A-66A-66A-71A |    |   |   |                 |                 |                 |                 |     |
| CA_2A-66C-71A     |    |   |   |                 |                 |                 |                 |     |
| CA_3A-7A-8A       | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_3C-7A-8A       | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_3A-7A-20A-42A  | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-7A-8A-40A   | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_3A-7A-28A-40A  | 40 |   |   | 25              | 50              | 75              | 100             | TDD |
| CA_3A-7A-42A      | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-8A-32A      | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_3A-8A-42A      | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-8A-42C      |    |   |   |                 |                 |                 |                 |     |
| CA_3A-8A-42A      | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_3A-8A-42C      |    |   |   |                 |                 |                 |                 |     |
| CA_3A-11A-28A     | 28 |   |   | 12              | 25              |                 |                 | FDD |
| CA_3A-18A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-18A-42C     |    |   |   |                 |                 |                 |                 |     |
| CA_3A-19A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-19A-21A-42A | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-20A-32A-42A | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
|                   | 20 |   |   | 8               | 16              | 25              | 25              |     |
| CA_3A-19A-21A-42C | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-20A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-21A-28A-42A | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-21A-28A-42C | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-21A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-28A-40A     | 40 |   |   | 25              | 50              | 75              | 100             | TDD |
| CA_3A-28A-41A-42A | 3  |   |   |                 | 25              | 36              | 50              | FDD |
| CA_3A-28A-41A-42A | 28 |   |   |                 | 10              | 15              | 20              | FDD |
| CA_3A-31A         | 31 |   |   | 5               | 5               | 5               | 5               | FDD |
| CA_3A-32A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-32A-42A-43A | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-42A         | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-3A-42A      | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-42A-42A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_3A-42A-43A     | 3  |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_4A-5A-12A      | 12 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_4A-7A-12A      | 12 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_4A-7A-28A      | 28 |   |   | [8]             | [16]            | [25]            | [25]            | FDD |
| CA_4A-12A         | 12 | 2 | 5 | 8               | 16              | 20              | 20              | FDD |
| CA_4A-12A-30A     | 12 |   |   | 8               | 16              |                 |                 | FDD |
| CA_4A-17A         | 17 |   |   | 8               | 16              |                 |                 | FDD |
| CA_4A-28A         | 28 |   |   | [8]             | [16]            | [25]            | [25]            | FDD |
| CA_5A-12A-66A     | 12 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_5A-48A-66A     | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_5A-48A-66A-66A |    |   |   |                 |                 |                 |                 |     |
| CA_7A-8A          | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_7A-8A-20A      | 8  |   |   |                 | 16              | 25              | 25              | FDD |
| CA_7A-12A-66A     | 12 |   |   | 8               | 16              |                 |                 | FDD |
| CA_7A-12B-66A     | 12 |   |   | 8               | 16              |                 |                 | FDD |
| CA_7A-28A-40A     | 40 |   |   | 25              | 50              | 75              | 100             | TDD |
| CA_8A-42A         | 8  |   |   | 8               | 16              | 25              | 25              | FDD |

|   |    |   |   |                 |                 |                 |                 |     |
|---|----|---|---|-----------------|-----------------|-----------------|-----------------|-----|
| CA_8A_11A_42A<br>CA_8A_11A_42C  | 8  |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_11A-28A  | 28 |   |   | 12              | 25              |                 |                 | FDD |
| CA_12A-30A-66A  | 12 |   |   | 8               | 16              |                 |                 | FDD |
| CA_12A-66A  | 12 | 2 | 5 | 8               | 16              | 20              | 20              | FDD |
| CA_13A-48A-66A<br>CA_13A-48A-66A-66A<br>CA_13A-48A-66B<br>CA_13A-48A-66C<br>CA_13A-48A-48A-66A<br>CA_13A-48C-66A<br>CA_13A-48D-66A<br>CA_13A-48A-48C-66A<br>CA_13A-48E-66A  | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_20A-32A-42A  | 20 |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_20A-40A <sup>3</sup><br>CA_20A-40D <sup>3</sup><br>CA_20A-38A-40A-40A <sup>3</sup><br>CA_20A-38A-40C <sup>3</sup>  | 40 |   |   | 25              | 50              | 75              | 100             | TDD |
| CA_20A-40C <sup>3</sup>   | 40 |   |   | 25              | 50              | 75              |                 | TDD |
| CA_20A-40A-40A <sup>3</sup>   | 40 |   |   | 25              | 50              | 75              |                 | TDD |
| CA_20A-38A-40A <sup>3</sup>   | 40 |   |   | 25              | 50              | 75              |                 | TDD |
| CA_20A-38A-40D <sup>3</sup>   | 40 |   |   | 25              | 50              | 75              |                 | TDD |
| CA_20A-41A<br>CA_20A-41C<br>CA_20A-41D  | 20 |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_20A-42A,<br>CA_20A-42A-42A   | 20 |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_28A-32A  | 28 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_28A-40A  | 40 |   |   | 25              | 50              | 75              | 100             | TDD |
| CA_28A-41A-42A  | 28 |   |   |                 | 10              | 15              | 20              | FDD |
| CA_28A-42A  | 28 |   |   | 5               | 10              | 15              | 20              | FDD |
| CA_28A-66A  | 28 |   |   | 8               | 16              | 25              | 25              | FDD |
| CA_48A-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48A-48A-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48A-48A-66A-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48A-48A-66B  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48A-48A-66C  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48C-66A-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48C-66B  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48C-66C  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48A-66A-66A  | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_48A-66B  | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_48A-66C  | 66 |   |   | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_48C-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_48E-66A  | 66 |   |   | 12              | 25              | 36              | 50              | FDD |
| CA_66A-70A-71A  | 71 |   |   | 8               | 16              | 20              |                 | FDD |
| CA_66A-66A-70A-71A  | 71 |   |   | 8               | 16              | 20              |                 | FDD |
| CA_66A-70C-71A  | 71 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_66A-66A-70C-71A  | 71 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_66C-70A-71A  | 71 |   |   | 8               | 16              | 20              |                 | FDD |
| CA_66C-70C-71A  | 71 |   |   | 8               | 16              | 20              | 20              | FDD |
| CA_70A-71A  | 71 |   |   | 8               | 16              | 20              |                 | FDD |
| CA_70C-71A  | 71 |   |   | 8               | 16              | 20              | 20              | FDD |
| NOTE 1: refers to the UL resource blocks, which shall be centred within the transmission bandwidth configuration for the channel bandwidth.   |    |   |   |                 |                 |                 |                 |     |
| NOTE 2: the UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.1-2 for the uplink bandwidth in which case the allocation according to Table 7.3.1-2 applies. |    |   |   |                 |                 |                 |                 |     |

NOTE 3: <sup>3</sup> refers to the UL resource blocks shall be located between 2373-2400MHz.  
 NOTE 4: These configurations apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.  
 NOTE 5: These configurations apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a high band.

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bA, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by the uplink being active within a specified frequency range as noted in Table 7.3.1A-0bA. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0bA and Table 7.3.1A-0bB.

**Table 7.3.1A-0bA: Reference sensitivity for carrier aggregation QPSK  $P_{REFSENS, CA}$  (exceptions for two bands due to close proximity of UL to DL channel)**

| EUTRA CA Configuration      | EUTRA band     | Channel bandwidth |             |             |              |              |              | Duplex mode |
|-----------------------------|----------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                             |                | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| CA_1A-3A <sup>4</sup>       | 3 <sup>9</sup> |                   | [-95.7]     | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-3A <sup>5</sup>       | 3              |                   | -98.7       | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-1A-3A <sup>4</sup>    | 3 <sup>9</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-1A-3A <sup>5</sup>    | 3              |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-1A-3A-3A <sup>4</sup> | 3 <sup>9</sup> |                   | [-95.7]     | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-1A-3A-3A <sup>5</sup> | 3              |                   | -98.7       | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-3A-3A <sup>4</sup>    | 3 <sup>9</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-3A-3A <sup>5</sup>    | 3              |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-3C <sup>4</sup>       | 3 <sup>9</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-3C <sup>5</sup>       | 3              |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-1A-3C <sup>4</sup>    | 3 <sup>9</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-1A-3C <sup>5</sup>    | 3              |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1C-3A <sup>4</sup>       | 3 <sup>9</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1C-3A <sup>5</sup>       | 3              |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_18A-28A <sup>6</sup>     | 28             |                   |             | -94         | -92.5        |              |              | FDD         |
| CA_19A-28A <sup>7</sup>     | 28             |                   |             | -94         | -92          |              |              | FDD         |

NOTE 1: The transmitter shall be set to  $P_{UMAX}$  as defined in subclause 6.2.5A.  
 NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1  
 NOTE 3: The signal power is specified per port  
 NOTE 4: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.  
 NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq$  60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.  
 NOTE 6: These requirements apply when the uplink is active in Band 18 and the downlink channels in Band 28 are confined within the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 18.  
 NOTE 7: These requirements apply when the uplink is active in Band 19 and the downlink channels in Band 28 are allocated at the middle of the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 19.  
 NOTE 8: Void  
 NOTE 9: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.

**Table 7.3.1A-0bB: Uplink configuration for the uplink band (exceptions for two bands due to close proximity of UL to DL channel)**

| E-UTRA Band / Channel bandwidth of the affected DL band / N <sub>RB</sub> / Duplex mode |         |         |       |       |        |        |        |             |
|---|---------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration  | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A <sup>1,2</sup>   | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A <sup>1,3</sup>   | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3A <sub>1,2</sub>  | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3A <sub>1,3</sub>  | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3A-3A <sup>1,2</sup>   | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3A-3A <sup>1,3</sup>   | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3C <sup>1,2</sup>   | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C <sup>1,3</sup>   | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3C <sup>1,2</sup>  | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3C <sup>1,3</sup>  | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1C-3A <sup>1,2</sup>   | 1       |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1C-3A <sup>1,3</sup>   | 1       |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_18A-28A <sup>4</sup>   | 18      |         |       | 18    | 18     |        |        | FDD         |
| CA_19A-28A <sup>4</sup>   | 19      |         |       | 18    | 18     |        |        | FDD         |

NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1.

NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz

NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.

NOTE 4: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 28 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bC, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by the uplink being active within a specified frequency range as noted in Table 7.3.1A-0bC. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0bC and Table 7.3.1A-0bD.

**Table 7.3.1A-0bC: Reference sensitivity for carrier aggregation QPSK P<sub>REFSENS, CA</sub> (exceptions for three bands due to close proximity of UL to DL channel)**

| EUTRA CA Configuration      | EUTRA band        | Channel bandwidth |             |             |              |              |              | Duplex mode |
|-----------------------------|-------------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                             |                   | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| CA_1A-3A-5A <sup>4</sup>    | 3 <sup>12</sup>   |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-3A-5A <sup>5</sup>    | 3                 |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-1A-3A-5A <sup>4</sup> | 3 <sup>12</sup>   |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-1A-3A-5A <sup>5</sup> | 3                 |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-1A-3C-5A <sup>4</sup> | 3 <sup>12</sup>   |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-1A-3C-5A <sup>5</sup> | 3                 |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-3A-3A-5A <sup>4</sup> | 3 <sup>9</sup>    |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1A-3A-3A-5A <sup>5</sup> | 3                 |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1C-3A-5A <sup>4</sup>    | 3 <sup>12</sup>   |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
| CA_1C-3A-5A <sup>5</sup>    | 3                 |                   |             | -97         | -94          | -92.2        | -91          | FDD         |
| CA_1A-3A-3A-7A-7A           | 3 <sup>4,12</sup> |                   |             | -94         | -91.5        | -90          | -89          | FDD         |
|                             | 3 <sup>5</sup>    |                   |             | -97         | -94          | -92.2        | -91          |             |

|                              |                   |  |  |         |       |       |       |     |
|------------------------------|-------------------|--|--|---------|-------|-------|-------|-----|
| CA_1A-3C-5A <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3C-5A <sup>5</sup>     | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-7A <sup>9</sup>     | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-7A <sup>10</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-1A-3A-7A <sup>9</sup>  | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-1A-3A-7A <sup>10</sup> | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-7A               | 3 <sup>9,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                              | 3 <sup>10</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-7A-7A               | 3 <sup>9,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                              | 3 <sup>10</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-7C <sup>9</sup>     | 3 <sup>12</sup>   |  |  |         | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-7C <sup>9</sup>  | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-7C <sup>10</sup>    | 3                 |  |  |         | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-7C <sup>10</sup> | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3C-7A <sup>9</sup>     | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3C-7A <sup>10</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-1A-3C-7A <sup>9</sup>  | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-1A-3C-7A <sup>10</sup> | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3C-7C                  | 3 <sup>9,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                              | 3 <sup>10</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-8A <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-8A <sup>5</sup>     | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-8A <sup>4</sup>  | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-8A <sup>5</sup>  | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3C-8A <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3C-8A <sup>5</sup>     | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-11A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-11A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-19A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-19A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-19A <sup>4</sup> | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-19A <sup>5</sup> | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-20A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-20A <sup>4</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3A-20A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-20A <sup>5</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3C-20A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3C-20A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-21A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-21A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-3A-21A <sup>4</sup> | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-21A <sup>5</sup> | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-26A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-26A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-28A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-1A-3A-28A <sup>4</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3A-3A-28A <sup>4</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3A-28A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-1A-3A-28A <sup>5</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3A-3A-28A <sup>5</sup> |                   |  |  |         |       |       |       |     |
| CA_1A-3C-28A <sup>4</sup>    | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3C-28A <sup>5</sup>    | 3                 |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-40A                 | 3 <sup>4,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                              | 3 <sup>5</sup>    |  |  | -97     | -94   | -92.2 | -91   |     |
|                              | 40                |  |  | [-93.4] | -91.3 | -90   | -88.9 | TDD |

|                               |                   |  |  |         |       |       |       |     |
|-------------------------------|-------------------|--|--|---------|-------|-------|-------|-----|
| CA_1A-3A-40C                  | 3 <sup>4,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>    |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40                |  |  | [-93.4] | -91.3 | -90   | -88.9 | TDD |
| CA_1A-3C-40A                  | 3 <sup>4,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>    |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40                |  |  | [-93.4] | -91.3 | -90   | -88.9 | TDD |
| CA_1A-3C-40C                  | 3 <sup>4,12</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>    |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40                |  |  | [-93.4] | -91.3 | -90   | -88.9 | TDD |
| CA_1A-3A-42A <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42A <sup>5</sup>     | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-3A-42A <sup>4</sup>  | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-3A-42A <sup>5</sup>  | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-42A-42A <sup>4</sup> | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42A-42A <sup>5</sup> | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-42A-42C <sup>4</sup> | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42A-42C <sup>5</sup> | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-42C <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42C <sup>5</sup>     | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-3A-42C <sup>4</sup>  | 3 <sup>12</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
| CA_1A-3A-3A-42C <sup>5</sup>  | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-42C-42C <sup>4</sup> | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42C-42C <sup>5</sup> | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-42D <sup>4</sup>     | 3 <sup>12</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-42D <sup>5</sup>     | 3                 |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-18A-28A <sup>6</sup>    | 28                |  |  | -94     | -92.5 |       |       | FDD |
| CA_1A-19A-28A <sup>8</sup>    | 28                |  |  | -94     | -92   |       |       | FDD |

NOTE 1: The transmitter shall be set to  $P_{UMAX}$  as defined in subclause 6.2.5A.

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

NOTE 3: The signal power is specified per port

NOTE 4: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in the Bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.

NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq$  60 MHz. For each channel bandwidth in the Bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.

NOTE 6: These requirements apply when the uplink is active in Band 18 and the downlink channels in Band 28 are confined within the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 18.

NOTE 7: Void

NOTE 8: These requirements apply when the uplink is active in Band 19 and the downlink channels in Band 28 are allocated at the middle of the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 19.

NOTE 9: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3 and Band 7, the requirement applies regardless of channel bandwidth in Band 1.

NOTE 10: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq$  60 MHz. For each channel bandwidth in Band 3 and Band 7, the requirement applies regardless of channel bandwidth in Band 1.

NOTE 11: Void

NOTE 12: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.

Table 7.3.1A-0bD: Uplink configuration for the uplink band (exceptions for three bands due to close proximity of UL to DL channel)

| E-UTRA Band / Channel bandwidth of the affected DL band / N <sub>RB</sub> / Duplex mode |                  |         |       |       |        |        |        |             |
|---|------------------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration  | UL band          | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A-5A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-5A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3A-5A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3A-5A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1C-3A-5A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1C-3A-5A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-7A-7A   | 1 <sup>1,2</sup> |         |       | 25    | 25     | 25     | 25     | FDD         |
|   | 1 <sup>1,3</sup> |         |       | 25    | 45     | 45     | 45     |             |
| CA_1A-3C-5A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C-5A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-7A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-7A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3A-7A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3A-7A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-1A-3C-7A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-1A-3C-7A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-7A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-3A-7C <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-3A-7A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-7C <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-7A-7A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-7A-7A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3C-7A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C-7A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-7C <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-7C <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3C-7C <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C-7C <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-8A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-8A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-8A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-3A-8A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3C-8A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C-8A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-11A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-11A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-19A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-19A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-19A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-3A-19A <sup>1,3</sup>  | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-20A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-3A-20A <sup>1,2</sup>  |                  |         |       |       |        |        |        |             |
| CA_1A-3A-20A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-20A <sup>1,3</sup>  |                  |         |       |       |        |        |        |             |
| CA_1A-3C-20A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3C-20A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-21A <sup>1,2</sup>   | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-21A <sup>1,3</sup>   | 1                |         |       | 25    | 45     | 45     | 45     | FDD         |
| CA_1A-3A-3A-21A <sup>1,2</sup>  | 1                |         |       | 25    | 25     | 25     | 25     | FDD         |



|  |                  |  |  |    |    |    |    |     |
|--|------------------|--|--|----|----|----|----|-----|
| CA_1A-3A-3A-21A <sup>1,3</sup>   | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-26A <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-26A <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-28A <sup>1,2</sup>  |                  |  |  |    |    |    |    |     |
| CA_1A-1A-3A-28A <sup>1,2</sup>   | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-3A-28A <sup>1,2</sup>   |                  |  |  |    |    |    |    |     |
| CA_1A-3A-28A <sup>1,3</sup>  |                  |  |  |    |    |    |    |     |
| CA_1A-1A-3A-28A <sup>1,3</sup>   | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-3A-28A <sup>1,3</sup>   |                  |  |  |    |    |    |    |     |
| CA_1A-3C-28A <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3C-28A <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-40A   | 1 <sup>1,2</sup> |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-40C   |                  |  |  |    |    |    |    |     |
| CA_1A-3C-40A   | 1 <sup>1,3</sup> |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3C-40C   |                  |  |  |    |    |    |    |     |
| CA_1A-3A-42A <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-42A <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-3A-42A <sup>1,2</sup>   | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-3A-42A <sup>1,3</sup>   | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-42A-42A <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-42A-42A <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-42A-42C <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-42A-42C <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-42C-42C <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-42C-42C <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-42D <sup>1,2</sup>  | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-42D <sup>1,3</sup>  | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-3A-42C <sup>1,2</sup>   | 1                |  |  | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-3A-42C <sup>1,3</sup>   | 1                |  |  | 25 | 45 | 45 | 45 | FDD |
| CA_1A-18A-28A <sup>4</sup>   | 18               |  |  | 18 | 18 |    |    | FDD |
| CA_1A-19A-28A <sup>4</sup>   | 19               |  |  | 18 | 18 |    |    | FDD |
| NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1. |                  |  |  |    |    |    |    |     |
| NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz  |                  |  |  |    |    |    |    |     |
| NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.   |                  |  |  |    |    |    |    |     |
| NOTE 4: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 28 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).                                |                  |  |  |    |    |    |    |     |

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bD1, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by the uplink being active within a specified frequency range as noted in Table 7.3.1A-0bD1. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0bD1 and Table 7.3.1A-0bD2.

**Table 7.3.1A-0bD1: Reference sensitivity for carrier aggregation QPSK P<sub>REFSENS, CA</sub> (exceptions for four bands due to close proximity of UL to DL channel)**

| EUTRA CA Configuration | EUTRA band | Channel bandwidth |             |             |              |              |              | Duplex mode |
|------------------------|------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                        |            | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
|                        |            |                   |             |             |              |              |              |             |

|                                |                  |  |  |       |         |       |        |     |
|--------------------------------|------------------|--|--|-------|---------|-------|--------|-----|
| CA_1A-3A-5A-7A                 | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
| CA_1A-3A-3A-5A-7A              | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-5A-7A-7A              |                  |  |  |       |         |       |        |     |
| CA_1A-3A-5A-28A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-5A-40A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
|                                | 40               |  |  |       | -91.9   | -90.4 | -89.4  | TDD |
| CA_1A-3A-5A-41A <sup>7,8</sup> | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
|                                | 41               |  |  |       |         |       | [88.1] | TDD |
| CA_1A-3C-7A-8A                 | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
| CA_1A-3A-3A-7A-8A              | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-7A-7A-8A              |                  |  |  |       |         |       |        |     |
| CA_1A-3A-3A-7A-8A              |                  |  |  |       |         |       |        |     |
| CA_1A-3C-7A-20A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-7A-7A-26A             | 3 <sup>4.9</sup> |  |  |       | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-7A-8A                 | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-7A-20A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-3A-7A-20A             | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
| CA_1A-3A-7A-7A-20A             | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    | FDD |
| CA_1A-3A-7A-26A                | 3 <sup>4.9</sup> |  |  |       | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-7A-28A                | 3 <sup>4.9</sup> |  |  |       | [-91.5] | [-90] | [-89]  | FDD |
|                                | 3 <sup>5</sup>   |  |  |       | -94     | -92.2 | -91    |     |
| CA_1A-3A-7C-28A                | 3 <sup>4.9</sup> |  |  |       | [-91.5] | [-90] | [-89]  | FDD |
| CA_1A-1A-3A-7A-28A             | 3 <sup>5</sup>   |  |  |       |         |       |        |     |
| CA_1A-1A-3A-7C-28A             |                  |  |  |       |         |       |        |     |
| CA_1A-1A-3C-7A-28A             |                  |  |  |       |         |       |        |     |
| CA_1A-1A-3C-7C-28A             |                  |  |  |       | -94     | -92.2 | -91    |     |
| CA_1A-3A-3A-7C-28A             |                  |  |  |       |         |       |        |     |
| CA_1A-1A-3A-3A-7A-28A          |                  |  |  |       |         |       |        |     |
| CA_1A-1A-3A-3A-7C-28A          |                  |  |  |       |         |       |        |     |
|                                |                  |  |  |       |         |       |        |     |
| CA_1A-3A-7A-38A                | 3 <sup>e.9</sup> |  |  | -93.8 | -91.3   | -89.8 | -88.8  | FDD |
| CA_1A-3C-7A-38A                | 3 <sup>5</sup>   |  |  | -96.8 | -93.8   | -92   | -90.8  |     |
| CA_1A-3A-7A-42A                | 3 <sup>4.9</sup> |  |  | -93.8 | -91.3   | -89.8 | -88.8  | FDD |
|                                | 3 <sup>5</sup>   |  |  | -96.8 | -93.8   | -92   | -90.8  |     |
| CA_1A-3A-8A-11A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-8A-28A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |
|                                | 3 <sup>5</sup>   |  |  | -97   | -94     | -92.2 | -91    |     |
| CA_1A-3A-8A-38A                | 3 <sup>4.9</sup> |  |  | -94   | -91.5   | -90   | -89    | FDD |

|                               |                  |  |  |         |       |       |       |     |
|-------------------------------|------------------|--|--|---------|-------|-------|-------|-----|
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-11A-28A              | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-8A-40A               | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40               |  |  | [-93.4] | -91.9 | -90.4 | -89.4 | TDD |
| CA_1A-3A-8A-42A               | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-8A-42C               | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-18A-42A              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-18A-42C              | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-19A-21A <sup>4</sup> | 3 <sup>9</sup>   |  |  | -93.7   | -91.2 | -89.7 | -88.7 | FDD |
| CA_1A-3A-19A-21A <sup>5</sup> | 3                |  |  | -96.7   | -93.7 | -91.9 | -90.7 | FDD |
| CA_1A-3A-19A-21A <sup>4</sup> | 3 <sup>9</sup>   |  |  | -93.7   | -91.2 | -89.7 | -88.7 | FDD |
| CA_1A-3A-19A-21A <sup>5</sup> | 3                |  |  | -96.7   | -93.7 | -91.9 | -90.7 | FDD |
| CA_1A-3A-7A-40C <sup>4</sup>  | 3 <sup>9</sup>   |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 40               |  |  | -92.6   | -90.5 | -89.2 | -88.1 | TDD |
| CA_1A-3A-7A-40C <sup>5</sup>  | 3                |  |  | -97     | -94   | -92.2 | -91   | FDD |
|                               | 40               |  |  | -92.6   | -90.5 | -89.2 | -88.1 | TDD |
| CA_1A-3A-19A-42A              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
|                               | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-19A-42C              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
|                               | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-20A-28A              | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
| CA_1A-3A-3A-20A-28A           | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   | FDD |
| CA_1A-3A-20A-42A              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
|                               | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-20A-43A              | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   |       | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 |       |     |
| CA_1A-3A-21A-28A <sup>4</sup> | 3 <sup>9</sup>   |  |  | -93.7   | -91.2 | -89.7 | -88.7 | FDD |
| CA_1A-3A-21A-28A <sup>5</sup> | 3                |  |  | -96.7   | -93.7 | -91.9 | -90.7 | FDD |
| CA_1A-3A-21A-42A <sup>4</sup> | 3 <sup>9</sup>   |  |  | -93.7   | -91.2 | -89.7 | -88.7 | FDD |
| CA_1A-3A-21A-42A <sup>5</sup> | 3                |  |  | -96.7   | -93.7 | -91.9 | -90.7 | FDD |
| CA_1A-3A-21A-42C              | 3 <sup>4,9</sup> |  |  | -93.7   | -91.2 | -89.7 | -88.7 | FDD |
|                               | 3 <sup>5</sup>   |  |  | -96.7   | -93.7 | -91.9 | -90.7 |     |
| CA_1A-3A-28A-40A              | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40               |  |  | [-93.4] | -91.9 | -90.4 | -89.4 | TDD |
| CA_1A-3A-28A-40C              | 3 <sup>4,9</sup> |  |  | -94     | -91.5 | -90   | -89   | FDD |
|                               | 3 <sup>5</sup>   |  |  | -97     | -94   | -92.2 | -91   |     |
|                               | 40               |  |  | -92.6   | -90.5 | -89.2 | -88.1 | TDD |
| CA_1A-3A-28A-42A <sup>4</sup> | 3 <sup>9</sup>   |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
| CA_1A-3A-28A-42A <sup>5</sup> | 3                |  |  | -96.8   | -93.8 | -92   | -90.8 | FDD |
| CA_1A-3A-28A-42C              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 | -88.8 | FDD |
|                               | 3 <sup>5</sup>   |  |  | -96.8   | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-32A-42A              | 3 <sup>4,9</sup> |  |  | -93.8   | -91.3 | -89.8 |       | FDD |

|   |                  |  |  |       |       |       |       |     |
|---|------------------|--|--|-------|-------|-------|-------|-----|
|   | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   |       |     |
| CA_1A-3A-32A-43A  | 3 <sup>4,9</sup> |  |  | -94   | -91.5 | -90   |       | FDD |
|   | 3 <sup>5</sup>   |  |  | -97   | -94   | -92.2 |       |     |
| CA_1A-3A-41A-42A<br>CA_1A-3A-41C-42A<br>CA_1A-3A-41A-42C<br>CA_1A-3A-41C-42C  | 3 <sup>4,9</sup> |  |  | -93.8 | -91.3 | -89.8 | -88.8 | FDD |
|   | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-42A-43A  | 3 <sup>4,9</sup> |  |  | -93.8 | -91.3 | -89.8 |       | FDD |
|   | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   |       |     |
| <p>NOTE 1: The transmitter shall be set to P<sub>UMAX</sub> as defined in subclause 6.2.5A.</p> <p>NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1</p> <p>NOTE 3: The signal power is specified per port</p> <p>NOTE 4: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is &lt; 60 MHz. For each channel bandwidth in the bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.</p> <p>NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz. For each channel bandwidth in the bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.</p> <p>NOTE 6: Void</p> <p>NOTE 7: The Band 41 requirements are modified by -0.5dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2545-2690MHz.</p> <p>NOTE 8: The Band 41 requirements also apply to the supported CA_1A-41A.</p> <p>NOTE 9: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.</p> |                  |  |  |       |       |       |       |     |

**Table 7.3.1A-0bD2: Uplink configuration for the low band (exceptions for four bands due to close proximity of UL to DL channel)**

| E-UTRA Band / Channel bandwidth of the affected DL band / N <sub>RB</sub> / Duplex mode  |                  |         |       |       |        |        |        |             |
|--|------------------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration   | UL band          | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A-5A-7A<br>CA_1A-3A-3A-5A-7A<br>CA_1A-3A-5A-7A-7A<br>CA_1A-3A-5A-28A<br>CA_1A-3A-5A-40A<br>CA_1A-3A-5A-41A<br>CA_1A-3A-7A-7A-26A<br>CA_1A-3A-7A-8A<br>CA_1A-3C-7A-8A<br>CA_1A-3A-3A-7A-8A           | 1 <sup>1,2</sup> |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-7A-7A-8A<br>CA_1A-3A-3A-7A-7A-8A<br>CA_1A-3A-7A-20A<br>CA_1A-3C-7A-20A<br>CA_1A-3A-3A-7A-20A<br>CA_1A-3A-7A-7A-20A<br>CA_1A-3A-7A-26A<br>CA_1A-3A-7A-28A<br>CA_1A-3A-7C-28A<br>CA_1A-1A-3A-7A-28A | 1 <sup>1,3</sup> |         |       | 25    | 45     | 45     | 45     |             |

|   |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|
| CA_1A-1A-3A-7C-28A  |  |  |  |  |  |  |  |  |
| CA_1A-1A-3C-7A-28A  |  |  |  |  |  |  |  |  |
| CA_1A-1A-3C-7C-28A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-3A-7C-28A  |  |  |  |  |  |  |  |  |
| CA_1A-1A-3A-3A-7A-28A   |  |  |  |  |  |  |  |  |
| CA_1A-1A-3A-3A-7C-28A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-7A-38A   |  |  |  |  |  |  |  |  |
| CA_1A-3C-7A-38A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-7A-40C   |  |  |  |  |  |  |  |  |
| CA_1A-3A-7A-42A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-11A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-28A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-38A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-11A-28A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-40A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-42A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-8A-42C   |  |  |  |  |  |  |  |  |
| CA_1A-3A-18A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-18A-42C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-19A-21A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-3A-19A-21A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-19A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-19A-42C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-20A-28A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-3A-20A-28A   |  |  |  |  |  |  |  |  |
| CA_1A-3A-20A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-20A-43A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-21A-28A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-21A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-21A-42C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-28A-40A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-28A-40C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-28A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-32A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-32A-43A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-41A-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-41C-42A  |  |  |  |  |  |  |  |  |
| CA_1A-3A-41A-42C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-41C-42C  |  |  |  |  |  |  |  |  |
| CA_1A-3A-42A-43A  |  |  |  |  |  |  |  |  |
| <p>NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1.</p> <p>NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is &lt; 60 MHz</p> <p>NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.</p> |  |  |  |  |  |  |  |  |

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bD3, exceptions are allowed when the uplink is active within a specified frequency range as noted in Table 7.3.1A-0bD3. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0bD3 and Table 7.3.1A-0bD4.

**Table 7.3.1A-0bD3: Reference sensitivity for carrier aggregation QPSK  $P_{REFSENS, CA}$  (exceptions for five bands due to close proximity of UL to DL channel)**

| Channel bandwidth      |            |               |             |             |              |              |              |             |
|------------------------|------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
| EUTRA CA Configuration | EUTRA band | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex mode |

|                      |                  |  |  |       |       |       |       |     |
|----------------------|------------------|--|--|-------|-------|-------|-------|-----|
| CA_1A-3A-5A-7A-28A   | 3 <sup>4,9</sup> |  |  | -94   | -91.5 | -90   | -89   | FDD |
|                      | 3 <sup>5</sup>   |  |  | -97   | -94   | -92.2 | -91   |     |
| CA_1A-3A-7A-8A-20A   | 3 <sup>4,7</sup> |  |  | -94   | -91.5 | -90   | -89   | FDD |
|                      | 3 <sup>5</sup>   |  |  | -97   | -94   | -92.2 | -91   |     |
| CA_1A-3A-7A-20A-28A  | 3 <sup>4,7</sup> |  |  | -94   | -91.5 | -90   | -89   | FDD |
|                      | 3 <sup>5</sup>   |  |  | -97   | -94   | -92.2 | -91   |     |
| CA_1A-3A-7A-20A-42A  | 3 <sup>4,7</sup> |  |  | -93.8 | -91.3 | -89.8 | -88.8 | FDD |
|                      | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   | -90.8 |     |
| CA_1A-3A-20A-32A-42A | 3 <sup>4,7</sup> |  |  | -93.8 | -91.3 | -89.8 |       | FDD |
|                      | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   |       |     |
| CA_1A-3A-20A-32A-43A | 3 <sup>4,7</sup> |  |  | -94   | -91.5 | -90   |       | FDD |
|                      | 3 <sup>5</sup>   |  |  | -97   | -94   | -92.2 |       |     |
| CA_1A-3A-32A-42A-43A | 3 <sup>4,7</sup> |  |  | -93.8 | -91.3 | -89.8 |       | FDD |
|                      | 3 <sup>5</sup>   |  |  | -96.8 | -93.8 | -92   |       |     |

NOTE 1: The transmitter shall be set to P<sub>UMAX</sub> as defined in subclause 6.2.5A.  
 NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1  
 NOTE 3: The signal power is specified per port  
 NOTE 4: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in the bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.  
 NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz. For each channel bandwidth in the bands other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.  
 NOTE 6: Void  
 NOTE 7: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.

**Table 7.3.1A-0bD4: Uplink configuration for the low band (exceptions for five bands due to close proximity of UL to DL channel)**

| E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |                  |         |       |       |        |        |        |             |
|---|------------------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration  | UL band          | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A-5A-7A-28A  | 1 <sup>1,2</sup> |         |       | 25    | 25     | 25     | 25     | FDD         |
| CA_1A-3A-7A-8A-20A  |                  |         |       |       |        |        |        |             |
| CA_1A-3A-7A-20A-28A   |                  |         |       |       |        |        |        |             |
| CA_1A-3A-7A-20A-42A   | 1 <sup>1,3</sup> |         |       | 25    | 45     | 45     | 45     |             |
| CA_1A-3A-20A-32A-42A  |                  |         |       |       |        |        |        |             |
| CA_1A-3A-20A-32A-43A  |                  |         |       |       |        |        |        |             |
| CA_1A-3A-32A-42A-43A  |                  |         |       |       |        |        |        |             |
| CA_1A-3A-32A-42A-43A  |                  |         |       |       |        |        |        |             |

NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1.  
 NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz.  
 NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bE, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by uplink being active

in the applicable active UL bands of the same CA configuration in Table 7.3.1A-0bE. For these exceptions, the UE shall meet the reference sensitivities specified in Table 7.3.1A-0bE and Table 7.3.1A-0bF.

**Table 7.3.1A-0bE: Reference sensitivity for carrier aggregation QPSK  $P_{REFSENS, CA}$  (exceptions due to cross band isolation issues of TDD and FDD bands)**

| EUTRA CA Configuration                                   | EUTRA band       | Channel bandwidth |             |             |              |              |              | Duple x mode | Applicable active UL band |
|--|------------------|-------------------|-------------|-------------|--------------|--------------|--------------|--------------|---------------------------|
|  |                  | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |              |                           |
| CA_1A-3A-5A-40A  | 40 <sup>19</sup> |                   |             |             | -92.9        | -91.3        | -90.2        | TDD          | 3                         |
| CA_1A-3A-5A-40A  | 1 <sup>19</sup>  |                   |             | -91.7       | [-89.5]      | [-87.9]      | [-86.9]      | FDD          | 40                        |
|  | 3 <sup>19</sup>  |                   |             | -94.2       | -91.2        | -89.5        | -88.3        |              |                           |
| CA_1A-3A-5A-41A <sup>5</sup>                             | 41               |                   |             |             |              |              | [-88.1]      | TDD          | 3                         |
| CA_1A-3A-7A-20A-42A                                      | 42 <sup>19</sup> |                   |             | -95.6       | -93          | -91.5        | -90.4        | TDD          | 7                         |
| CA_1A-3A-7A-20A-42A                                      | 7 <sup>19</sup>  |                   |             |             | -93          | -91.3        | -90.1        | FDD          | 42                        |
| CA_1A-3A-7A-38A<br>CA_1A-3C-7A-38A                       | 7 <sup>19</sup>  |                   |             | -93.3       | -90.7        | -89.2        | -88.1        | FDD          | 1                         |
|  | 38 <sup>19</sup> |                   |             | -93.3       | -90.7        | -89.2        | -88.1        | TDD          |                           |
| CA_1A-3A-7A-38A<br>CA_1A-3C-7A-38A                       | 7 <sup>19</sup>  |                   |             | -93.3       | -90.7        | -89.2        | -88.1        | FDD          | 3                         |
|  | 38 <sup>19</sup> |                   |             | -93.3       | -90.7        | -89.2        | -88.1        | TDD          |                           |
| CA_1A-3A-7A-40A <sup>15</sup>                            | 3 <sup>19</sup>  |                   |             | -94         | -91.5        | -90          | -89          | FDD          | 1                         |
|  | 40 <sup>19</sup> |                   |             | -92.6       | -90.5        | -89.2        | -88.1        | TDD          |                           |
| CA_1A-3A-7A-40A <sup>16</sup>                            | 3                |                   |             | -97         | -94          | -92.2        | -91          | FDD          | 1                         |
|  | 40 <sup>19</sup> |                   |             | -92.6       | -90.5        | -89.2        | -88.1        | TDD          |                           |
| CA_1A-3A-7A-40A  | 40 <sup>19</sup> |                   |             | -94.6       | -92.1        | -90.5        | -89.4        | TDD          | 3                         |
| CA_1A-3A-7A-40A  | 40 <sup>19</sup> |                   |             | -96         | -93.3        | -91.7        | -90.6        | TDD          | 7                         |
| CA_1A-3A-7A-40A  | 1 <sup>19</sup>  |                   |             | -91.7       | -89.5        | -87.9        | -86.9        | FDD          | 40                        |
|  | 3 <sup>19</sup>  |                   |             | -94.2       | -91.2        | -89.5        | -88.3        |              |                           |
|  | 7 <sup>19</sup>  |                   |             |             | -94          | -92.4        | -91.2        |              |                           |
| CA_1A-3A-7A-40C  | 40               |                   |             | -94.6       | -92.1        | -90.5        | -89.4        | TDD          | 3                         |
| CA_1A-3A-7A-40C  | 40               |                   |             | -96         | -93.3        | -91.7        | -90.6        | TDD          | 7                         |
| CA_1A-3A-7A-40C  | 1                |                   |             | -91.7       | -89.5        | -87.9        | -86.9        | FDD          | 40                        |
|  | 3                |                   |             | -94.2       | -91.2        | -89.5        | -88.3        |              |                           |
|  | 7                |                   |             |             | -94          | -92.4        | -91.2        |              |                           |
| CA_1A-3A-7A-42A  | 42 <sup>19</sup> |                   |             | -95.6       | -93          | -91.5        | -90.4        | TDD          | 7                         |
|  | 7 <sup>19</sup>  |                   |             |             | -93          | -91.3        | -90.1        | FDD          | 42                        |
|  | 42               |                   |             | -98.5       | -95.5        | -93.7        | -92.5        | TDD          |                           |
| CA_1A-3A-8A-40A  | 40 <sup>19</sup> |                   |             | -95.4       | -92.9        | -91.3        | -90.2        | TDD          | 3                         |
| CA_1A-3A-8A-40A  | 1 <sup>19</sup>  |                   |             | -91.7       | [-89.5]      | [-87.9]      | [-86.9]      | FDD          | 40                        |
|  | 3 <sup>19</sup>  |                   |             | -94.2       | -91.2        | -89.5        | -88.3        |              |                           |
| CA_1A-3A-28A-40A<br>CA_1A-3A-28A-40C                     | 1 <sup>19</sup>  |                   |             | -91.7       | [-89.5]      | [-87.9]      | [-86.9]      | FDD          | 40                        |
|  | 3 <sup>19</sup>  |                   |             | -94.2       | -91.2        | -89.5        | -88.3        | FDD          |                           |
|  | 28               |                   |             | -96.8       | -94.1        | -92.5        | -89.8        | FDD          |                           |
| CA_1A-3A-28A-40A<br>CA_1A-3A-28A-40C                     | 40 <sup>19</sup> |                   |             | [-93.4]     | -91.9        | -90.4        | -89.4        | TDD          | 1                         |
| CA_1A-3A-28A-40A<br>CA_1A-3A-28A-40C                     | 40 <sup>19</sup> |                   |             | -94.6       | -92.1        | -90.5        | -89.4        | TDD          | 3                         |
| CA_1A-3A-28A-40A<br>CA_1A-3A-28A-40C                     | 40 <sup>19</sup> |                   |             | -95.1       | -92.9        | -91.4        | -90.5        | TDD          | 28                        |
| CA_1A-3A-38A <sup>12</sup><br>CA_1A-3C-38A <sup>12</sup> | 3 <sup>19</sup>  |                   |             | -94         | -91.5        | -90          | -89          | FDD          | 1                         |
|  | 38               |                   |             | -97.1       | -94.4        | -92.8        | -91.7        | TDD          |                           |
|  | 38               |                   |             | -97.1       | -94.4        | -92.8        | -91.7        | TDD          | 3                         |
|  | 1 <sup>19</sup>  |                   |             | -98.1       | -95.1        | -93.3        | -92.1        | FDD          | 38                        |
|  | 3 <sup>19</sup>  |                   |             | -95.1       | -92.1        | -90.3        | -89.1        |              |                           |
| CA_1A-3A-38A <sup>13</sup>                               | 3                |                   |             | -97         | -94          | -92.2        | -91          | FDD          | 1                         |

|                                   |                  |  |  |       |         |         |         |     |    |
|-----------------------------------|------------------|--|--|-------|---------|---------|---------|-----|----|
| CA_1A-3C-38A <sup>13</sup>        | 38               |  |  | -97.1 | -94.4   | -92.8   | -91.7   | TDD |    |
|                                   | 38               |  |  | -97.1 | -94.4   | -92.8   | -91.7   | TDD | 3  |
|                                   | 1 <sup>19</sup>  |  |  | -98.1 | -95.1   | -93.3   | -92.1   | FDD | 38 |
|                                   | 3 <sup>19</sup>  |  |  | -95.1 | -92.1   | -90.3   | -89.1   |     |    |
| CA_1A-3A-40A                      | 40 <sup>19</sup> |  |  | -100  | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_1A-3A-40A                      | 1 <sup>19</sup>  |  |  | -91.7 | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
|                                   | 3 <sup>19</sup>  |  |  | -94.2 | -91.2   | -89.5   | -88.3   |     |    |
| CA_1A-3A-40C                      | 40 <sup>19</sup> |  |  | -100  | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_1A-3A-40C                      | 1 <sup>19</sup>  |  |  | -91.7 | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
|                                   | 3 <sup>19</sup>  |  |  | -94.2 | -91.2   | -89.5   | -88.3   |     |    |
| CA_1A-3C-40A                      | 40 <sup>19</sup> |  |  | -100  | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_1A-3C-40A                      | 1 <sup>19</sup>  |  |  | -91.7 | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
|                                   | 3 <sup>19</sup>  |  |  | -94.2 | -91.2   | -89.5   | -88.3   |     |    |
| CA_1A-3A-41A <sup>12,14</sup>     | 3 <sup>19</sup>  |  |  | -94   | -91.5   | -90     | -89     | FDD | 1  |
| CA_1A-3A-41C <sup>12,14</sup>     | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41D <sup>12,14</sup>     | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41A <sup>13,14</sup>     | 3                |  |  | -97   | -94     | -92.2   | -91     | FDD | 1  |
| CA_1A-3A-41C <sup>13,14</sup>     | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41D <sup>13,14</sup>     | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41A-42A <sup>12,14</sup> | 3 <sup>19</sup>  |  |  | -94   | -91.5   | -90     | -89     | FDD | 1  |
|                                   | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
|                                   | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41A-42C <sup>12,14</sup> |                  |  |  |       |         |         |         |     | 3  |
| CA_1A-3A-41C-42A <sup>12,14</sup> |                  |  |  |       |         |         |         |     |    |
| CA_1A-3A-41C-42C <sup>12,14</sup> |                  |  |  |       |         |         |         |     |    |
| CA_1A-3A-41A-42A <sup>13,14</sup> | 3                |  |  | -97   | -94     | -92.2   | -91     | FDD | 1  |
| CA_1A-3A-41A-42C <sup>13,14</sup> | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41C-42A <sup>13,14</sup> | 41 <sup>19</sup> |  |  | -93.3 | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-3A-41C-42C <sup>13,14</sup> |                  |  |  |       |         |         |         |     |    |
| CA_1A-3C-40C                      | 40 <sup>19</sup> |  |  | -100  | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_1A-3C-40C                      | 1 <sup>19</sup>  |  |  | -91.7 | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
|                                   | 3 <sup>19</sup>  |  |  | -94.2 | -91.2   | -89.5   | -88.3   |     |    |
| CA_1A-5A-40A                      | 40 <sup>19</sup> |  |  |       | -91.9   | -90.4   | -89.4   | TDD | 1  |
| CA_1A-5A-40A                      | 1 <sup>19</sup>  |  |  | -91.7 | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
| CA_1A-7A-8A-40A                   | 40 <sup>19</sup> |  |  | -92.6 | -90.5   | -89.2   | -88.1   | TDD | 1  |
| CA_1A-7A-8A-40A                   | 40 <sup>19</sup> |  |  | -96   | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_1A-7A-8A-40A                   | 1 <sup>19</sup>  |  |  | -91.7 | -89.5   | -87.9   | -86.9   | FDD | 40 |
|                                   | 7 <sup>19</sup>  |  |  |       | -94     | -92.4   | -91.2   |     |    |
| CA_1A-7A-8A-40C                   | 40 <sup>19</sup> |  |  | -92.6 | -90.5   | -89.2   | -88.1   | TDD | 1  |
| CA_1A-7A-8A-40C                   | 40 <sup>19</sup> |  |  | -96   | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_1A-7A-8A-40C                   | 1 <sup>19</sup>  |  |  | -91.7 | -89.5   | -87.9   | -86.9   | FDD | 40 |
|                                   | 7 <sup>19</sup>  |  |  |       | -94     | -92.4   | -91.2   |     |    |
| CA_1A-7A-20A-42A                  | 42 <sup>19</sup> |  |  | -95.6 | -93     | -91.5   | -90.4   | TDD | 7  |
| CA_1A-7A-20A-42A                  | 7 <sup>19</sup>  |  |  | -96.2 | -93.2   | -91.5   | -90.3   | FDD | 42 |
| CA_1A-7A-28A-40A                  | 1 <sup>19</sup>  |  |  | -91.7 | -89.5   | -87.9   | -86.9   | FDD | 40 |
|                                   | 7 <sup>19</sup>  |  |  | -96.8 | -94     | -92.4   | -91.2   | FDD |    |
|                                   | 28               |  |  | -96.8 | -94.1   | -92.5   | -89.8   | FDD |    |
| CA_1A-7A-28A-40A                  | 40 <sup>19</sup> |  |  | -92.6 | -90.5   | -89.2   | -88.1   | TDD | 1  |
| CA_1A-7A-28A-40C                  | 40 <sup>19</sup> |  |  | -96   | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_1A-7A-28A-40A                  | 40 <sup>19</sup> |  |  | -95.1 | -92.9   | -91.4   | -90.5   | TDD | 28 |



|                                |                  |  |         |         |         |         |         |     |    |
|--------------------------------|------------------|--|---------|---------|---------|---------|---------|-----|----|
| CA_1A-7A-28A-40C               |                  |  |         |         |         |         |         |     |    |
| CA_1A-7A-38A                   | 7 <sup>19</sup>  |  |         | -93.3   | -90.7   | -89.2   | -88.1   | FDD | 1  |
|                                | 38               |  |         | -93.3   | -90.7   | -89.2   | -88.1   | TDD |    |
| CA_1A-7A-40A                   | 40 <sup>19</sup> |  |         | -92.6   | -90.5   | -89.2   | -88.1   | TDD | 1  |
| CA_1A-7A-40A                   | 40 <sup>19</sup> |  |         | -96     | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_1A-7A-40A                   | 1 <sup>19</sup>  |  |         | -91.7   | -89.5   | -87.9   | -86.9   | FDD | 40 |
|                                | 7 <sup>19</sup>  |  |         |         | -94     | -92.4   | -91.2   |     |    |
| CA_1A-7A-40C                   | 40 <sup>19</sup> |  |         | -92.6   | -90.5   | -89.2   | -88.1   | TDD | 1  |
| CA_1A-7A-40C                   | 40 <sup>19</sup> |  |         | -96     | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_1A-7A-40C                   | 1 <sup>19</sup>  |  |         | -91.7   | -89.5   | -87.9   | -86.9   | FDD | 40 |
|                                | 7 <sup>19</sup>  |  |         |         | -94     | -92.4   | -91.2   |     |    |
| CA_1A-7A-42A                   | 42 <sup>19</sup> |  |         | -95.6   | -93     | -91.5   | -90.4   | TDD | 7  |
|                                | 7 <sup>19</sup>  |  |         | -96.2   | -93.2   | -91.5   | -90.3   | FDD | 42 |
| CA_1A-8A-40A                   | 40 <sup>19</sup> |  |         | [-93.4] | -91.9   | -90.4   | -89.4   | TDD | 1  |
| CA_1A-8A-40A                   | 1 <sup>19</sup>  |  |         | -91.7   | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
| CA_1A-8A-40C                   | 40 <sup>19</sup> |  |         | [-93.4] | -91.9   | -90.4   | -89.4   | TDD | 1  |
| CA_1A-8A-40C                   | 1 <sup>19</sup>  |  |         | -91.7   | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
| CA_1A-28A-40A<br>CA_1A-28A-40C | 1 <sup>19</sup>  |  |         | -91.7   | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
|                                | 28               |  |         | -96.8   | -94.1   | -92.5   | -89.8   |     |    |
| CA_1A-28A-40A<br>CA_1A-28A-40C | 40 <sup>19</sup> |  |         | [-93.4] | -91.9   | -90.4   | -89.4   | TDD | 1  |
|                                | 40 <sup>19</sup> |  |         | -95.1   | -92.9   | -91.4   | -90.5   |     |    |
| CA_1A-40A                      | 40 <sup>19</sup> |  |         | [-93.4] | -91.9   | -90.4   | -89.4   | TDD | 1  |
| CA_1A-40A                      | 1 <sup>19</sup>  |  |         | -91.7   | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
| CA_1A-40C                      | 40 <sup>19</sup> |  |         | [-93.4] | -91.9   | -90.4   | -89.4   | TDD | 1  |
| CA_1A-40C                      | 1 <sup>19</sup>  |  |         | -91.7   | [-89.5] | [-87.9] | [-86.9] | FDD | 40 |
| CA_3A-5A-40A                   | 40 <sup>19</sup> |  |         |         | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3A-5A-40A                   | 3 <sup>19</sup>  |  | [-95.3] | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3A-5A-41A <sup>5</sup>      | 41               |  |         |         |         |         | [-88.1] | TDD | 3  |
| CA_3A-5A-41A <sup>5,18</sup>   | 3                |  |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                | 41               |  |         |         |         |         | -91.5   |     |    |
| CA_3A-7A-8A-38A                | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 3  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3A-7A-8A-38A                | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 8  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3C-7A-8A-38A                | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 3  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3C-7A-8A-38A                | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 3  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3A-7A-8A-40A                | 40 <sup>19</sup> |  |         | -94.6   | -92.1   | -90.5   | -89.4   | TDD | 3  |
| CA_3A-7A-8A-40A                | 40 <sup>19</sup> |  |         | -96     | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_3A-7A-8A-40C                | 40 <sup>19</sup> |  |         | -94.6   | -92.1   | -90.5   | -89.4   | TDD | 3  |
| CA_3A-7A-8A-40C                | 40 <sup>19</sup> |  |         | -96     | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_3A-7A-8A-40A                | 3 <sup>19</sup>  |  |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
|                                | 7 <sup>19</sup>  |  |         |         | -94     | -92.4   | -91.2   |     |    |
| CA_3A-7A-8A-40C                | 3 <sup>19</sup>  |  |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
|                                | 7 <sup>19</sup>  |  |         |         | -94     | -92.4   | -91.2   |     |    |
| CA_3A-7A-28A-38A               | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 3  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3A-7A-28A-38A               | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 28 |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |
| CA_3C-7A-28A-38A               | 7 <sup>19</sup>  |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | FDD | 3  |
|                                | 38               |  |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] |     |    |

|                                      |                  |  |  |         |                     |                     |                     |     |    |
|--------------------------------------|------------------|--|--|---------|---------------------|---------------------|---------------------|-----|----|
| CA_3C-7A-28A-38A                     | 7 <sup>19</sup>  |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | FDD | 3  |
|                                      | 38               |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | TDD |    |
| CA_3A-7A-28A-40A<br>CA_3A-7A-28A-40C | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
|                                      | 7 <sup>19</sup>  |  |  | -96.8   | -94                 | -92.4               | -91.2               | FDD |    |
|                                      | 28               |  |  | -96.8   | -94.1               | -92.5               | -89.8               | FDD |    |
| CA_3A-7A-28A-40A<br>CA_3A-7A-28A-40C | 40 <sup>19</sup> |  |  | -94.6   | -92.1               | -90.5               | -89.4               | TDD | 3  |
| CA_3A-7A-28A-40A<br>CA_3A-7A-28A-40C | 40 <sup>19</sup> |  |  | -96     | -93.3               | -91.7               | -90.6               | TDD | 7  |
| CA_3A-7A-28A-40A<br>CA_3A-7A-28A-40C | 40 <sup>19</sup> |  |  | -95.1   | -92.9               | -91.4               | -90.5               | TDD | 28 |
| CA_3A-7A-38A                         | 7 <sup>19</sup>  |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | FDD | 3  |
|                                      | 38               |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | TDD |    |
| CA_3C-7A-38A                         | 7 <sup>19</sup>  |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | FDD | 3  |
|                                      | 38               |  |  | [-93.8] | [-91.2]             | [-89.7]             | [-88.6]             | TDD |    |
| CA_3A-7A-40A                         | 40 <sup>19</sup> |  |  | -94.6   | -92.1               | -90.5               | -89.4               | TDD | 3  |
| CA_3A-7A-40A                         | 40 <sup>19</sup> |  |  | -96     | -93.3               | -91.7               | -90.6               | TDD | 7  |
| CA_3A-7A-40A                         | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
|                                      | 7 <sup>19</sup>  |  |  | -96.8   | -94                 | -92.4               | -91.2               |     |    |
| CA_3A-7A-40C                         | 40 <sup>19</sup> |  |  | -94.6   | -92.1               | -90.5               | -89.4               | TDD | 3  |
| CA_3A-7A-40C                         | 40 <sup>19</sup> |  |  | -96     | -93.3               | -91.7               | -90.6               | TDD | 7  |
| CA_3A-7A-40C                         | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
|                                      | 7 <sup>19</sup>  |  |  | -96.8   | -94                 | -92.4               | -91.2               |     |    |
| CA_3A-7A-42A                         | 42 <sup>19</sup> |  |  | -95.6   | -93                 | -91.5               | -90.4               | TDD | 7  |
|                                      | 3                |  |  | [-96.6] | [-93.6]             | [-91.8]             | [-90.6]             | FDD |    |
|                                      | 7 <sup>19</sup>  |  |  | -96.2   | -93.2               | -91.5               | -90.3               |     |    |
| CA_3A-8A-40A                         | 40 <sup>19</sup> |  |  | -95.4   | -92.9               | -91.3               | -90.2               | TDD | 3  |
| CA_3A-8A-40C                         | 40 <sup>19</sup> |  |  | -95.4   | -92.9               | -91.3               | -90.2               | TDD | 3  |
| CA_3A-8A-40C                         | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
| CA_3A-8A-40A                         | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
| CA_3A-20A-32A                        | 32               |  |  | -99.5   | -96.5               | -94.7               | -93.5               | FDD | 3  |
| CA_3A-28A-40A                        | 40 <sup>19</sup> |  |  | -95.4   | -92.9               | -91.3               | -90.2               | TDD | 3  |
| CA_3A-28A-40A                        | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
| CA_3A-28A-40A                        | 40 <sup>19</sup> |  |  | -95.1   | -92.9               | -91.4               | -90.5               | TDD | 28 |
| CA_3A-28A-40C                        | 40 <sup>19</sup> |  |  | -95.4   | -92.9               | -91.3               | -90.2               | TDD | 3  |
| CA_3A-28A-40C                        | 40 <sup>19</sup> |  |  | -95.1   | -92.9               | -91.4               | -90.5               | TDD | 28 |
| CA_3A-28A-40C                        | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
|                                      | 28               |  |  | -96.8   | -94.1               | -92.5               | -89.8               |     |    |
| CA_3A-28A-40D                        | 40 <sup>19</sup> |  |  |         | -92.9               | -91.3               | -90.2               | TDD | 3  |
| CA_3A-28A-40D                        | 40 <sup>19</sup> |  |  |         | -92.9               | -91.4               | -90.5               | TDD | 28 |
| CA_3A-28A-40D                        | 3 <sup>19</sup>  |  |  | -94.2   | -91.2               | -89.5               | -88.3               | FDD | 40 |
|                                      | 28               |  |  | -96.8   | -94.1               | -92.5               | -89.8               |     |    |
| CA_3A-28A-41A <sup>5</sup>           | 41 <sup>19</sup> |  |  | [-93.3] | [-90.7]             | [-89.2]             | [-88.1]             | TDD | 3  |
|                                      | 3 <sup>19</sup>  |  |  | [-94]   | [-91]               | [-89.2]             | [-87.9]             | FDD |    |
| CA_3A-28A-41C <sup>5</sup>           | 41 <sup>19</sup> |  |  | [-93.3] | [-90.7]             | [-89.2]             | [-88.1]             | TDD | 3  |
|                                      | 3 <sup>19</sup>  |  |  | [-94]   | [-91]               | [-89.2]             | [-87.9]             | FDD |    |
| CA_3A-28A-41A-42A                    | 3 <sup>19</sup>  |  |  | [-94]   | [-91]               | [-89.2]             | [-87.9]             | FDD | 41 |
|                                      | 41               |  |  |         | -94.5 <sup>17</sup> | -92.7 <sup>17</sup> | -91.5 <sup>17</sup> | TDD |    |
|                                      | 41 <sup>19</sup> |  |  |         | [-90.7]             | [-89.2]             | [-88.1]             | TDD |    |
| CA_3A-28A-41A-42C                    | 41 <sup>19</sup> |  |  |         | [-90.7]             | [-89.2]             | [-88.1]             | TDD | 3  |
|                                      | 3 <sup>19</sup>  |  |  | [-94]   | [-91]               | [-89.2]             | [-87.9]             | FDD |    |
|                                      | 41               |  |  |         | -94.5 <sup>17</sup> | -92.7 <sup>17</sup> | -91.5 <sup>17</sup> | TDD |    |
| CA_3A-28A-41C-42A                    | 41 <sup>19</sup> |  |  |         | [-90.7]             | [-89.2]             | [-88.1]             | TDD | 3  |
|                                      | 3 <sup>19</sup>  |  |  | [-94]   | [-91]               | [-89.2]             | [-87.9]             | FDD |    |
|                                      | 41               |  |  |         | -94.5 <sup>17</sup> | -92.7 <sup>17</sup> | -91.5 <sup>17</sup> | TDD |    |

|                                  |                  |         |         |         |         |         |         |     |    |
|----------------------------------|------------------|---------|---------|---------|---------|---------|---------|-----|----|
| CA_3A-40A                        | 40 <sup>19</sup> |         |         | -95.4   | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3A-40A                        | 3 <sup>19</sup>  | [-97.4] | [-95.3] | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3A-40A-40A                    | 40 <sup>19</sup> |         |         |         | -92.9   |         | -90.2   | TDD | 3  |
| CA_3A-40A-40A                    | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   |         |         | FDD | 40 |
| CA_3A-40C                        | 40 <sup>19</sup> |         |         | -95.4   | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3A-40D                        | 40 <sup>19</sup> |         |         | -95.4   | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3A-40D                        | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3A-40E                        | 40 <sup>19</sup> |         |         |         |         | -91.3   | -90.2   | TDD | 3  |
| CA_3A-40E                        | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3A-40C                        | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3C-40A                        | 40 <sup>19</sup> |         |         | -95.4   | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3C-40A                        | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3C-40C                        | 40 <sup>19</sup> |         |         | -95.4   | -92.9   | -91.3   | -90.2   | TDD | 3  |
| CA_3C-40C                        | 3 <sup>19</sup>  |         |         | -94.2   | -91.2   | -89.5   | -88.3   | FDD | 40 |
| CA_3A-41A <sup>5</sup>           | 3 <sup>19</sup>  |         | [-95.3] | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3A-41C <sup>5</sup>           | 3 <sup>19</sup>  |         |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3A-41D <sup>5</sup>           | 3 <sup>19</sup>  |         |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3A-3A-41A                     | 3                |         | [-95.3] | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41               |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3C-41A <sup>5</sup>           | 3 <sup>19</sup>  |         |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3C-41C <sup>5</sup>           | 3 <sup>19</sup>  |         |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3C-41D <sup>5</sup>           | 3 <sup>19</sup>  |         |         | [-94]   | [-91]   | [-89.2] | [-87.9] | FDD | 41 |
|                                  | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
| CA_3A-41A-42A <sup>5,6,7,8</sup> | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         | -71.7   | -71.7   | -71.7   | -71.7   |     |    |
| CA_3A-41A-42A <sup>5,6,9</sup>   | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         | -97.1   | -94.7   | -93.2   | -92.5   |     |    |
| CA_3A-41A-42A <sup>5,6,10</sup>  | 3 <sup>19</sup>  |         |         | [-93.5] | [-90.5] | [-88.7] | [-87.4] | FDD | 41 |
| CA_3A-41A-42C <sup>5,6,7,8</sup> | 41 <sup>19</sup> |         |         |         | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         |         | -71.7   | -71.7   | -71.7   |     |    |
| CA_3A-41A-42C <sup>5,6,9</sup>   | 41 <sup>19</sup> |         |         |         | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         |         | -94.7   | -93.2   | -92.5   |     |    |
| CA_3A-41A-42C <sup>5,6,10</sup>  | 3 <sup>19</sup>  |         |         | [-93.5] | [-90.5] | [-88.7] | [-87.4] | FDD | 41 |
|                                  | 42               |         |         |         | -95.5   | -93.7   | -92.5   | TDD |    |
| CA_3A-41C-42A <sup>5,6,7,8</sup> | 41 <sup>19</sup> |         |         |         | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         |         | -71.7   | -71.7   | -71.7   |     |    |
| CA_3A-41C-42A <sup>5,6,9</sup>   | 41 <sup>19</sup> |         |         |         | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42               |         |         |         | -94.7   | -93.2   | -92.5   |     |    |
| CA_3A-41C-42A <sup>5,6,10</sup>  | 3 <sup>19</sup>  |         |         | [-93.5] | [-90.5] | [-88.7] | [-87.4] | FDD | 41 |
| CA_3A-41C-42C <sup>5,6,7,8</sup> | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         | -71.7   | -71.7   | -71.7   | -71.7   |     |    |
| CA_3A-41C-42C <sup>5,6,9</sup>   | 41 <sup>19</sup> |         |         | [-93.3] | [-90.7] | [-89.2] | [-88.1] | TDD | 3  |
|                                  | 42 <sup>19</sup> |         |         | -97.1   | -94.7   | -93.2   | -92.5   |     |    |
| CA_3A-41C-42C <sup>5,6,10</sup>  | 3 <sup>19</sup>  |         |         | [-93.5] | [-90.5] | [-88.7] | [-87.4] | FDD | 41 |
| CA_7A-8A-38A                     | 7 <sup>19</sup>  |         |         |         | [-91.2] | [-89.7] | [-88.6] | FDD | 8  |
|                                  | 38               |         |         | [-93.8] | [-91.2] | [-89.7] | [-88.6] | TDD |    |
| CA_7A-8A-40A                     | 40 <sup>19</sup> |         |         | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
|                                  | 7 <sup>19</sup>  |         |         | -88     | -87.4   | -87     | -86.7   | FDD | 8  |

|   |                  |  |  |         |         |         |         |     |    |
|---|------------------|--|--|---------|---------|---------|---------|-----|----|
|   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
| CA_7A-8A-40C  | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
|   | 7 <sup>19</sup>  |  |  | -88     | -87.4   | -87     | -86.7   | FDD | 8  |
|   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
| CA_7A-20A-42A   | 42 <sup>19</sup> |  |  | -95.6   | -93     | -91.5   | -90.4   | TDD | 7  |
|   | 7 <sup>19</sup>  |  |  | -96.2   | -93.2   | -91.5   | -90.3   | FDD | 42 |
| CA_7A-28A-38A   | 7 <sup>19</sup>  |  |  |         | [-91.2] | [-89.7] | [-88.6] | FDD | 8  |
|   | 38               |  |  | [-93.8] | [-91.2] | [-89.7] | [-88.6] | TDD |    |
| CA_7A-28A-40A<br>CA_7A-28A-40C  | 7 <sup>19</sup>  |  |  | -96.8   | -94     | -92.4   | -91.2   | FDD | 40 |
|   | 28               |  |  | -96.8   | -94.1   | -92.5   | -89.8   | FDD |    |
| CA_7A-28A-40A<br>CA_7A-28A-40C  | 40 <sup>19</sup> |  |  | -96     | -93.3   | -91.7   | -90.6   | TDD | 7  |
| CA_7A-28A-40A<br>CA_7A-28A-40C  | 40 <sup>19</sup> |  |  | -95.1   | -92.9   | -91.4   | -90.5   | TDD | 28 |
|   | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
| CA_7A-40A   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
|   | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
| CA_7A-40C   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
|   | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
| CA_7A-40D   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
|   | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
| CA_7A-40E   | 7 <sup>19</sup>  |  |  | -97.1   | -94.3   | -92.7   | -91.5   | FDD | 40 |
|   | 40 <sup>19</sup> |  |  | -96.3   | -93.6   | -92     | -90.9   | TDD | 7  |
| CA_7A-42A   | 42 <sup>19</sup> |  |  | -95.6   | -93     | -91.5   | -90.4   | TDD | 7  |
|   | 7 <sup>19</sup>  |  |  | -96.2   | -93.2   | -91.5   | -90.3   | FDD | 42 |
| CA_7A-42A-42A   | 42 <sup>19</sup> |  |  | -95.6   | -93     | -91.5   | -90.4   | TDD | 7  |
|   | 7 <sup>19</sup>  |  |  | -96.2   | -93.2   | -91.5   | -90.3   | FDD | 42 |
| CA_25A-41A,<br>CA_25A-25A-41A,<br>CA_25A-41C,<br>CA_25A-25A-41C,<br>CA_25A-41D,<br>CA_25A-25A-41D,<br>CA_25A-41E,<br>CA_25A-25A-41E,<br>CA_25A-41F,<br>CA_25A-25A-41F | 25               |  |  | [-95.9] | [-92.9] | [-91.1] | [-89.9] | FDD | 41 |
| CA_28A-40A  | 40               |  |  | -95.1   | -92.9   | -91.4   | -90.5   | TDD | 28 |
| CA_28A-40A  | 28               |  |  | -96.8   | -94.1   | -92.5   | -89.8   | FDD | 40 |
| CA_28A-40C  | 40               |  |  | -95.1   | -92.9   | -91.4   | -90.5   | TDD | 28 |
| CA_28A-40C  | 28               |  |  | -96.8   | -94.1   | -92.5   | -89.8   | FDD | 40 |
| CA_28A-40D  | 40               |  |  | -95.1   | -92.9   | -91.4   | -90.5   | TDD | 28 |
| CA_28A-40D  | 28               |  |  | -96.8   | -94.1   | -92.5   | -89.8   | FDD | 40 |

NOTE 1: The transmitter shall be set to P<sub>UMAX</sub> as defined in subclause 6.2.5A

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

NOTE 3: The signal power is specified per port

NOTE 4: These requirements apply regardless of the channel bandwidth and the location of UL band.

NOTE 5: The B41 requirements are modified by -0.5dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2545-2690 MHz.

NOTE 6: The antenna isolation for MSD calculation is assumed as 10 dB. For conducted mode REFSENS test such antenna isolation is not observed as the antennas are disconnected. Additionally antenna isolation assumption is under discussion depending on the frequency range

NOTE 7: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ΔF<sub>HD</sub> above and below the edge of this downlink transmission bandwidth. The value ΔF<sub>HD</sub> depends on the E-UTRA configuration: ΔF<sub>HD</sub> = 10 MHz for CA\_3A-42A, CA\_3A-42C, CA\_3A-42D, CA\_3A-3A-42C, CA\_3A-42A-42C, CA\_1A-3A-42A, CA\_1A-3A-42C, CA\_1A-3A-42D, CA\_3A-19A-42A, CA\_3A-19A-42C, CA\_1A-3A-19A-42A, CA\_3A-41A-42A, CA\_3A-41A-42C, CA\_3A-41C-42A, and CA\_3A-41C-42C.

- NOTE 8: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor \cdot 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.
- NOTE 9: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher band) with  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.
- NOTE 10: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx.
- NOTE 11: Void
- NOTE 12: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3 and Band 41, the requirement applies regardless of channel bandwidth in Band 1.
- NOTE 13: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq 60$  MHz. For each channel bandwidth in Band 3 and Band 41, the requirement applies regardless of channel bandwidth in Band 1.
- NOTE 14: The B41 requirements also apply to the supported CA\_1A-41A.
- NOTE 15: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth other than Band 1, the requirement applies regardless of channel bandwidth in Band 1
- NOTE 16: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq 60$  MHz. For each channel bandwidth other than Band 1, the requirement applies regardless of channel bandwidth in Band 1.
- NOTE 17: The B41 requirements are modified by -0.1dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2545-2690 MHz.
- NOTE 18: No requirements apply when there is at least one individual RE within the downlink transmission bandwidth of band5 for which the 3rd receiver harmonic is within the uplink transmission bandwidth of band41. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).
- NOTE 19: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.

**Table 7.3.1A-0bF: Uplink configuration for reference sensitivity (exceptions due to cross band isolation issues of TDD and FDD bands)**

| E-UTRA Band / Channel bandwidth of the affected DL band / N <sub>RB</sub> / Duplex mode |                  |         |       |       |                 |                 |                 |             |
|---|------------------|---------|-------|-------|-----------------|-----------------|-----------------|-------------|
| EUTRA CA Configuration  | E-UTRA Band      | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz          | 15 MHz          | 20 MHz          | Duplex Mode |
| CA_1A-3A-5A-41A   | 3                |         |       | 25    | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| CA_1A-3A-7A-20A-42A   | 7                |         |       | 25    | 50              | 75              | 75 <sup>1</sup> | FDD         |
|   | 42               |         |       | 25    | 50              | 75              | 100             | FDD         |
| CA_1A-3A-7A-38A   | 1                |         |       | 25    | 50              | 75              | 100             | FDD         |
| CA_1A-3C-7A-38A   | 3                |         |       | 25    | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| CA_1A-3A-7A-40A   | 1 <sup>1,3</sup> |         |       | 25    | 25              | 25              | 25              | FDD         |
|   | 1 <sup>1,4</sup> |         |       | 25    | 45              | 45              | 45              | FDD         |
| CA_1A-3A-7A-40C   | 3                |         |       | 25    | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
|   | 7                |         |       | 25    | 50              | 75              | 75 <sup>1</sup> | FDD         |
|   | 40               |         |       | 25    | 50              | 75              | 100             | TDD         |
| CA_1A-3A-7A-42A   | 7                |         |       | 25    | 50              | 75              | 75 <sup>1</sup> | FDD         |
|   | 42               |         |       | 25    | 50              | 75              | 100             | TDD         |
| CA_1A-3A-28A-40A  | 1                |         |       | 25    | 50              | 75              | 100             | FDD         |
|   | 3                |         |       | 25    | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
|   | 28               |         |       | 25    | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD         |

|  |                  |  |  |                 |                   |                   |                   |     |
|--|------------------|--|--|-----------------|-------------------|-------------------|-------------------|-----|
| CA_1A-3A-28A-40C   | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-3A-38A<br>CA_1A-3C-38A   | 1 <sup>1,3</sup> |  |  | 25              | 25                | 25                | 25                | FDD |
|  | 1 <sup>1,4</sup> |  |  | 25              | 45                | 45                | 45                | FDD |
|  | 3                |  |  | 25              | 50                | 50 <sup>1</sup>   | 50 <sup>1</sup>   | FDD |
|  | 38               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-3A-41A<br>CA_1A-3A-41C<br>CA_1A-3A-41D                                 | 1                |  |  | 25 <sup>3</sup> | 25 <sup>1,3</sup> | 25 <sup>1,3</sup> | 25 <sup>1,3</sup> | FDD |
|  |                  |  |  | 25 <sup>4</sup> | 45 <sup>1,4</sup> | 45 <sup>1,4</sup> | 45 <sup>1,4</sup> | FDD |
|  | 3                |  |  | 25              | 50                | 50 <sup>1</sup>   | 50 <sup>1</sup>   | FDD |
| CA_1A-3A-41A-42A<br>CA_1A-3A-41A-42C<br>CA_1A-3A-41C-42A<br>CA_1A-3A-41C-42C | 1                |  |  | 25 <sup>3</sup> | 25 <sup>1,3</sup> | 25 <sup>1,3</sup> | 25 <sup>1,3</sup> | FDD |
|  |                  |  |  | 25 <sup>4</sup> | 45 <sup>1,4</sup> | 45 <sup>1,4</sup> | 45 <sup>1,4</sup> | FDD |
|  | 3                |  |  | 25              | 50                | 50 <sup>1</sup>   | 50 <sup>1</sup>   | FDD |
| CA_1A-5A-40A   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-8A-40A  | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-8A-40C  | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-28A-40A<br>CA_1A-7A-28A-40C   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 28               |  |  | 25              | 25 <sup>1</sup>   | 25 <sup>1</sup>   | 25 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-8A-40A   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-8A-40C   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-20A-42A   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 20               |  |  | 25              | 20 <sup>1</sup>   | 20 <sup>5</sup>   | 20 <sup>5</sup>   | FDD |
|  | 42               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-38A   | 1                |  |  | 25              | 45                | 45 <sup>1</sup>   | 45 <sup>1</sup>   | FDD |
| CA_1A-7A-40A   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-40C   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-7A-42A   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 7                |  |  | 25              | 50                | 75                | 75 <sup>1</sup>   | FDD |
|  | 42               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-40A  | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_1A-28A-40A<br>CA_1A-28A-40C   | 1                |  |  | 25              | 50                | 75                | 100               | FDD |
|  | 28               |  |  | 25              | 25 <sup>1</sup>   | 25 <sup>1</sup>   | 25 <sup>1</sup>   | FDD |
|  | 40               |  |  | 25              | 50                | 75                | 100               | TDD |
| CA_3A-5A-41A   | 3                |  |  | 25              | 50                | 50 <sup>1</sup>   | 50 <sup>1</sup>   | FDD |
|  | 41               |  |  |                 |                   |                   | 100               | TDD |
| CA_3A-7A-8A-38A  | 3                |  |  | 25              | 50                | 50 <sup>1</sup>   | 50 <sup>1</sup>   | FDD |

|   |    |   |    |    |                 |                 |                 |     |
|---|----|---|----|----|-----------------|-----------------|-----------------|-----|
| CA_3C-7A-8A-38A   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3A-7A-8A-40A   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-7A-8A-40C   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-7A-28A-38A  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3C-7A-28A-38A  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3A-7A-28A-40A<br>CA_3A-7A-28A-40C  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 28 |   |    | 25 | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-7A-38A  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3C-7A-38A  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3A-7A-40A  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-7A-40C  | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-7A-42A  | 7  |   |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 42 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-8A-40A  | 3  | 6 | 15 | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-8A-40C  | 3  | 6 | 15 | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-28A-41A   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 28 |   |    | 25 | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
|   | 41 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-28A-41C   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 28 |   |    | 25 | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
|   | 41 |   |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-28A-41A-42A   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 28 |   |    | 25 | 25 <sup>1</sup> |                 |                 | FDD |
|   | 41 |   |    |    | 50              | 75              | 100             | TDD |
|   | 42 |   |    |    | 50              | 75              | 100             | TDD |
| CA_3A-28A-41A-42C   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 41 |   |    |    | 50              | 75              | 100             | TDD |
| CA_3A-28A-41C-42A   | 3  |   |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 41 |   |    |    | 50              | 75              | 100             | TDD |
| CA_3A-40A<br>CA_3A-40C<br>CA_3A-40D<br>CA_3A-40E<br>CA_1A-3A-40A<br>CA_1A-3C-40A<br>CA_1A-3A-40C<br>CA_1A-3C-40C<br>CA_3A-5A-40A<br>CA_3A-28A-40A<br>CA_3A-28A-40C<br>CA_1A-3A-5A-40A | 3  | 6 | 15 | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 40 |   |    | 25 | 50              | 75              | 100             | TDD |

|   |    |  |    |    |                 |                 |                 |     |
|---|----|--|----|----|-----------------|-----------------|-----------------|-----|
| CA_1A-3A-8A-40A   |    |  |    |    |                 |                 |                 |     |
| CA_3A-40A-40A   | 3  |  |    | 25 | 50              |                 |                 | FDD |
|   | 40 |  |    |    | 50              |                 | 100             | TDD |
| CA_3A-41A   | 3  |  | 15 | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3A-3A-41A  | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-41C   | 3  |  |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3C-41A   | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_3C-41D   |    |  |    |    |                 |                 |                 |     |
| CA_3A-41D   | 3  |  |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_3C-41C   | 3  |  |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_3A-41A-42A   | 3  |  |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|   | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-8A-38A  | 8  |  |    | 25 | 50              |                 |                 | FDD |
| CA_7A-8A-40A  | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 8  |  |    | 8  | 16              |                 |                 |     |
|   | 40 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-8A-40C  | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 8  |  |    | 8  | 16              |                 |                 |     |
|   | 40 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-20A-42A   | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 20 |  |    | 25 | 50              | 75              | 100             |     |
|   | 42 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-28A-38A   | 28 |  |    | 25 | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_7A-28A-40A<br>CA_7A-28A-40C  | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 28 |  |    | 25 | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
|   | 40 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-40A,<br>CA_7A-40C,<br>CA_7A-40D,<br>CA_7A-40E   | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 40 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_7A-42A,<br>CA_7A-42A-42A   | 7  |  |    | 25 | 50              | 75              | 75 <sup>1</sup> | FDD |
|   | 42 |  |    | 25 | 50              | 75              | 100             | TDD |
| CA_25A-41A,<br>CA_25A-41C,<br>CA_25A-41D,<br>CA_25A-41E,<br>CA_25A-41F,<br>CA_25A-25A-41A,<br>CA_25A-25A-41C,<br>CA_25A-25A-41D,<br>CA_25A-25A-41E,<br>CA_25A-25A-41F   | 25 |  |    | 25 | 50              | 75              | 100             | FDD |
| CA_28A-40A,<br>CA_28A-40C   | 41 |  |    | 25 | 50              | 75              | 100             | TDD |
|   | 28 |  |    | 25 | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD |
|   | 40 |  |    | 25 | 50              | 75              | 100             | TDD |
| <p>NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).</p> <p>NOTE 2: the UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.1-2 for the uplink bandwidth in which case the allocation according to Table 7.3.1-2 applies.</p> <p>NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is &lt; 60 MHz.</p> |    |  |    |    |                 |                 |                 |     |



NOTE 4: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is  $\geq 60$  MHz.  
 NOTE 5: <sup>5</sup> refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 16

For band combinations including operating bands without uplink band (as noted in Table 5.5-1), the requirements are specified in Table 7.3.1A-0d and for any uplink band with uplink configuration specified in Table 7.3.1-2.

**Table 7.3.1A-0d: Reference sensitivity QPSK P<sub>REFSENS</sub> (CA with a SDL band)**

| EUTRA CA Configuration        | Channel bandwidth |               |             |             |              |              |              | Duplex mode |
|-------------------------------|-------------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                               | EUTRA band        | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| CA_1A-3A-7A-20A-32A           | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3 <sup>5,6</sup>  |               |             | -94         | -91          | -90          | -89          |             |
|                               | 3 <sup>7</sup>    |               |             | -97         | -94          | -92.2        | -91          |             |
|                               | 7                 |               |             |             | -95          | -93.2        | -92          |             |
|                               | 20                |               |             | -97         | -94          | -91.2        | -90          |             |
| CA_1A-3A-20A-32A <sup>6</sup> | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -94         | -91.5        | -90          | -89          |             |
|                               | 20                |               |             | -97         | -94          | -91.2        | -90          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-20A-32A-42A          | 1                 |               |             | -100        | -97          | -95.2        |              | FDD         |
|                               | 3                 |               |             | -97         | -94          | -92.2        |              | FDD         |
|                               | 20                |               |             | -97         |              |              |              | FDD         |
|                               | 32                |               |             | -99.5       | -96.5        | -94.7        | -93.5        | FDD         |
|                               | 42                |               |             | -98.5       | -95.5        | -93.7        | -92.5        | TDD         |
| CA_1A-3A-20A-32A-43A          | 1                 |               |             | -100        | -97          | -95.2        |              | FDD         |
|                               | 3                 |               |             | -97         | -94          | -92.2        |              | FDD         |
|                               | 20                |               |             | -97         |              |              |              | FDD         |
|                               | 32                |               |             | -99.5       | -96.5        | -94.7        | -93.5        | FDD         |
|                               | 43                |               |             | -98.5       | -95.5        | -93.7        | -92.5        | TDD         |
| CA_1A-3A-20A-32A <sup>7</sup> | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -97         | -94          | -92.2        | -91          |             |
|                               | 20                |               |             | -97         | -94          | -91.2        | -90          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-32A <sup>6</sup>     | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -94         | -91.5        | -90          | -89          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-32A <sup>7</sup>     | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -97         | -94          | -92.2        | -91          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-7A-32A <sup>6</sup>  | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -94         | -91.5        | -90          | -89          |             |
|                               | 7                 |               |             | -98         | -95          | -93.2        | -92          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-7A-32A <sup>7</sup>  | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |
|                               | 3                 |               |             | -97         | -94          | -92.2        | -91          |             |
|                               | 7                 |               |             | -98         | -95          | -93.2        | -92          |             |
|                               | 32                |               |             | -100        | -97          | -95.2        | -94          |             |
| CA_1A-3A-32A-42A <sup>7</sup> | 1                 |               |             | -99.8       | -96.8        | -95          |              | FDD         |
|                               | 3                 |               |             | -96.8       | -93.8        | -92          |              |             |
|                               | 32                |               |             | -99.5       | -96.5        | -94.7        | -93.5        |             |

|                                      |    |  |  |       |       |       |       |     |
|--------------------------------------|----|--|--|-------|-------|-------|-------|-----|
|                                      | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-3A-32A-43A <sup>7</sup>        | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 3  |  |  | -97   | -94   | -92.2 |       |     |
|                                      | 32 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                                      | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-3A-32A-42A-43A                 | 1  |  |  | -99.8 | -96.8 | -95   |       | FDD |
|                                      | 3  |  |  | -96.8 | -93.8 | -92   |       | FDD |
|                                      | 32 |  |  | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
|                                      | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
|                                      | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-20A-32A-42A                    | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 20 |  |  | -97   |       |       |       |     |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   |     |
|                                      | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-20A-32A-43A                    | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 20 |  |  | -97   |       |       |       |     |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   |     |
|                                      | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-32A                            | 1  |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_1A-32A-42A                        | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                                      | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-32A-43A                        | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                                      | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_1A-32A-42A-43A                    | 1  |  |  | -100  | -97   | -95.2 |       | FDD |
|                                      | 32 |  |  | -100  | -97   | -95.2 | -94   |     |
|                                      | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 |     |
|                                      | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 |     |
| CA_2A-4A-5A-29A                      | 2  |  |  | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
|                                      | 4  |  |  | -99.7 | -96.7 | -94.9 | -93.7 |     |
|                                      | 5  |  |  | -98   | -95   |       |       |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
| CA_2A-4A-29A                         | 2  |  |  | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
|                                      | 4  |  |  | -99.7 | -96.7 | -94.9 | -93.7 |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
| CA_2A-4A-29A-30A                     | 2  |  |  | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
|                                      | 4  |  |  | -99.6 | -96.6 | -94.8 | -93.6 |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
|                                      | 30 |  |  | -98.5 | -95.5 |       |       |     |
| CA_2A-5A-29A                         | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |
|                                      | 5  |  |  | -98   | -95   |       |       |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
| CA_2A-7A-29A<br>CA_2A-7C-29A         | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |
|                                      | 7  |  |  |       | -95   | -93.2 | -92   |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
| CA_2A-7A-7A-29A                      | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |
|                                      | 7  |  |  | -98   | -95   | -93.2 | -92   |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |
| CA_2A-7A-29A-66A<br>CA_2A-7C-29A-66A | 2  |  |  | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
|                                      | 7  |  |  |       | -94.5 | -92.7 | -91.5 |     |
|                                      | 29 |  |  | -97   | -94   |       |       |     |

|                     |                |  |       |       |       |       |       |     |
|---------------------|----------------|--|-------|-------|-------|-------|-------|-----|
| CA_2A-7A-7A-29A-66A | 66             |  |       | -99   | -96   | -94.2 | -93   |     |
| CA_2A-29A           | 2              |  |       | -98   | -95   | -93.2 | -92   | FDD |
|                     | 29             |  | -98.7 | -97   | -94   |       |       |     |
| CA_2A-2A-29A        | 2              |  |       | -98   | -95   | -93.2 | -92   | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
| CA_2C-29A           | 2              |  |       | -98   | -95   | -93.2 | -92   | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
| CA_2A-29A-30A       | 2              |  |       | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
|                     | 30             |  |       | -98.5 | -95.5 |       |       |     |
| CA_2A-2A-29A-30A    | 2              |  |       | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
|                     | 30             |  |       | -98.5 | -95.5 |       |       |     |
| CA_2C-29A-30A       | 2              |  |       | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
|                     | 30             |  |       | -98.5 | -95.5 |       |       |     |
| CA_2A-29A-30A-66A   | 2              |  |       | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
|                     | 30             |  |       | -98.5 | -95.5 |       |       |     |
|                     | 66             |  |       | -99.1 | -96.1 | -94.3 | -93.1 |     |
| CA_2A-29A-66A       | 2              |  |       | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
|                     | 66             |  |       | -99.2 | -96.2 | -94.4 | -93.2 |     |
| CA_4A-4A-29A        | 4              |  |       | -100  | -97   | -95.2 | -94   | FDD |
|                     | 29             |  |       | -97   | -94   |       |       |     |
| CA_3A-7A-20A-32A    | 3              |  |       | -97   | -94   | -92.2 | -91   | FDD |
|                     | 7              |  |       | -98   | -95   | -93.2 | -92   |     |
|                     | 20             |  |       | -97   | -94   | -91.2 | -90   |     |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_3A-7A-32A        | 3              |  |       | -97   | -94   | -92.2 | -91   | FDD |
|                     | 7              |  |       | -98   | -95   | -93.2 | -92   |     |
|                     | 32             |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_3A-20A-32A-42A   | 3              |  |       | -96.8 | -93.8 | -92   |       | FDD |
|                     | 20             |  |       | -97   |       |       |       |     |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                     | 42             |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_3A-20A-32A-43A   | 3              |  |       | -97   | -94   | -92.2 |       | FDD |
|                     | 20             |  |       | -97   |       |       |       |     |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 | TDD |
|                     | 43             |  |       | -98.5 | -95.5 | -93.7 | -92.5 |     |
| CA_3A-32A           | 3              |  |       | -97   | -94   | -92.2 | -91   | FDD |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_3C-32A           | 3 <sup>5</sup> |  |       | -97   | -94   | -92.2 | -91   | FDD |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_3A-32A-42A       | 3              |  |       | -96.8 | -93.8 | -92   |       | FDD |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
|                     | 42             |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_3A-32A-43A       | 3              |  |       | -97   | -94   | -92.2 |       | FDD |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
|                     | 43             |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_3A-32A-42A-43A   | 3              |  |       | -96.8 | -93.8 | -92   |       | FDD |
|                     | 32             |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                     | 42             |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |

|  |    |  |       |       |       |       |       |     |
|--|----|--|-------|-------|-------|-------|-------|-----|
|  | 43 |  |       | -98.5 | -95.5 | -93.7 | -92.5 |     |
| CA_3A-69A                                | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
|  | 69 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_4A-4A-29A-30A                         | 4  |  |       | -99.6 | -96.6 | -94.8 | -93.6 | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
|  | 30 |  |       | -98.5 | -95.5 |       |       |     |
| CA_4A-5A-29A                             | 4  |  |       | -100  | -97   | -95.2 | -94   | FDD |
|  | 5  |  |       | -98   | -95   |       |       |     |
|  | 29 |  |       | -97   | -94   |       |       |     |
| CA_4A-29A                                | 4  |  |       | -100  | -97   | -95.2 | -94   | FDD |
|  | 29 |  | -98.7 | -97   | -94   |       |       |     |
| CA_4A-29A-30A                            | 4  |  |       | -99.6 | -96.6 | -94.8 | -93.6 | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
|  | 30 |  |       | -98.5 | -95.5 |       |       |     |
| CA_5A-29A                                | 5  |  |       | -98   | -95   |       |       | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
| CA_7A-20A-32A                            | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
|  | 20 |  |       | -97   | -94   | -91.2 | -90   |     |
|  | 32 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_7A-29A<br>CA_7A-7A-29A<br>CA_7C-29A   | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
| CA_7A-29A-66A                            | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
|  | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_7A-7A-29A-66A                         | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
|  | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_7C-29A-66A                            | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
|  | 29 |  |       | -97   | -94   |       |       |     |
|  | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_7A-32A                                | 7  |  |       |       | -95   | -93.2 | -92   | FDD |
|  | 32 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_20A-32A                               | 20 |  |       | -97   | -94   | -91.2 | -90   | FDD |
|  | 32 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_20A-32A-42A                           | 20 |  |       | -97   |       |       |       | FDD |
|  | 32 |  |       | -100  | -97   | -95.2 | -94   | FDD |
|  | 42 |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_20A-32A-43A                           | 20 |  |       | -97   |       |       |       | FDD |
|  | 32 |  |       | -100  | -97   | -95.2 | -94   | FDD |
|  | 43 |  |       | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_20A-75A                               | 20 |  |       | -97   | -94   | -91.2 | -90   | FDD |
|  | 75 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_20A-76A                               | 20 |  |       | -97   | -94   | -91.2 | -90   | FDD |
|  | 76 |  |       | -100  |       |       |       |     |
| CA_20A-67A                               | 20 |  |       | -97   | -94   | -91.2 | -90   | FDD |
|  | 67 |  |       | -100  | -97   | -95.2 | -94   |     |
| CA_23A-29A                               | 23 |  |       | -100  | -97   | -95.2 | -94   | FDD |
|  | 29 |  | -98.7 | -97   | -94   |       |       |     |
| CA_29A-30A                               | 29 |  |       | -97   | -94   |       |       | FDD |
|  | 30 |  |       | -99   | -96   |       |       |     |
| CA_29A-30A-66A<br>CA_29A-30A-66A-<br>66A | 29 |  |       | -97   | -94   |       |       | FDD |
|  | 30 |  |       | -98.5 | -95.5 |       |       |     |
|  | 66 |  |       | -99.1 | -96.1 | -94.3 | -93.1 |     |

|                    |    |  |  |       |       |       |       |     |
|--------------------|----|--|--|-------|-------|-------|-------|-----|
| CA_29A-66A         | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_29A-66C         | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_29A-66A-66A     | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
| CA_29A-66A-70A     | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 |       |     |
| CA_29A-66A-70C     | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_29A-66C-70A     | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 |       |     |
| CA_29A-66A-66A-70A | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 |       |     |
| CA_29A-66C-70C     | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_29A-66A-66A-70C | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 |     |
|                    | 70 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_29A-70A         | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 70 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_29A-70C         | 29 |  |  | -97   | -94   |       |       | FDD |
|                    | 70 |  |  | -100  | -97   | -95.2 | -94   |     |
| CA_32A-42A         | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                    | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_32A-43A         | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                    | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
| CA_32A-42A-43A     | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|                    | 42 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |
|                    | 43 |  |  | -98.5 | -95.5 | -93.7 | -92.5 | TDD |

NOTE 1: The transmitter shall be set to  $P_{UMAX}$  as defined in subclause 6.2.5A.  
 NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1  
 NOTE 3: The signal power is specified per port.  
 NOTE 4: Void  
 NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured.  
 NOTE 6: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.  
 NOTE 7: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.

Table 7.3.1A-0e: Void

For band combinations including operating band 46 (Table 5.5-1), the requirements are specified in Table 7.3.1A-0eA for the uplink in any band other than band 46 with the uplink configuration specified in Table 7.3.1-2 and Table 7.3.1A-0eC.

For band combinations including operating band 49 (Table 5.5-1), the requirements are specified in Table 7.3.1A-0eA for the uplink in any band other than Band 49 with uplink configurations specified in Table 7.3.1-2 and measurement exclusion region in Table 7.3.1A-0eD.

**Table 7.3.1A-0eA: Reference sensitivity QPSK  $P_{\text{REFSENS}}$  (CA with band 46 or Band 49)**

| EUTRA CA Configuration | Channel bandwidth |               |             |             |              |              |              | Duplex mode |     |
|------------------------|-------------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|-----|
|                        | EUTRA band        | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |     |
| CA_1A-3A-7A-46A        | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |     |
|                        | 3                 |               |             | -97         | -94          | -92.2        | -91          |             |     |
|                        | 7                 |               |             | -98         | -95          | -93.2        | -92          |             |     |
| CA_1A-3A-7A-46D        | 46                |               |             |             |              |              |              | TDD         |     |
| CA_1A-3A-7A-46E        |                   |               |             |             |              | -90          |              |             |     |
| CA_1A-3A-46A           | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |     |
|                        | 3                 |               |             | -97         | -94          | -92.2        | -91          |             |     |
|                        | 46                |               |             |             | -93          |              | -90          |             | TDD |
| CA_1A-3A-46C           | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |     |
|                        | 5                 |               |             | -98         | -95          |              |              |             |     |
|                        | 7                 |               |             |             | -95          | -93.2        | -92          |             |     |
| CA_1A-3A-46D           | 46                |               |             |             |              |              |              | TDD         |     |
| CA_1A-3A-46E           |                   |               |             |             |              | -90          |              |             |     |
| CA_1A-5A-7A-46A        | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |     |
|                        | 5                 |               |             | -98         | -95          |              |              |             |     |
|                        | 7                 |               |             |             | -95          | -93.2        | -92          |             |     |
| CA_1A-5A-46C           | 46                |               |             |             |              |              |              | TDD         |     |
| CA_1A-5A-46D           |                   |               |             |             |              | -90          |              |             |     |
| CA_1A-5A-46A           | 1                 |               |             | -100        | -97          | -95.2        | -94          | FDD         |     |
|                        | 5                 |               |             | -98         | -95          |              |              | FDD         |     |
|                        | 46                |               |             |             |              |              | -90          | TDD         |     |
| CA_2A-5A-46A           | 2                 |               |             | -98         | -95          | -93.2        | -92          | FDD         |     |
|                        | 5                 |               |             | -98         | -95          |              |              |             |     |
|                        | 46                |               |             |             |              |              | -90          |             |     |
| CA_2A-5A-46A-66A       | 2                 |               |             | -98         | -95          | -93.2        | -92          | FDD         |     |
| CA_2A-5A-46C-66A       | 5                 |               |             | -98         | -95          |              |              | FDD         |     |
| CA_2A-5A-46D-66A       | 46                |               |             |             |              |              | -90          | TDD         |     |
| CA_2A-5A-46E-66A       | 66                |               |             |             |              |              |              | FDD         |     |
| CA_2A-5A-46A-66A-66A   |                   |               |             | -99.5       | -96.5        | -94.7        | -93.5        |             |     |
| CA_2A-5A-46C-66A-66A   |                   |               |             |             |              |              |              |             |     |
| CA_2A-5A-46D-66A-66A   |                   |               |             |             |              |              |              |             |     |
| CA_2A-5A-46E-66A-66A   |                   |               |             |             |              |              |              |             |     |
| CA_2A-7A-46A-66A       | 2                 |               |             | -98         | -95          | -93.2        | -92          | FDD         |     |
|                        | 7                 |               |             | -98         | -95          | -93.2        | -92          |             |     |
|                        | 46                |               |             |             | -93          |              | -90          |             | TDD |
|                        | 66                |               |             | -99.5       | -96.5        | -94.7        | -93.5        |             | FDD |
| CA_2A-13A-46A          | 2                 |               |             | -98         | -95          | -93.2        | -92          | FDD         |     |
|                        | 13                |               |             | -97         | -94          |              |              |             |     |
|                        | 46                |               |             |             |              |              | -90          |             | TDD |

|                       |    |  |  |       |       |       |       |     |       |
|-----------------------|----|--|--|-------|-------|-------|-------|-----|-------|
| CA_1A-7A-46A          | 1  |  |  | -100  | -97   | -95.2 | -94   | FDD |       |
|                       | 7  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
| CA_1A-7A-46C          | 46 |  |  |       |       |       |       | TDD |       |
| CA_1A-7A-46D          |    |  |  |       |       |       | -90   |     |       |
| CA_1A-7A-46E          |    |  |  |       |       |       |       |     |       |
| CA_1A-46A             | 1  |  |  | -100  | -97   | -95.2 | -94   | FDD |       |
| CA_1A-46C             | 46 |  |  |       |       |       |       | TDD |       |
| CA_1A-46D             |    |  |  |       | -93   |       | -90   |     |       |
| CA_1A-46E             |    |  |  |       |       |       |       |     |       |
| CA_2A-5A-46C          | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
|                       | 5  |  |  | -98   | -95   |       |       | FDD |       |
|                       | 46 |  |  |       |       |       | -90   | TDD |       |
| CA_2A-5A-46D          | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
| CA_2A-5A-46E          | 5  |  |  | -98   | -95   |       |       |     |       |
|                       | 46 |  |  |       |       |       | -90   |     |       |
| CA_2A-7A-46A          | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
| CA_2A-7A-46A          | 7  |  |  | -98   | -95   | -93.2 | -92   |     |       |
| CA_2A-7A-46C          | 46 |  |  |       |       |       |       | TDD |       |
| CA_2A-7A-7A-46C       |    |  |  |       |       |       |       |     |       |
| CA_2A-7A-46D          |    |  |  |       |       |       |       |     |       |
| CA_2A-7A-7A-46D       |    |  |  |       |       |       |       |     |       |
| CA_2A-7A-46E          |    |  |  |       |       |       |       |     |       |
| CA_2A-7A-7A-46E       |    |  |  |       |       |       |       |     |       |
| CA_2A-13A-46C         | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
|                       | 13 |  |  | -97   | -94   |       |       | FDD |       |
|                       | 46 |  |  |       |       |       | -90   | TDD |       |
| CA_2A-13A-46A-66A     | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
| CA_2A-13A-46C-66A     | 13 |  |  | -97   | -94   |       |       | FDD |       |
| CA_2A-13A-46D-66A     | 46 |  |  |       |       |       | -90   | TDD |       |
| CA_2A-13A-46A-66A-66A | 66 |  |  |       |       |       |       | FDD |       |
| CA_2A-13A-46C-66A-66A |    |  |  |       | -99.5 | -96.5 | -94.7 |     | -93.5 |
| CA_2A-13A-46D-66A-66A |    |  |  |       |       |       |       |     |       |
| CA_2A-13A-46E-66A-66A |    |  |  |       |       |       |       |     |       |
| CA_2A-46A             | 2  |  |  | -98   | -95   | -93.2 | -92   | FDD |       |
| CA_2A-46E             | 46 |  |  |       |       |       |       | TDD |       |
| CA_2A-2A-46A          |    |  |  |       |       |       |       |     |       |
| CA_2A-2A-46D          |    |  |  |       |       |       |       |     |       |
| CA_2A-46C             |    |  |  |       |       |       |       |     |       |
| CA_2A-46A-46A         |    |  |  |       |       |       |       |     |       |
| CA_2A-2A-46C          |    |  |  |       |       |       |       |     |       |
| CA_2A-46A-46C         |    |  |  |       |       |       |       |     |       |
| CA_2A-46D             |    |  |  |       |       |       |       |     |       |
| CA_2A-46A-46D         |    |  |  |       |       |       |       |     |       |
|                       | 2  |  |  | -97.8 | -94.8 | -93.0 | -91.7 | FDD |       |

|                                    |    |  |  |       |       |       |       |     |
|------------------------------------|----|--|--|-------|-------|-------|-------|-----|
| CA_2A-46A-48A <sup>10,11</sup>     | 46 |  |  |       |       |       | -83   | TDD |
| CA_2A-46A-48C <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46A-48D <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46A-48E <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46C-48A <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46C-48C <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46C-48D <sup>10,11</sup>     | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-46C-48E <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46D-48A <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46D-48C <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46E-48A <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46E-48C <sup>10,11</sup>     |    |  |  |       |       |       |       |     |
| CA_2A-46A-48A <sup>12</sup>        | 2  |  |  | -97.8 | -94.8 | -93.0 | -91.7 | FDD |
| CA_2A-46A-48C <sup>12</sup>        | 46 |  |  |       |       |       | -83   | TDD |
| CA_2A-46A-48D <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46A-48E <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46C-48A <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46C-48C <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46C-48D <sup>12</sup>        | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-46C-48E <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46D-48A <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46E-48A <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46D-48C <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46E-48C <sup>12</sup>        |    |  |  |       |       |       |       |     |
| CA_2A-46A-48A-66A <sup>10,11</sup> | 2  |  |  | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
| CA_2A-46A-48C-66A <sup>10,11</sup> | 46 |  |  |       |       |       | -83   | TDD |
| CA_2A-46A-48D-66A <sup>10,11</sup> | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-46A-48E-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46C-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46C-48C-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46C-48D-66A <sup>10,11</sup> | 66 |  |  | -99.3 | -96.3 | -94.5 | -93.3 | FDD |
| CA_2A-46D-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46D-48C-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46E-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_2A-46A-48A-66A <sup>12</sup>    | 2  |  |  | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
| CA_2A-46A-48C-66A <sup>12</sup>    | 46 |  |  |       |       |       | -83   | TDD |



|   |    |  |       |       |       |       |       |     |
|---|----|--|-------|-------|-------|-------|-------|-----|
| CA_2A-46A-48D-66A <sup>12</sup>   | 48 |  |       | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-46C-48C-66A <sup>12</sup>   |    |  |       |       |       |       |       |     |
| CA_2A-46C-48D-66A <sup>12</sup>   |    |  |       |       |       |       |       |     |
| CA_2A-46D-48A-66A <sup>12</sup>   | 66 |  |       | -99.3 | -96.3 | -94.5 | -93.3 | FDD |
| CA_2A-46D-48C-66A <sup>12</sup>   |    |  |       |       |       |       |       |     |
| CA_2A-46E-48A-66A <sup>12</sup>   |    |  |       |       |       |       |       |     |
| CA_2A-46A-48C-66A <sup>12</sup>   | 2  |  |       | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
| CA_2A-46C-48A-66A <sup>12</sup>   | 46 |  |       |       |       |       | -83   | TDD |
| CA_2A-46C-48A-66A <sup>12</sup>   | 48 |  |       | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-46C-48A-66A <sup>12</sup>   | 66 |  |       | -99.3 | -96.3 | -94.5 | -93.3 | FDD |
| CA_2A-46A-66A   | 2  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_2A-46A-66A   | 46 |  |       |       |       |       | -90   | TDD |
| CA_2A-46A-66A   | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
| CA_2A-46A-46A-66A   | 2  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_2A-46C-66A   | 46 |  |       |       |       |       | -90   | TDD |
| CA_2A-46C-66A   | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
| CA_2A-46A-46C-66A   | 2  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_2A-46D-66A   | 46 |  |       |       |       |       | -90   | TDD |
| CA_2A-46E-66A   |    |  |       |       |       |       |       |     |
| CA_2A-46A-66A-66A,<br>CA_2A-46C-66A-66A,<br>CA_2A-46D-66A-66A,<br>CA_2A-46E-66A-66A | 66 |  |       | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
| CA_2A-49A <sup>9</sup>  | 2  |  |       | -97.8 | -94.8 | -93.0 | -91.7 | FDD |
| CA_2A-49A <sup>9</sup>  | 49 |  |       |       | -95.5 |       | -92.5 | TDD |
| CA_3A-7A-46C  | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3A-7A-46C  | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_3A-7A-46C  | 46 |  |       |       |       |       | -90   | TDD |
| CA_3A-7A-46D  | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3A-7A-46D  | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_3A-7A-46D  | 46 |  |       |       |       |       | -90   | TDD |
| CA_3A-7A-46E  | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3A-7A-46E  | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_3A-7A-46E  | 46 |  |       |       |       |       | -90   | TDD |
| CA_3A-46A   | 3  |  | -98.7 | -97   | -94   | -92.2 | -91   | FDD |
| CA_3A-46C   |    |  |       |       |       |       |       |     |
| CA_3A-46D   | 46 |  |       |       | -93   |       | -90   | TDD |
| CA_3A-46E   |    |  |       |       |       |       |       |     |
| CA_3C-46A   | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3C-46A   | 46 |  |       |       |       |       | -90   | TDD |
| CA_3A-3A-46A  | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3C-46C   |    |  |       |       |       |       | -90   | TDD |
| CA_3C-46D   |    |  |       |       |       |       |       |     |
| CA_3A-3A-46C  | 46 |  |       |       |       |       |       | TDD |
| CA_3A-7A-46A  | 3  |  |       | -97   | -94   | -92.2 | -91   | FDD |
| CA_3A-7A-46A  | 7  |  |       | -98   | -95   | -93.2 | -92   | FDD |

|  |    |  |  |       |       |       |       |     |
|--|----|--|--|-------|-------|-------|-------|-----|
| CA_3A-7C-46A<br>CA_3A-7C-46C<br>CA_3A-7C-46D<br>CA_3A-7C-46E   | 46 |  |  |       |       |       | -90   | TDD |
| CA_3A-32A-46A<br>CA_3A-32A-46C<br>CA_3A-32A-46D<br>CA_3A-32A-46E                                     | 3  |  |  | -97   | -94   | -92.2 | -91   | FDD |
|  | 32 |  |  | -100  | -97   | -95.2 | -94   | SDL |
| CA_3A-7A-32A-46A<br>CA_3A-7A-32A-46C<br>CA_3A-7A-32A-46D<br>CA_3A-7A-32A-46E                         | 3  |  |  | -97   | -94   | -92.2 | -91   | FDD |
|  | 7  |  |  |       | -95   | -93.2 | -92   | FDD |
| CA_3A-7A-32A-46A<br>CA_3A-7A-32A-46C<br>CA_3A-7A-32A-46D<br>CA_3A-7A-32A-46E                         | 32 |  |  | -100  | -97   | -95.2 | -94   | FDD |
|  | 46 |  |  |       |       |       | -90   | TDD |
| CA_4A-46A<br>CA_4A-46C<br>CA_4A-46A-46A<br>CA_4A-46A-46C<br>CA_4A-46D<br>CA_4A-46A-46D               | 4  |  |  | -100  | -97   | -95.2 | -94   | FDD |
|  | 46 |  |  |       |       |       | -90   | TDD |
| CA_5A-7A-46A<br>CA_5A-7A-46C<br>CA_5A-7A-46D   | 5  |  |  | -98   | -95   |       |       | FDD |
|  | 7  |  |  |       | -95   | -93.2 | -92   | FDD |
| CA_5A-7A-46A<br>CA_5A-7A-46D   | 46 |  |  |       |       |       | -90   | TDD |
|  | 46 |  |  |       |       |       | -90   | TDD |
| CA_5A-12A-46A, CA_5A-12A-46C,<br>CA_5A-12A-46D   | 5  |  |  | -98   | -95   |       |       | FDD |
|  | 12 |  |  | -97   | -94   |       |       | FDD |
| CA_5A-46A<br>CA_5A-46C<br>CA_5A-46D<br>CA_5A-46E<br>CA_5B-46A<br>CA_5B-46C<br>CA_5B-46D<br>CA_5B-46E | 46 |  |  |       |       |       | -90   | TDD |
|  | 5  |  |  | -98   | -95   |       |       | FDD |
| CA_5A-46A-66A  | 46 |  |  |       |       |       | -90   | FDD |
|  | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
| CA_5A-46C-66A  | 5  |  |  | -98   | -95   |       |       | FDD |
|  | 46 |  |  |       |       |       | -90   | TDD |
| CA_5A-46D-66A, CA_5A-46E-66A,<br>CA_5A-46A-66A-66A,<br>CA_5A-46C-66A-66A,<br>CA_5A-46D-              | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
|  | 5  |  |  | -98   | -95   |       |       | FDD |
| CA_5A-46D-66A, CA_5A-46E-66A,<br>CA_5A-46A-66A-66A,<br>CA_5A-46C-66A-66A,<br>CA_5A-46D-              | 46 |  |  |       |       |       | -90   | FDD |
|  | 66 |  |  | -99.5 | -96.5 | -94.7 | -93.5 | FDD |

|                                   |    |        |       |       |       |       |       |     |
|-----------------------------------|----|--------|-------|-------|-------|-------|-------|-----|
| 66A-66A,<br>CA_5A-46E-<br>66A-66A |    |        |       |       |       |       |       |     |
| CA_7A-46A                         | 7  |        |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_7A-46C                         | 46 |        |       |       |       |       |       | TDD |
| CA_7A-7A-<br>46C                  |    |        |       |       |       |       |       |     |
| CA_7A-46D                         |    |        |       |       | -93   |       | -90   |     |
| CA_7A-46E                         |    |        |       |       |       |       |       |     |
| CA_7C-46A                         |    |        |       |       |       |       |       |     |
| CA_7C-46C                         |    |        |       |       |       |       |       |     |
| CA_7C-46D                         |    |        |       |       |       |       |       |     |
| CA_7C-46E                         |    |        |       |       |       |       |       |     |
| CA_7A-7A-<br>46A                  | 7  |        |       | -98   | -95   | -93.2 | -92   | FDD |
| CA_7A-7A-<br>46D                  | 46 |        |       |       |       |       |       | TDD |
| CA_7A-7A-<br>46E                  |    |        |       |       |       |       | -90   |     |
| CA_7A-32A-<br>46A                 | 7  |        |       |       | -95   | -93.2 | -92   | FDD |
| CA_7A-32A-<br>46C                 | 32 |        |       | -100  | -97   | -95.2 | -94   | SDL |
| CA_7A-32A-<br>46D                 | 46 |        |       |       |       |       |       | TDD |
| CA_7A-32A-<br>46E                 |    |        |       |       |       |       | -90   |     |
| CA_7A-46A-<br>66A                 | 7  |        |       | -97.5 | -94.5 | -92.7 | -91.5 | FDD |
|                                   | 46 |        |       |       | -93   |       | -90   | TDD |
|                                   | 66 |        |       | -99   | -96   | -94.2 | -93   | FDD |
| CA_8A-46A                         | 8  | -102.2 | -99.2 | -97   | -94   |       |       | FDD |
| CA_8A-46D                         | 46 |        |       |       |       |       |       | TDD |
| CA_8A-46E                         |    |        |       |       |       |       | -90   |     |
| CA_8B-46C                         |    |        |       |       |       |       |       |     |
| CA_8B-46D                         |    |        |       |       |       |       |       |     |
| CA_8A-46C                         | 8  | -102.2 | -99.2 | -97   | -94   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_8B-46A                         | 8  | -102.2 | -99.2 | -97   | -94   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_11A-46A                        | 11 |        |       | -100  | -97   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_11A-46C                        | 11 |        |       | -100  | -97   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_11A-46D                        | 11 |        |       | -100  | -97   | -95.2 |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_11A-46E                        | 11 |        |       | -100  | -97   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_12A-46A                        | 12 |        |       | -97   | -94   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_12A-46E                        | 12 |        |       | -97   | -94   |       |       | FDD |
|                                   | 46 |        |       |       |       |       | -90   | TDD |
| CA_13A-46A                        | 13 |        |       | -97   | -94   |       |       | FDD |
| CA_13A-46A-<br>46A                | 46 |        |       |       |       |       |       | TDD |
| CA_13A-46A-<br>46C                |    |        |       |       |       |       |       |     |
| CA_13A-46A-<br>46D                |    |        |       |       |       |       |       |     |
| CA_13A-46C                        |    |        |       |       |       |       |       |     |
| CA_13A-46D                        |    |        |       |       |       |       |       |     |
| CA_13A-46E                        |    |        |       |       |       |       |       |     |
|                                   | 13 |        |       | -97   | -94   |       |       | FDD |

|                    |    |        |       |                    |                    |       |       |     |
|--------------------|----|--------|-------|--------------------|--------------------|-------|-------|-----|
| CA_13A-46A-66A     | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_13A-46C-66A     |    |        |       |                    |                    |       |       |     |
| CA_13A-46D-66A     |    |        |       |                    |                    |       |       |     |
| CA_13A-46A-66A-66A | 66 |        |       | -99.5              | -96.5              | -94.7 | -93.5 | FDD |
| CA_13A-46C-66A-66A |    |        |       |                    |                    |       |       |     |
| CA_13A-46D-66A-66A |    |        |       |                    |                    |       |       |     |
| CA_13A-46E-66A     |    |        |       |                    |                    |       |       |     |
| CA_19A-46A         | 19 |        |       | -100               | -97                | -95.2 |       | FDD |
| CA_19A-46C         |    |        |       |                    |                    |       |       |     |
| CA_19A-46D         | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_19A-46E         |    |        |       |                    |                    |       |       |     |
| CA_21A-46A         | 21 |        |       | -100               | -97                | -95.2 |       | FDD |
| CA_21A-46C         |    |        |       |                    |                    |       |       |     |
| CA_21A-46D         | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_21A-46E         |    |        |       |                    |                    |       |       |     |
| CA_25A-46A         | 25 | -101.2 | -98.2 | -96.5              | -93.5              | -91.7 | -90.5 | FDD |
| CA_25A-46C         | 46 |        |       |                    | -93                |       | -90   | TDD |
| CA_25A-46D         |    |        |       |                    |                    |       |       |     |
| CA_26A-46A         | 26 |        | -99.7 | -97.5 <sup>7</sup> | -94.5 <sup>7</sup> |       |       | FDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_28A-46A         | 28 |        |       | -98.5              | -95.5              | -93.7 | -91   | FDD |
| CA_28A-46C         |    |        |       |                    |                    |       |       |     |
| CA_28A-46D         | 46 |        |       |                    | -93                |       | -90   | TDD |
| CA_28A-46E         |    |        |       |                    |                    |       |       |     |
| CA_29A-46A-66A     | 29 |        |       | -97                | -94                |       |       | FDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
|                    | 66 |        |       | -99.5              | -96.5              | -94.7 | -93.5 | FDD |
| CA_39A-46A         | 39 |        |       | -100               | -97                | -95.2 | -94   | TDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_39A-46C         | 39 |        |       | -100               | -97                | -95.2 | -94   | TDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_39C-46A         | 39 |        |       | -100               | -97                | -95.2 | -94   | TDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_39A-46E         | 39 |        |       | -100               | -97                | -95.2 | -94   | TDD |
| CA_39C-46C         |    |        |       |                    |                    |       | -90   |     |
| CA_39C-46D         | 46 |        |       |                    |                    |       |       |     |
| CA_40A-46A         | 40 |        |       | -100               | -97                | -95.2 | -94   | TDD |
| CA_40A-46D         |    |        |       |                    |                    |       |       |     |
| CA_40A-46E         |    |        |       |                    |                    |       |       |     |
| CA_40C-46C         | 46 |        |       |                    | -93                |       | -90   | TDD |
| CA_40C-46D         |    |        |       |                    |                    |       |       |     |
| CA_40D-46A         |    |        |       |                    |                    |       |       |     |
| CA_40D-46C         |    |        |       |                    |                    |       |       |     |
| CA_40A-46C         | 40 |        |       | -100               | -97                | -95.2 | -94   | TDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_40C-46A         | 40 |        |       | -100               | -97                | -95.2 | -94   | TDD |
|                    | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_41A-46A         | 41 |        |       | -98                | -95                | -93.2 | -92   | TDD |
| CA_41A-46C         |    |        |       |                    |                    |       |       |     |
| CA_41A-46D         |    |        |       |                    |                    |       |       |     |
| CA_41A-46E         |    |        |       |                    |                    |       |       |     |
| CA_41C-46A         | 46 |        |       |                    |                    |       | -90   | TDD |
| CA_41C-46C         |    |        |       |                    |                    |       |       |     |
| CA_41C-46D         |    |        |       |                    |                    |       |       |     |
| CA_41D-46A         |    |        |       |                    |                    |       |       |     |
| CA_41D-46C         |    |        |       |                    |                    |       |       |     |
| CA_42A-46A         | 42 |        |       | -99                | -96                | -94.2 | -93   | TDD |
|                    | 46 |        |       |                    |                    |       | -83   | TDD |

|                                 |    |  |  |       |       |       |       |     |
|---------------------------------|----|--|--|-------|-------|-------|-------|-----|
| CA_46A-48A                      | 46 |  |  |       |       |       | -83   | TDD |
| CA_46A-48A-48A                  |    |  |  |       |       |       |       |     |
| CA_46A-48C                      |    |  |  |       |       |       |       |     |
| CA_46A-48D                      |    |  |  |       |       |       |       |     |
| CA_46A-48E                      |    |  |  |       |       |       |       |     |
| CA_46C-48A                      |    |  |  |       |       |       |       |     |
| CA_46C-48A-48A                  |    |  |  |       |       |       |       |     |
| CA_46C-48C                      | 48 |  |  | -99   | -96   | -94.2 | -93   | TDD |
| CA_46C-48D                      |    |  |  |       |       |       |       |     |
| CA_46C-48E                      |    |  |  |       |       |       |       |     |
| CA_46D-48A                      |    |  |  |       |       |       |       |     |
| CA_46D-48C                      |    |  |  |       |       |       |       |     |
| CA_46D-48A-48A                  |    |  |  |       |       |       |       |     |
| CA_46E-48A                      |    |  |  |       |       |       |       |     |
| CA_46E-48C                      |    |  |  |       |       |       |       |     |
| CA_46A-48A-66A <sup>10,11</sup> | 46 |  |  |       |       |       | -83   | FDD |
| CA_46A-48C-66A <sup>10,11</sup> | 48 |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_46A-48D-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46A-48E-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46C-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46C-48C-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46C-48D-66A <sup>10,11</sup> | 66 |  |  | -99.3 | -96.3 | -94.5 | -93.2 | FDD |
| CA_46C-48E-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46D-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46D-48C-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46E-48A-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46E-48C-66A <sup>10,11</sup> |    |  |  |       |       |       |       |     |
| CA_46A-48A-66A <sup>12</sup>    | 46 |  |  |       |       |       | -83   | FDD |
| CA_46A-48C-66A <sup>12</sup>    | 48 |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_46A-48D-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46A-48E-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46C-48A-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46C-48C-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46C-48D-66A <sup>12</sup>    | 66 |  |  | -99.3 | -96.3 | -94.5 | -93.2 | FDD |
| CA_46C-48E-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46D-48A-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46D-48C-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46E-48A-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46E-48C-66A <sup>12</sup>    |    |  |  |       |       |       |       |     |
| CA_46A-48A-71A                  | 46 |  |  |       |       |       | -83   | TDD |
|                                 | 48 |  |  | -99   | -96   | -94.2 | -93   | TDD |

|  |    |  |  |  |       |       |       |       |     |
|--|----|--|--|--|-------|-------|-------|-------|-----|
| CA_46A-48A-48A-71A<br>CA_46A-48C-71A<br>CA_46C-48A-71A<br>CA_46C-48C-71A<br>CA_46C-48A-48A-71A   | 71 |  |  |  | -97.2 | -94.2 | -92.0 | -87.5 | FDD |
| CA_46A-66A<br>CA_46A-46A-66A<br>CA_46A-66A-66A<br>CA_46A-66C<br>CA_46A-46C-66A<br>CA_46A-46D-66A<br>CA_46C-66A<br>CA_46C-66A-66A<br>CA_46D-66A<br>CA_46D-66A-66A<br>CA_46E-66A<br>CA_46E-66A-66A | 46 |  |  |  |       |       |       | -90   | TDD |
| CA_46A-66A<br>CA_46A-66A-66A<br>CA_46A-66C<br>CA_46A-46C-66A<br>CA_46A-46D-66A<br>CA_46C-66A<br>CA_46C-66A-66A<br>CA_46D-66A<br>CA_46D-66A-66A<br>CA_46E-66A<br>CA_46E-66A-66A                   | 66 |  |  |  | -99.5 | -96.5 | -94.7 | -93.5 | FDD |
| CA_46A-70A   | 46 |  |  |  |       |       |       | -90   | TDD |
|  | 70 |  |  |  | -100  | -97   | -95.2 |       | FDD |
| CA_46A-71A<br>CA_46C-71A<br>CA_46D-71A   | 46 |  |  |  |       |       |       | -90   | FDD |
|  | 71 |  |  |  | -97.2 | -94.2 | -92.0 | -87.5 | TDD |

NOTE 1: The transmitter shall be set to P<sub>UMAX</sub> as defined in subclause 6.2.5A.

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1.

NOTE 3: The signal power is specified per port.

NOTE 4: Void

NOTE 5: The requirement for B46 does not apply when there is at least one individual RE within the B46 downlink transmission bandwidth which falls into the reference sensitivity exclusion region as specified in Table 7.3.1A-0eC.

NOTE 6: Void

NOTE 7: <sup>7</sup> indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.

NOTE 8: When Band 46 have self interference problems by dual uplink CA, then the requirements not apply in exclusion zone which is frequency range within (harmonics frequency region + ΔF<sub>HD</sub>) and IMD frequency region as follow.

NOTE 9: The requirement for B49 does not apply when there is at least one individual RE within the B49 downlink transmission bandwidth which falls into the reference sensitivity exclusion region as specified in Table 7.3.1A-0eD.

NOTE 10: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band which excludes band 46 and a range ΔF<sub>HD</sub> above and below the edge of this downlink transmission bandwidth. The value ΔF<sub>HD</sub> depends on the E-UTRA configuration: ΔF<sub>HD</sub> = 10 MHz for CA\_2-46-48, CA\_46-48-66, and CA\_2-46-48-66. For harmonic issue not related with band 46, the uplink configuration of CA\_2-48, CA\_48-66 and CA\_2-48-66 in Table 7.3.1A-0b can be used.

NOTE 11: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$  in MHz and

$$F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$$

with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.

NOTE 12: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher) band with

$F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

IMD frequency range

| DL_CA configuration | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW |
|---------------------|---------------------|---------------------------------|-------------------|
| CA_1A-3A-46A        | CA_1A-3A            | 2*fc_1A + fc_3A                 | 2*BW_1A + BW_3A   |
| CA_1A-3A-46A        | CA_1A-3A            | fc_1A - 2*fc_3A                 | BW_1A + 2*BW_3A   |

IMD frequency range

| DL_CA configuration | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW |
|---------------------|---------------------|---------------------------------|-------------------|
| CA_1A-5A-46A        | CA_1A-5A            | 2*fc_1A + 2*fc_5A               | 2*BW_1A + 2*BW_5A |
| CA_1A-7A-46A        | CA_1A-7A            | 3*fc_7A - fc_1A                 | 3*BW_7A + BW_1A   |
| CA_5A-7A-46A        | CA_5A-7A            | 2*fc_7A + fc_5A                 | 2*BW_7A + BW_5A   |

IMD frequency range

| DL_CA configuration | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW |
|---------------------|---------------------|---------------------------------|-------------------|
| CA_2A-5A-46D        | CA_2A-5A            | 3*fc_5A + 1*fc_2A               | 3*BW_5A + 1*BW_2A |
| CA_2A-5A-46D        | CA_2A-5A            | 2*fc_5A - 3*fc_2A               | 2*BW_5A + 3*BW_2A |

IMD frequency range

| DL_CA configuration | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW  |
|---------------------|---------------------|---------------------------------|--------------------|
| CA_5A-46D-66A       | CA_5A-66A           | 3*fc_66A + 1*fc_5A              | 3*BW_66A + 1*BW_5A |
| CA_5A-46D-66A       | CA_5A-66A           | 2*fc_66A - 3*fc_5A              | 2*BW_66A + 3*BW_5A |
| CA_5A-46D-66A       | CA_5A-66A           | 2*fc_66A + 3*fc_5A              | 2*BW_66A + 3*BW_5A |

IMD frequency range

| DL_CA configuration | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW   |
|---------------------|---------------------|---------------------------------|---------------------|
| CA_13A-46D-66A      | CA_13A-66A          | 2*fc_66A + 2*fc_13A             | 2*BW_66A + 2*BW_13A |
| CA_13A-46D-66A      | CA_13A-66A          | 2*fc_66A + 3*fc_13A             | 2*BW_66A + 3*BW_13A |

IMD frequency range

| DL_CA configuration   | UL_CA configuration | Exclusion zone center frequency | Exclusion zone BW  |
|---|---------------------|---------------------------------|--------------------|
| CA_2A-13A-46D<br>CA_2A-13A-46A-46D<br>CA_2A-13A-46A-46C<br>CA_2A-13A-46C<br>CA_2A-13A-46A-46A<br>CA_2A-13A-46A<br>CA_2A-13A-46E | CA_2A-13A           | 3*fc_13A + 1*fc_2A              | 3*BW_13A + 1*BW_2A |

IMD frequency range

| DL_CA configuration  | UL_CA configuration | Exclusion zone center frequency  | Exclusion zone BW  |
|--|---------------------|--|--|
| CA_2A-46E-66A<br>CA_2A-46D-66A<br>CA_2A-46C-66A<br>CA_2A-46A-66A | CA_2A-66A           | 2*fc_2A + 1*fc_66A<br>2*fc_66A + 1*fc_2A<br>1*fc_2A - 4*fc_66A<br>1*fc_66A - 4*fc_2A | 2*BW_2A + 1*BW_66A<br>2*BW_66A + 1*BW_2A<br>1*BW_2A + 4*BW_66A<br>1*BW_66A + 4*BW_2A |

IMD frequency range

| DL_CA configuration  | UL_CA configuration | Exclusion zone center frequency          | Exclusion zone BW                        |
|--|---------------------|--|--|
| CA_2A-46E-48A,<br>CA_2A-46D-48A<br>CA_2A-46D-48C<br>CA_2A-46C-48C<br>CA_2A-46A-48C<br>CA_2A-46C-48A<br>CA_2A-46A-48A | CA_2A-48A           | 1*fc_2A + 1*fc_48A<br>2*fc_48A - 1*fc_2A | 1*BW_2A + 1*BW_48A<br>2*BW_48A + 1*BW_2A |

| IMD frequency range  |                     |  |  |
|--|---------------------|--|--|
| DL_CA configuration  | UL_CA configuration | Exclusion zone center frequency            | Exclusion zone BW                                |
| CA_46D-48C-66A<br>CA_46C-48C-66A<br>CA_46A-48C-66A<br>CA_46D-48A-66A<br>CA_46C-48A-66A<br>CA_46A-48A-66A | CA_48A-66A          | 1*fc_48A + 1*fc_66A<br>2*fc_48A – 1*fc_66A | 1*BW_48A +<br>1*BW_66A<br>2*BW_48A +<br>1*BW_66A |

**Table 7.3.1A-0eB: Void**

Table 7.3.1A-0eC specifies the Band 46 reference measurement exclusion region for different licensed component carriers and channel bandwidth. The exclusion region is defined according to the licensed component carrier channel bandwidth. The UL configurations to be adopted for the test are specified in Table 7.3.1-2. The exclusion region in Table 7.3.1A-0eC is specified for the case of 10MHz and 20MHz channel bandwidth in Band 46.

**Table 7.3.1A-0eC: Band 46 Reference sensitivity measurement exclusion region in MHz.**

| Licensed Component Carriers / E-UTRA Band / Harmonic order / Channel BW in UL |                |        |        |        |        |
|---|----------------|--------|--------|--------|--------|
| Licensed Component Carriers   | Harmonic order | 5MHz   | 10MHz  | 15MHz  | 20MHz  |
| 1   | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 2   | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 3   | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 4   | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 5   | 7              | +/- 10 | +/- 20 |        |        |
| 7 <sup>1</sup>  | 2              | +/- 15 | +/- 25 | +/- 38 | +/- 50 |
| 8   | 6              | +/- 10 | +/- 20 |        |        |
| 11  | 4              | +/- 15 | +/- 25 |        |        |
| 12  | 8              | +/- 10 | +/- 20 |        |        |
| 13  | 7              | +/- 10 | +/- 20 |        |        |
| 19  | 7              | +/- 10 | +/- 20 | +/- 30 |        |
| 21  | 4              | +/- 15 | +/- 25 | +/- 38 |        |
| 25  | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 26  | 7              | +/- 10 | +/- 20 | +/- 30 |        |
| 28  | 7              | +/- 10 | +/- 20 | +/- 30 | +/- 40 |
| 28  | 8              | +/- 10 | +/- 20 | +/- 30 | +/- 40 |
| 39  | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |
| 41  | 2              | +/- 15 | +/- 25 | +/- 38 | +/- 50 |
| 66  | 3              | +/- 15 | +/- 23 | +/- 35 | +/- 45 |

NOTE 1: Even though UL harmonic does not fall directly into Band 46 the exclusion region still applies.  
 NOTE 2: The center of the exclusion region is obtained by multiplying the UL channel center frequency by the harmonic order.

Table 7.3.1A-0eD specifies the Band 49 reference measurement exclusion region for different licensed component carriers and channel bandwidth. The exclusion region is defined according to the licensed component carrier channel bandwidth. The UL configurations to be adopted for the test are specified in Table 7.3.1-2.



**Table 7.3.1A-0eD: Band 49 reference sensitivity measurement exclusion region in MHz.**

| Licensed Component Carriers / E-UTRA Band / Harmonic order / Channel BW in UL  |                |          |        |          |        |
|--|----------------|----------|--------|----------|--------|
| Licensed Component Carriers  | Harmonic order | 5MHz     | 10MHz  | 15MHz    | 20MHz  |
| 2 <sup>1</sup>   | 2              | +/- 12.5 | +/- 25 | +/- 37.5 | +/- 50 |
| NOTE 1: Even though UL harmonic does not fall directly into Band 49 the exclusion region still applies.                      |                |          |        |          |        |
| NOTE 2: The center of the exclusion region is obtained by multiplying the UL channel center frequency by the harmonic order. |                |          |        |          |        |

In all cases for single uplink inter-band CA, unless given by Table 7.3.1-3 for the band with the active uplink carrier, the applicable reference sensitivity requirements shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

For inter-band carrier aggregation with one component carrier per operating band (up to four downlinks) and the uplink assigned to two E-UTRA bands the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1, Table 7.3.1-1a and Table 7.3.1-2. The reference sensitivity is defined to be met with all downlink component carriers active and both of the uplink carriers active.

For E-UTRA CA configurations with uplink and downlink assigned to two E-UTRA bands given in Table 7.3.1A-0f, the reference sensitivity is defined only for the specific uplink and downlink test points which are specified in Table 7.3.1A-0f. For E-UTRA CA configurations with uplink assigned to two E-UTRA bands and downlink assigned to three E-UTRA bands given in Table 7.3.1A-0g, the reference sensitivity is defined only for the specific uplink and downlink test points which are specified in Table 7.3.1A-0g. For these test points the reference sensitivity requirement specified in Table 7.3.1-1 and Table 7.3.1-1a are relaxed by the amount of the corresponding parameter MSD given in Table 7.3.1A-0f and Table 7.3.1A-0g.

The allowed exceptions defined in Table 7.3.1A-0a and Table 7.3.1A-0b for inter-band carrier aggregation with a single active uplink are also applicable for dual uplink operation.

**Table 7.3.1A-0f: 2DL/2UL interband Reference sensitivity QPSK  $P_{\text{REFSENS}}$  and uplink/downlink configurations**

| EUTRA CA Configuration | E-UTRA Band / Channel bandwidth / $N_{\text{RB}}$ / Duplex mode |                |                |                     |                |          |             | Source of IMD     |
|------------------------|---|----------------|----------------|---------------------|----------------|----------|-------------|-------------------|
|                        | EUTRA band  | UL $F_c$ (MHz) | UL/DL BW (MHz) | UL $C_{\text{LRB}}$ | DL $F_c$ (MHz) | MSD (dB) | Duplex mode |                   |
| CA_1A-3A               | 1   | 1950           | 5              | 25                  | 2140           | 23       | FDD         | IMD3              |
|                        | 3   | 1760           | 5              | 25                  | 1855           | N/A      |             | N/A               |
| CA_1A-8A               | 1   | 1965           | 5              | 25                  | 2155           | 6        | FDD         | IMD4              |
|                        | 8   | 887.5          | 5              | 25                  | 932.5          | N/A      |             | N/A               |
| CA_2A-4A               | 2   | 1860           | 20             | 50 <sup>2</sup>     | 1940           | 5        | FDD         | IMD3              |
|                        | 4   | 1752.5         | 5              | 25                  | 2152.5         | N/A      |             | N/A               |
| CA_2A-4A               | 2   | 1868.3         | 5              | 25                  | 1948.3         | N/A      | FDD         | N/A               |
|                        | 4   | 1735           | 5              | 25                  | 2135           | 5        |             | IMD5              |
| CA_2A-46A              | 2   | 1880           | 5              | 25                  | 1960           | 12.0     | FDD         | IMD3 <sup>4</sup> |
|                        | 46  | 5720           | 20             | 100                 | 5720           | N/A      |             | N/A               |
| CA_2A-48A              | 2   | 1852.5         | 5              | 25                  | 1932.5         | [12]     | FDD         | IMD4              |
|                        | 48  | 3625           | 20             | 100                 | 3625           | N/A      |             | TDD               |
| CA_2A-49A              | 2   | 1852.5         | 5              | 25                  | 1932.5         | [12]     | FDD         | IMD4              |
|                        | 49  | 3625           | 20             | 100                 | 3625           | N/A      |             | TDD               |
| CA_2A-66A              | 2   | 1855           | 5              | 25                  | 1935           | 20       | FDD         | IMD3              |
|                        | 66  | 1775           | 5              | 25                  | 2175           | N/A      |             | N/A               |
| CA_2A-66A              | 2   | 1883.3         | 5              | 25                  | 1963.3         | N/A      | FDD         | N/A               |
|                        | 66  | 1750           | 5              | 25                  | 2150           | 4        |             | IMD5              |
| CA_3A-5A               | 3   | 1771           | 10             | 50                  | 1866           | 4        | FDD         | IMD4              |
|                        | 5   | 838            | 5              | 25                  | 883            | N/A      |             | N/A               |
| CA_3A-5A               | 3   | 1721           | 10             | 50                  | 1816           | N/A      | FDD         | N/A               |
|                        | 5   | 838            | 5              | 25                  | 883            | 24       |             | IMD2 <sup>4</sup> |
| CA_3A-7A               | 3   | 1730           | 5              | 25                  | 1825           | N/A      | FDD         | N/A               |

|                         |    |        |     |     |        |       |     |                   |
|-------------------------|----|--------|-----|-----|--------|-------|-----|-------------------|
|                         | 7  | 2535   | 10  | 50  | 2655   | 13    |     | IMD4              |
| CA_3A-8A                | 3  | 1755   | 10  | 50  | 1850   | N/A   | FDD | N/A               |
|                         | 8  | 900    | 5   | 25  | 945    | 8     |     | IMD4 <sup>4</sup> |
| CA_3A-8A                | 3  | 1747.5 | 10  | 50  | 1842.5 | 6.4   | FDD | IMD5              |
|                         | 8  | 897.5  | 5   | 25  | 942.5  | N/A   |     | N/A               |
| CA_3A-18A               | 3  | 1721   | 5   | 25  | 1816   | 4     | FDD | IMD4              |
|                         | 18 | 823    | 5   | 25  | 868    | N/A   |     | N/A               |
| CA_3A-19A               | 3  | 1771   | 5   | 25  | 1866   | 4     | FDD | IMD4              |
|                         | 19 | 838    | 5   | 25  | 883    | N/A   |     | N/A               |
| CA_3A-19A               | 3  | 1721   | 5   | 25  | 1816   | N/A   | FDD | N/A               |
|                         | 19 | 838    | 5   | 25  | 883    | 27    |     | IMD2 <sup>4</sup> |
| CA_3A-20A               | 3  | 1775   | 5   | 25  | 1870   | 4     | FDD | IMD4              |
|                         | 20 | 840    | 5   | 25  | 799    | N/A   |     | N/A               |
| CA_3A-20A               | 3  | 1735   | 5   | 25  | 1830   | N/A   | FDD | N/A               |
|                         | 20 | 847    | 5   | 25  | 806    | 9     |     | IMD4              |
| CA_3A-26A               | 3  | 1771   | 5   | 25  | 1866   | 4     | FDD | IMD4              |
|                         | 26 | 838    | 5   | 25  | 883    | N/A   |     | N/A               |
| CA_3A-26A               | 3  | 1721   | 5   | 25  | 1816   | N/A   | FDD | N/A               |
|                         | 26 | 838    | 5   | 25  | 883    | 26    |     | IMD2 <sup>4</sup> |
| CA_3A-41A               | 3  | 1740   | 5   | 25  | 1835   | 8.2   | FDD | IMD4              |
|                         | 41 | 2657.5 | 5   | 25  | 2657.5 | N/A   |     | TDD               |
| CA_3A-42A               | 3  | 1740   | 5   | 25  | 1835   | 29.8  | FDD | IMD2 <sup>4</sup> |
|                         | 42 | 3575   | 5   | 25  | 3575   | N/A   |     | TDD               |
| CA_3A-42A               | 3  | 1765   | 5   | 25  | 1860   | 8.0   | FDD | IMD4 <sup>4</sup> |
|                         | 42 | 3435   | 5   | 25  | 3435   | N/A   |     | TDD               |
| CA_4A-5A                | 4  | 1721   | 5   | 25  | 2121   | N/A   | FDD | N/A               |
|                         | 5  | 838    | 5   | 25  | 883    | 26    |     | IMD2 <sup>4</sup> |
| CA_4A-7A                | 4  | 1730   | 5   | 25  | 2130   | N/A   | FDD | N/A               |
|                         | 7  | 2535   | 5   | 25  | 2655   | 15    |     | IMD4              |
| CA_5A-7A                | 5  | 834    | 5   | 25  | 879    | 12    | FDD | IMD3 <sup>4</sup> |
|                         | 7  | 2547   | 10  | 50  | 2667   | N/A   |     | N/A               |
| CA_5A-66A               | 5  | 838    | 5   | 25  | 883    | 30    | FDD | IMD2 <sup>4</sup> |
|                         | 66 | 1721   | 5   | 25  | 2121   | N/A   |     | N/A               |
| CA_7A-20A               | 7  | 2512   | 10  | 50  | 2632   | N/A   | FDD | N/A               |
|                         | 20 | 851    | 5   | 25  | 810    | 12    |     | IMD3 <sup>4</sup> |
| CA_7A-26A               | 7  | 2556   | 5   | 25  | 2676   | N/A   | FDD | N/A               |
|                         | 26 | 837    | 5   | 25  | 882    | 16.0  | FDD | IMD3              |
|                         | 7  | 2567.5 | 5   | 25  | 2687.5 | 2.5   | FDD | IMD5              |
|                         | 26 | 816.5  | 5   | 25  | 861.5  | N/A   | FDD | N/A               |
| CA_8A-41A               | 8  | 882.5  | 5   | 25  | 927.5  | 12.1  | FDD | IMD3 <sup>4</sup> |
|                         | 41 | 2685   | 10  | 50  | 2685   | N/A   |     | TDD               |
| CA_19A-42A <sup>3</sup> | 19 | N/A    | N/A | N/A | N/A    | N/A   | FDD | N/A               |
|                         | 42 | N/A    | N/A | N/A | N/A    | N/A   |     | TDD               |
| CA_21A-28A              | 21 | 1450.4 | 5   | 25  | 1498.4 | [2.5] | FDD | IMD5              |
|                         | 28 | 735.5  | 5   | 25  | 790.5  | N/A   |     | TDD               |
| CA_21A-42A <sup>3</sup> | 21 | N/A    | N/A | N/A | N/A    | N/A   | FDD | N/A               |
|                         | 42 | N/A    | N/A | N/A | N/A    | N/A   |     | TDD               |
| CA_28A-42A              | 28 | 705.5  | 5   | 25  | 760.5  | [5.5] | FDD | IMD5              |
|                         | 42 | 3582.5 | 5   | 25  | 3582.5 | N/A   |     | TDD               |
| CA_40A-42A              | 40 | 2350   | 5   | 25  | 2350   | N/A   | TDD | N/A               |
|                         | 42 | 3500   | 5   | 25  | 3550   | 5     |     | IMD4              |
|                         | 40 | 2350   | 5   | 25  | 2350   | 5     | TDD | IMD4              |
|                         | 42 | 3525   | 5   | 25  | 3525   | N/A   |     | N/A               |

NOTE 1: Both of the transmitters shall be set min(+20 dBm, P<sub>C<sub>MAX</sub>L,c</sub>) as defined in subclause 6.2.5A

NOTE 2: RB<sub>START</sub> = 0

NOTE 3: No requirements apply when there is at least one individual RE within the intermodulation generated by the dual uplink is within the downlink transmission bandwidth of the FDD band. The reference sensitivity should only be verified when this is not the case (the requirements specified in clause 7.3.1 apply).

NOTE 4: This band is subject to IMD5 also which MSD is not specified.

NOTE 5: Void

NOTE 6: For operations with 4 antenna ports, the MSD in the applicable bands shall be modified by the absolute value of  $\Delta R_{IB,4R}$  in Table 7.3.1-1a when MSD > 0.

**Table 7.3.1A-0g: 3DL/2UL interband Reference sensitivity QPSK  $P_{REFSENS}$  and uplink/downlink configurations**

| E-UTRA Band / Channel bandwidth / NRB / Duplex mode |                  |            |          |       |           |          |       |      |             | Source of IMD |
|---|------------------|------------|----------|-------|-----------|----------|-------|------|-------------|---------------|
| EUTRA CA  | EUTRA CA         | EUTRA band | UL $F_c$ | UL BW | UL        | DL $F_c$ | DL BW | MSD  | Duplex mode |               |
| DL Configuration                                    | UL Configuration |            | (MHz)    | (MHz) | $C_{LRB}$ | (MHz)    | (MHz) | (dB) |             |               |
| CA_1A-3A-28A  | CA_1A-28A        | 1          | 1975     | 5     | 25        | 2165     | 5     | N/A  | FDD         | N/A           |
|   |                  | 28         | 710.5    | 5     | 25        | 765.5    | 5     | N/A  |             | N/A           |
|   |                  | 3          | 1723.5   | 5     | 25        | 1818.5   | 5     | 4.0  |             | IMD5          |
|   | CA_3A-28A        | 3          | 1780     | 5     | 25        | 1875     | 5     | N/A  | FDD         | N/A           |
|   |                  | 28         | 710.5    | 5     | 25        | 765.5    | 5     | N/A  |             | N/A           |
|   |                  | 1          | 1949     | 5     | 25        | 2139     | 5     | 11.0 |             | IMD4          |
| CA_1A-3A-40A  | CA_1A-3A         | 1          | 1950     | 5     | 25        | 2140     | 5     | N/A  | FDD         | N/A           |
|   |                  | 3          | 1735     | 5     | 25        | 1830     | 5     | N/A  | FDD         | N/A           |
|   |                  | 40         | 2380     | 5     | 25        | 2380     | 5     | 8.0  | TDD         | IMD5          |
| CA_1A-3A-41A  | CA_1A-3A         | 1          | 1977.5   | 5     | 25        | 2167.5   | 5     | N/A  | FDD         | N/A           |
|   |                  | 3          | 1712.5   | 5     | 25        | 1807.5   | 5     | N/A  | FDD         | N/A           |
|   |                  | 41         | 2507.5   | 5     | 25        | 2507.5   | 5     | 5.0  | TDD         | IMD5          |
| CA_1A-3A-42A  | CA_1A-3A         | 1          | 1922.5   | 5     | 25        | 2112.5   | 5     | N/A  | FDD         | N/A           |
|   |                  | 3          | 1782.5   | 5     | 25        | 1877.5   | 5     | N/A  | FDD         | N/A           |
|   |                  | 42         |          |       |           | 3425     | 5     | 13.0 | TDD         | IMD4          |
| CA_1A-5A-7A   | CA_1A-7A         | 1          | 1968     | 5     | 25        | 2158     | 5     | N/A  | FDD         | N/A           |
|   |                  | 7          | 2512     | 10    | 50        | 2632     | 10    | N/A  |             | N/A           |
|   |                  | 5          | 835      | 5     | 25        | 880      | 5     | 1.0  |             | IMD5          |
| CA_1A-5A-40A  | CA_1A-5A         | 1          | 1977.5   | 5     | 25        | 2167.5   | 5     | N/A  | FDD         | N/A           |
|   |                  | 5          | 826.5    | 5     | 25        | 871.5    | 5     | N/A  | FDD         | N/A           |
|   |                  | 40         | 2305     | 10    | 50        | 2305     | 10    | 9.0  | TDD         | IMD4          |
| CA_1A-7A-26A  | CA_1A-7A         | 1          | 1965     | 5     | 25        | 2155     | 5     | N/A  | FDD         | N/A           |
|   |                  | 7          | 2510     | 10    | 50        | 2630     | 10    | N/A  |             | N/A           |
|   |                  | 26         | 830      | 5     | 50        | 875      | 5     | 3.5  |             | IMD5          |
| CA_1A-7A-28A  | CA_1A-7A         | 1          | 1935     | 5     | 25        | 2125     | 5     | N/A  | FDD         | N/A           |
|   |                  | 7          | 2510     | 10    | 50        | 2630     | 10    | N/A  |             | N/A           |
|   |                  | 28         | 730      | 10    | 50        | 785      | 10    | 4.5  |             | IMD5          |
|   | CA_1A-28A        | 1          | 1935     | 5     | 25        | 2125     | 5     | N/A  | FDD         | N/A           |
|   |                  | 28         | 730      | 10    | 50        | 785      | 10    | N/A  |             | N/A           |
|   |                  | 7          | 2545     | 10    | 50        | 2665     | 10    | 28.0 |             | IMD2          |
| CA_1A-28A-42A                                       | CA_1A-28A        | 1          | 1955     | 5     | 25        | 2145     | 5     | N/A  | FDD         | N/A           |
|   |                  | 28         | 735      | 5     | 25        | 790      | 5     | N/A  | FDD         | N/A           |
|   |                  | 42         | 3425     | 5     | 25        | 3425     | 5     | 15.0 | TDD         | IMD3          |
|   | CA_28A-42A       | 28         | 710.5    | 5     | 25        | 765.5    | 5     | N/A  | FDD         | N/A           |
|   |                  | 42         | 3560     | 5     | 25        | 3560     | 5     | N/A  | TDD         | N/A           |
|   |                  | 1          | 1949     | 5     | 25        | 2139     | 5     | 11.0 | FDD         | IMD3          |
| CA_2A-12A-30A                                       | CA_2A-12A        | 2          | 1885     | 5     | 25        | 1965     | 5     | N/A  | FDD         | N/A           |
|   |                  | 12         | 708.5    | 5     | 25        | 738.5    | 5     | N/A  |             | N/A           |
|   |                  | 30         | 2308     | 5     | 25        | 2353     | 5     | 12.0 |             | IMD4          |
| CA_2A-2A-4A-5A                                      | CA_2A-5A         | 2          | 1900     | 5     | 25        | 1980     | 5     | N/A  | FDD         | N/A           |
|   |                  | 5          | 834      | 5     | 25        | 879      | 5     |      |             | N/A           |
|   |                  | 4          | 1732     | 5     | 25        | 2132     | 5     |      |             | 7.6           |
| CA_2A-4A-13A  |                  | 2          | 1855     | 5     | 25        | 1935     | 5     | N/A  | FDD         | N/A           |

|                                |  |           |      |      |     |      |      |      |         |                   |                   |                        |
|--------------------------------|--|-----------|------|------|-----|------|------|------|---------|-------------------|-------------------|------------------------|
|                                | CA_2A-13A  | 13        | 782  | 5    | 25  | 751  | 5    | 7.6  | FDD     | N/A               |                   |                        |
|                                |  | 4         | 1746 | 5    | 25  | 2146 | 5    |      |         | IMD4              |                   |                        |
|                                | CA_4A-13A  | 4         | 1750 | 5    | 25  | 2150 | 5    | N/A  |         | N/A               |                   |                        |
|                                |  | 13        | 780  | 5    | 25  | 749  | 5    |      |         | N/A               |                   |                        |
|                                | CA_2A-13A  | 2         | 1860 | 5    | 25  | 1940 | 5    | 6.2  | IMD4    |                   |                   |                        |
|                                |  | 2         | 1900 | 5    | 25  | 1980 | 5    |      | N/A     | N/A               |                   |                        |
|                                | 5  | 834       | 5    | 25   | 879 | 5    | N/A  | N/A  |         |                   |                   |                        |
|                                | CA_2A-2A-5A-66A-66A,<br>CA_2A-5A-66A,<br>CA_2A-5A-66B,<br>CA_2A-5A-66C,<br>CA_2A-5B-66A,<br>CA_2A-5B-66B,<br>CA_2A-5B-66C,<br>CA_2A-2A-5A-66A,<br>CA_2A-2A-5A-66B,<br>CA_2A-2A-5A-66C,<br>CA_2A-5A-66A-66A | CA_2A-5A  | 66   | 1712 | 5   | 25   | 2132 | 5    | 7.2     | FDD               | IMD4              |                        |
| CA_2A-5B-66A-66A               | CA_2A-5A   | 2         | 1900 | 5    | 25  | 1980 | 5    | N/A  | FDD     | N/A               |                   |                        |
|                                |  | 5         | 834  | 5    | 25  | 879  | 5    |      |         | N/A               |                   |                        |
|                                |  | 66        | 1712 | 5    | 25  | 2132 | 5    |      |         | 7.2               | IMD4              |                        |
| CA_2A-13A-66A-66B              | CA_2A-13A  | 2         | 1860 | 5    | 25  | 1940 | 5    | N/A  | FDD     | N/A               |                   |                        |
|                                |  | 13        | 782  | 5    | 25  | 751  | 5    |      |         | N/A               |                   |                        |
|                                |  | 66        | 1736 | 5    | 25  | 2156 | 5    |      |         | 7.2               | IMD4              |                        |
| CA_2A-13A-66A-66B              | CA_13A-66A   | 2         | 1880 | 5    | 25  | 1960 | 5    | 6.2  | FDD     | IMD4              |                   |                        |
|                                |  | 13        | 782  | 5    | 25  | 751  | 5    |      |         | N/A               | N/A               |                        |
|                                |  | 66        | 1762 | 5    | 25  | 2162 | 5    |      |         |                   | N/A               |                        |
| CA_2A-48A-66A<br>CA_2A-48C-66A | CA_48A-66A   | 2         | 1880 | 5    | 25  | 1960 | 5    | 28.3 | FDD-TDD | IMD2              |                   |                        |
|                                |  | 48        | 3695 | 5    | 25  | 3695 | 5    | N/A  |         | N/A               |                   |                        |
|                                |  | 66        | 1735 | 5    | 25  | 2135 | 5    | N/A  |         | N/A               |                   |                        |
| CA_2A-48A-66A<br>CA_2A-48C-66A | CA_2A-48A  | 2         | 1905 | 5    | 25  | 1985 | 5    | N/A  | FDD-TDD | N/A               |                   |                        |
|                                |  | 48        | 3560 | 5    | 25  | 3560 | 5    | N/A  |         | N/A               |                   |                        |
|                                |  | 66        | 1755 | 5    | 25  | 2155 | 5    | 12.1 |         | IMD4              |                   |                        |
| CA_3A-5A-7A                    | CA_3A-5A   | 3         | 1780 | 10   | 50  | 1875 | 10   | N/A  | FDD     | N/A               |                   |                        |
|                                |  | 5         | 845  | 5    | 25  | 890  | 5    | N/A  |         | N/A               |                   |                        |
|                                |  | 7         | 2505 | 10   | 50  | 2625 | 10   | 30.0 |         | IMD2 <sup>1</sup> |                   |                        |
|                                | CA_3A-7A   | CA_3A-7A  | 3    | 1725 | 10  | 50   | 1820 | 10   | N/A     | FDD               | N/A               |                        |
|                                |  |           | 7    | 2565 | 10  | 50   | 2685 | 10   | N/A     |                   | N/A               |                        |
|                                |  |           | 5    | 840  | 5   | 25   | 885  | 5    | 19.0    |                   | IMD3              |                        |
| CA_3A-7A-8A                    | CA_3A-7A   | 3         | 1735 | 5    | 25  | 1830 | 5    | N/A  | FDD     | N/A               |                   |                        |
|                                |  | 7         | 2530 | 10   | 50  | 2650 | 10   |      |         | N/A               | N/A               |                        |
|                                |  | 8         | 895  | 5    | 25  | 940  | 5    |      |         | 18.0              | IMD3              |                        |
|                                | CA_3A-8A   | CA_3A-8A  | 3    | 1780 | 5   | 25   | 1875 | 5    | N/A     | FDD               | N/A               |                        |
|                                |  |           | 8    | 890  | 5   | 25   | 935  | 5    |         |                   | N/A               | N/A                    |
|                                |  |           | 7    | 2550 | 10  | 50   | 2670 | 10   |         |                   | 29.0              | IMD2+IMD3 <sup>4</sup> |
| CA_3A-7A-20A                   | CA_3A-7A   | 3         | 1737 | 5    | 25  | 1832 | 5    | N/A  | FDD     | N/A               |                   |                        |
|                                |  | 7         | 2543 | 10   | 50  | 2663 | 10   | N/A  |         | N/A               |                   |                        |
|                                |  | 20        | 847  | 10   | 20  | 806  | 10   | 10.5 |         | IMD2              |                   |                        |
|                                | CA_3A-20A  | CA_3A-20A | 3    | 1775 | 10  | 50   | 1870 | 10   | N/A     | FDD               | N/A               |                        |
|                                |  |           | 20   | 855  | 5   | 25   | 896  | 5    | N/A     |                   | N/A               |                        |
|                                |  |           | 7    | 2510 | 10  | 50   | 2630 | 10   | 26.0    |                   | IMD2 <sup>1</sup> |                        |
| CA_3A-7A-26A                   |  | 3         | 1720 | 5    | 25  | 1815 | 5    | N/A  | FDD     | N/A               |                   |                        |

|               |            |    |        |    |    |        |    |      |         |                   |
|---------------|------------|----|--------|----|----|--------|----|------|---------|-------------------|
|               | CA_3A-7A   | 7  | 2560   | 10 | 50 | 2680   | 10 | N/A  |         | N/A               |
|               |            | 26 | 835    | 5  | 25 | 880    | 5  | 17.5 |         | IMD3              |
| CA_3A-7A-26A  | CA_3A-26A  | 3  | 1780   | 5  | 25 | 1875   | 5  | N/A  | FDD     | N/A               |
|               |            | 26 | 845    | 5  | 25 | 890    | 5  | N/A  |         | N/A               |
|               |            | 7  | 2505   | 10 | 50 | 2625   | 10 | 29.0 |         | IMD2 <sup>1</sup> |
| CA_3A-7A-28A  | CA_3A-7A   | 3  | 1747   | 5  | 25 | 1842   | 5  | N/A  | FDD     | N/A               |
|               |            | 7  | 2543   | 5  | 25 | 2663   | 5  | N/A  |         | N/A               |
|               |            | 28 | 741    | 5  | 25 | 796.0  | 5  | 20.0 |         | IMD2              |
|               | CA_3A-28A  | 3  | 1712.5 | 5  | 25 | 1807.5 | 5  | N/A  | FDD     | N/A               |
|               |            | 28 | 743    | 5  | 25 | 798    | 5  | N/A  |         | N/A               |
|               |            | 7  | 2562   | 5  | 25 | 2682   | 5  | 17.0 |         | IMD3              |
|               | CA_7A-28A  | 7  | 2543   | 5  | 25 | 2663   | 5  | N/A  | FDD     | N/A               |
|               |            | 28 | 710.5  | 5  | 25 | 765.5  | 5  | N/A  |         | N/A               |
|               |            | 3  | 1737.5 | 5  | 25 | 1832.5 | 5  | 26.0 |         | IMD2              |
| CA_3A-7A-32A  | CA_3A-7A   | 3  | 1775   | 5  | 25 | 1870   | 5  | N/A  | FDD     | N/A               |
|               |            | 7  | 2510   | 10 | 50 | 2630   | 10 | N/A  |         | N/A               |
|               |            | 32 | -      | -  | -  | 1470   | 5  | 10.5 |         | IMD4              |
| CA_3A-8A-38A  | CA_3A-8A   | 3  | 1720   | 5  | 25 | 1815   | 5  | N/A  | FDD-TDD | N/A               |
|               |            | 8  | 890    | 5  | 25 | 935    | 5  | N/A  |         | N/A               |
|               |            | 38 | 2610   | 5  | 25 | 2610   | 5  | 26.4 |         | IMD2              |
|               | CA_3A-8A   | 3  | 1750   | 5  | 25 | 1845   | 5  | N/A  | FDD-TDD | N/A               |
|               |            | 8  | 900    | 5  | 25 | 945    | 5  | N/A  |         | N/A               |
|               |            | 38 | 2600   | 5  | 25 | 2600   | 5  | 15.7 |         | IMD3              |
| CA_3A-11A-18A | CA_3A-11A  | 3  | 1725   | 5  | 25 | 1820   | 5  | N/A  | FDD     | N/A               |
|               |            | 11 | 1440   | 5  | 25 | 1448   | 5  | N/A  |         | N/A               |
|               |            | 18 | 825    | 5  | 25 | 870    | 5  | 4.9  |         | IMD5              |
|               | CA_11A-18A | 11 | 1432   | 5  | 25 | 1481   | 5  | N/A  | FDD     | N/A               |
|               |            | 18 | 820    | 5  | 25 | 865    | 5  | N/A  |         | N/A               |
|               |            | 3  | 1753   | 5  | 25 | 1848   | 5  | 4.0  |         | IMD5              |
| CA_3A-11A-26A | CA_3A-11A  | 3  | 1725   | 5  | 25 | 1820   | 5  | N/A  | FDD     | N/A               |
|               |            | 11 | 1440   | 5  | 25 | 1448   | 5  | N/A  |         | N/A               |
|               |            | 26 | 825    | 5  | 25 | 870    | 5  | 4.9  |         | IMD5              |
|               | CA_3A-26A  | 3  | 1782.5 | 5  | 25 | 1877.5 | 5  | N/A  | FDD     | N/A               |
|               |            | 26 | 816.5  | 5  | 25 | 861.5  | 5  | N/A  |         | N/A               |
|               |            | 11 | 1435.5 | 5  | 25 | 1483.5 | 5  | 5.0  |         | IMD5              |
|               | CA_11A-26A | 11 | 1440   | 5  | 25 | 1488   | 5  | N/A  | FDD     | N/A               |
|               |            | 26 | 824    | 5  | 25 | 869    | 5  | N/A  |         | N/A               |
|               |            | 3  | 1761   | 5  | 25 | 1856   | 5  | 4.5  |         | IMD5              |
| CA_3A-19A-21A | CA_19A-21A | 19 | 832.5  | 5  | 25 | 877.5  | 5  | N/A  | FDD     | N/A               |
|               |            | 21 | 1460.4 | 5  | 25 | 1508.4 | 5  | N/A  |         | N/A               |
|               |            | 3  | 1774.6 | 5  | 25 | 1869.6 | 5  | 4.0  |         | IMD5              |
| CA_3A-21A-28A | CA_3A-21A  | 3  | 1782   | 5  | 25 | 1877   | 5  | N/A  | FDD     | N/A               |
|               |            | 21 | 1451   | 5  | 25 | 1499   | 5  | N/A  |         | N/A               |
|               |            | 28 | 734    | 5  | 25 | 789    | 5  | 3.0  |         | IMD5              |
| CA_3A-28A-41A | CA_3A-41   | 3  | 1720   | 5  | 25 | 1815   | 5  | N/A  | FDD     | N/A               |
|               |            | 41 | 2510   | 5  | 25 | 2510   | 5  | N/A  | TDD     | N/A               |
|               |            | 28 | 735    | 5  | 25 | 790    | 5  | 26.0 | FDD     | IMD2 <sup>1</sup> |
| CA_3A-41A-42A |            | 41 | 2640   | 10 | 50 | 2640   | 10 | N/A  | TDD     | N/A               |

|   |            |    |        |    |     |        |    |      |         |      |
|---|------------|----|--------|----|-----|--------|----|------|---------|------|
|   | CA_41A-42A | 42 | 3425   | 10 | 50  | 3425   | 10 |      | TDD     | N/A  |
|   |            | 3  | 1760   | 5  | 25  | 1855   | 5  | 16.0 | FDD     | IMD3 |
| CA_5A-46D-66A   | CA_5A_46D  | 5  | 834    | 5  | 25  | 879    | 5  | N/A  | FDD-TDD | N/A  |
|   |            | 46 | 5491   | 20 | 100 | 5491   | 20 |      |         | N/A  |
|   |            | 66 | 1755   | 5  | 25  | 2155   | 5  | 0.3  |         | IMD5 |
| CA_13A-48A-66A  | CA_13A-48A | 13 | 782    | 5  | 25  | 751    | 5  | N/A  | FDD-TDD | N/A  |
|   |            | 48 | 3695   | 5  | 25  | 3695   | 5  | N/A  |         | N/A  |
|   |            | 66 | 1731   | 5  | 25  | 2131   | 5  | 17.1 |         | IMD3 |
| CA_19A-21A-42A  | CA_19A-21A | 19 | 842.5  | 5  | 25  | 887.5  | 5  | N/A  | FDD     | N/A  |
|   |            | 21 | 1450.4 | 5  | 25  | 1498.4 | 5  | N/A  | FDD     | N/A  |
|   |            | 42 | 3508.7 | 5  | 25  | 3508.7 | 5  | 13.0 | TDD     | IMD4 |
|   | CA_21A-42A | 21 | 1460.4 | 5  | 25  | 1508.4 | 5  | N/A  | FDD     | N/A  |
|   |            | 42 | 3500   | 5  | 25  | 3500   | 5  | N/A  | FDD     | N/A  |
|   |            | 19 | 836.2  | 5  | 25  | 881.2  | 5  | 13.0 | TDD     | IMD4 |
| CA_28A-41A-42A  | CA_41A-42A | 41 | 2672   | 10 | 50  | 2672   | 10 | N/A  | TDD     | N/A  |
|   |            | 42 | 3460   | 10 | 50  | 3460   | 10 |      | TDD     | N/A  |
|   |            | 28 | 733    | 5  | 25  | 788    | 5  | 26.0 | FDD     | IMD2 |
| CA_1A-21A-42A <sup>6</sup>  | CA_1A-42A  | 1  |        |    |     |        |    |      | FDD     | N/A  |
|   |            | 42 |        |    |     |        |    |      | TDD     | N/A  |
|   |            | 21 |        |    |     |        |    |      | FDD     | N/A  |
| CA_2A-5A-48A<br>CA_2A-5A-48C<br>CA_2A-5A-48D  | CA_5A-48A  | 2  | 1882   | 5  | 25  | 1962   | 5  | 15.6 | FDD-TDD | IMD3 |
|   |            | 5  | 839    | 5  | 25  | 884    | 5  | N/A  |         | N/A  |
|   |            | 48 | 3640   | 5  | 25  | 3640   | 5  | N/A  |         | N/A  |
| CA_2A-5A-48C<br>CA_2A-5A-48D  | CA_2A-5A   | 2  | 1905   | 5  | 25  | 1985   | 5  | N/A  | FDD-TDD | N/A  |
|   |            | 5  | 844    | 5  | 25  | 889    | 5  | N/A  |         | N/A  |
|   |            | 48 | 3593   | 5  | 25  | 3593   | 5  | 16.6 |         | IMD3 |
| CA_2A-13A-48A<br>CA_2A-13A-48C<br>CA_2A-13A-48D   | CA_13A-48A | 2  | 1903.5 | 5  | 25  | 1983.5 | 5  | 15.6 | FDD-TDD | IMD3 |
|   |            | 13 | 784.5  | 5  | 25  | 753.5  | 5  | N/A  |         | N/A  |
|   |            | 48 | 3552.5 | 5  | 25  | 3552.5 | 5  | N/A  |         | N/A  |
| CA_2A-48A-66A,<br>CA_2A-48D-66A,<br>CA_2A-48E-66A,<br>CA_2A-48A-66A-66A,<br>CA_2A-48C-66A-66A,<br>CA_2A-48D-66A-66A,<br>CA_2A-48E-66A-66A | CA_2A-66A  | 2  | 1855   | 5  | 25  | 1935   | 5  | N/A  | FDD-TDD | N/A  |
|   |            | 48 | 3625   | 5  | 25  | 3625   | 5  | 32.0 |         | IMD2 |
|   |            | 66 | 1770   | 5  | 25  | 2190   | 5  | N/A  |         | N/A  |
| CA_2A-14A-66A,<br>CA_2A-2A-14A-66A,<br>CA_2A-14A-66A-66A,<br>CA_2A-2A-14A-66A-66A,<br>CA_2A-14A-66A-66A,<br>CA_2A-14A-66A-66A-66A         | CA_2A-14A  | 2  | 1870   | 5  | 25  | 1950   | 5  | N/A  | FDD     | N/A  |
|   |            | 14 | 793    | 5  | 25  | 763    | 5  | N/A  |         | N/A  |
|   |            | 66 | 1734   | 5  | 25  | 2154   | 5  | 7.2  |         | IMD4 |
|   | CA_14A-66A | 2  | 1874   | 5  | 25  | 1954   | 5  | 6.2  | FDD     | IMD4 |
|   |            | 14 | 793    | 5  | 25  | 763    | 5  | N/A  |         | N/A  |
|   |            | 66 | 1770   | 5  | 25  | 2190   | 5  | N/A  |         | N/A  |

NOTE 1: This band is subject to IMD3 also which MSD is not specified.  
 NOTE 1: Both of the transmitters shall be set min(+20 dBm, P<sub>C<sub>MAX,L,c</sub></sub>) as defined in subclause 6.2.5A  
 NOTE 2: RB<sub>START</sub> = 0  
 NOTE 3: Void  
 NOTE 4: This MSD requirement apply with both IMD2 and IMD3 products should be generated.  
 NOTE 5: For operations with 4 antenna ports, the MSD in the applicable bands shall be modified by the absolute value of ΔR<sub>IB,4R</sub> in Table 7.3.1-1a when MSD > 0.  
 NOTE 6: Due to the spectrum holdings of the operator, the deployed frequency ranges do not result MSD to interested downlink channel. Therefore, no requirements apply for this CA configuration.

For intra-band contiguous carrier aggregation the throughput of each component carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters

specified in Table 7.3.1-1, Table 7.3.1-1a, Table 7.3.1-1A, Table 7.3.1-1B, Table 7.3.1-1C, Table 7.3.1A-0h and Table 7.3.1A-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the power levels in Table 7.3.1-1 and Table 7.3.1-1a also apply for an SCC assigned in the unpaired part. The requirement is verified using an uplink CA configuration with the largest number of carriers supported by the UE. Table 7.3.1A-0h, Table 7.3.1A-1 and Table 7.3.1A-2 specifies the maximum number of allocated uplink resource blocks for which the intra-band contiguous carrier aggregation reference sensitivity requirement shall be met. The PCC and SCC allocations as defined in Table 7.3.1A-0h, Table 7.3.1A-1 and Table 7.3.1A-2 form a contiguous allocation where TX–RX frequency separations of the component carriers are as defined in Table 5.7.4-1. In case downlink CA configuration has additional SCC(s) compared to uplink CA configuration those are configured furthers away from uplink band. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2 and the downlink PCC carrier center frequency shall be configured closer to uplink operating band than any of the downlink SCC center frequency. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

**Table 7.3.1A-0h: Intra-band contiguous CA uplink configuration for reference sensitivity for Bandwidth Class B**

| CA configuration / CC combination / $N_{RB\_agg}$ / Duplex mode   |           |     |           |     |           |     |           |     |             |
|---|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-------------|
| Uplink CA configuration   | 25RB+25RB |     | 50RB+25RB |     | 50RB+50RB |     | 75RB+25RB |     | Duplex Mode |
|   | PCC       | SCC | PCC       | SCC | PCC       | SCC | PCC       | SCC |             |
| CA_5B   | N/A       | N/A | 25        | 0   | 25        | 0   | N/A       | N/A | FDD         |
| CA_8B   | N/A       | N/A | 25        | 0   | 25        | 0   | N/A       | N/A | FDD         |
| CA_66B  | 25        | 25  | 50        | 25  | 50        | 50  | 75        | 25  | FDD         |
| NOTE 1: The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.   |           |     |           |     |           |     |           |     |             |
| NOTE 2: The transmitted power over both PCC and SCC shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.  |           |     |           |     |           |     |           |     |             |
| NOTE 3: The UL resource blocks in both PCC and SCC shall be confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).   |           |     |           |     |           |     |           |     |             |
| NOTE 4: The UL resource blocks in PCC shall be located as close as possible to the downlink operating band, while the UL resource blocks in SCC shall be located as far as possible from the downlink operating band. |           |     |           |     |           |     |           |     |             |
| NOTE 5: In case a CA configuration consists of CC channel bandwidths which are unequal in bandwidth the PCC channel bandwidth shall be the larger one for reference sensitivity test.                                 |           |     |           |     |           |     |           |     |             |

**Table 7.3.1A-1: Intra-band contiguous CA uplink configuration for reference sensitivity for Bandwidth Class C**

| CA configuration / CC combination / $N_{RB\_agg}$ / Duplex mode   |            |     |            |     |           |     |           |     |            |     |             |     |             |
|---|------------|-----|------------|-----|-----------|-----|-----------|-----|------------|-----|-------------|-----|-------------|
| Uplink CA configuration   | 100RB+25RB |     | 100RB+50RB |     | 75RB+75RB |     | 75RB+50RB |     | 100RB+75RB |     | 100RB+100RB |     | Duplex Mode |
|   | PCC        | SCC | PCC        | SCC | PCC       | SCC | PCC       | SCC | PCC        | SCC | PCC         | SCC |             |
| CA_1C   | N/A        | N/A | N/A        | N/A | 75        | 54  | N/A       | N/A | N/A        | N/A | 100         | 30  | FDD         |
| CA_3C   | 50         | 0   | 50         | 0   | N/A       | N/A | N/A       | N/A | 50         | 0   | 50          | 0   | FDD         |
| CA_7C   | N/A        | N/A | 75         | 0   | 75        | 0   | 75        | 0   | 75         | 0   | 75          | 0   | FDD         |
| CA_38C  | N/A        | N/A | N/A        | N/A | 75        | 75  | N/A       | N/A | N/A        | N/A | 100         | 100 | TDD         |
| CA_39C  | 100        | 25  | 100        | 50  | N/A       | N/A | N/A       | N/A | 100        | 75  | N/A         | N/A | TDD         |
| CA_40C  | N/A        | N/A | 100        | 50  | 75        | 75  | N/A       | N/A | 100        | 75  | 100         | 100 | TDD         |
| CA_41C  | 100        | 25  | 100        | 50  | 75        | 75  | 75        | 50  | 100        | 75  | 100         | 100 | TDD         |
| CA_42C  | 100        | 25  | 100        | 50  | N/A       | N/A | N/A       | N/A | 100        | 75  | 100         | 100 | TDD         |
| CA_48C  | 100        | 25  | 100        | 50  | N/A       | N/A | N/A       | N/A | 100        | 75  | 100         | 100 | TDD         |
| CA_66C  | 100        | 25  | 100        | 50  | 75        | 75  | 75        | 50  | 100        | 75  | 100         | 100 | FDD         |
| NOTE 1: The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.   |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 2: The transmitted power over both PCC and SCC shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.  |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 3: The UL resource blocks in both PCC and SCC shall be confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).   |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 4: The UL resource blocks in PCC shall be located as close as possible to the downlink operating band, while the UL resource blocks in SCC shall be located as far as possible from the downlink operating band. |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 5: In case a CA configuration consists of CC channel bandwidths which are unequal in bandwidth the PCC channel bandwidth shall be the larger one for reference sensitivity test.                                 |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 6: Void.   |            |     |            |     |           |     |           |     |            |     |             |     |             |
| NOTE 7: Void  |            |     |            |     |           |     |           |     |            |     |             |     |             |

**Table 7.3.1A-2: Intra-band contiguous CA uplink configuration for reference sensitivity for Bandwidth Class D**

| CA configuration / CC combination / N <sub>RB_agg</sub> / Duplex mode   |  |   |     |     |
|---|--|---|-----|-----|
| Uplink CA configuration   | CC combination   | Number of uplink resource blocks per CC |     |     |
|   |  | PCC                                     | SCC | SCC |
| CA_40D  | 75RB+75RB+75RB<br>100RB+75RB+75RB<br>100RB+100RB+50RB<br>100RB+100RB+75RB<br>100RB+100RB+100RB | NOTE 6                                  |     |     |
| CA_41D  | 75RB+75RB+75RB<br>100RB+75RB+75RB<br>100RB+100RB+50RB<br>100RB+100RB+75RB<br>100RB+100RB+100RB | NOTE 6                                  |     |     |
| NOTE 1: The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.<br>NOTE 2: The transmitted power over both PCC and SCC shall be set to PUMAX as defined in subclause 6.2.5A.<br>NOTE 3: The UL resource blocks in both PCC and SCC shall be confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).<br>NOTE 4: The UL resource blocks in PCC shall be located as close as possible to the downlink operating band, while the UL resource blocks in SCC shall be located as far as possible from the downlink operating band.<br>NOTE 5: In case a CA configuration consists of CC channel bandwidths which are unequal in bandwidth the PCC channel bandwidth shall be the larger one for reference sensitivity test.<br>NOTE 6: All uplink CCs are fully allocated |  |   |     |     |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, the throughput of each downlink component carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) and parameters specified in Table 7.3.1-1, Table 7.3.1-1a, Table 7.3.1-1A, Table 7.3.1-1B, Table 7.3.1-1C and Table 7.3.1A-3 with the reference sensitivity power level increased by  $\Delta R_{IBNC}$  given in Table 7.3.1A-3 for the SCC(s). For aggregation of more than two downlink FDD carriers with one uplink carrier the reference sensitivity is defined only for the specific uplink and downlink test points which are specified in Table 7.3.1A-3. The requirements apply with all downlink carriers active. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

**Table 7.3.1A-3: Intra-band non-contiguous CA with one uplink configuration for reference sensitivity**

| CA configuration | Aggregated channel bandwidth (PCC+SCC) | W <sub>gap</sub> / [MHz]   | UL PCC allocation | $\Delta R_{IBNC}$ (dB) | Duplex mode |
|------------------|--|----------------------------|-------------------|------------------------|-------------|
| CA_1A-1A         | 25RB + 25RB                            | $0.0 < W_{gap} \leq 50.0$  | 25 <sup>1</sup>   | 0.5                    | FDD         |
|                  | 25RB + 50RB                            | $0.0 < W_{gap} \leq 45.0$  | 25 <sup>1</sup>   | 0.5                    |             |
|                  | 25RB + 75RB                            | $0.0 < W_{gap} \leq 40.0$  | 25 <sup>1</sup>   | 0.5                    |             |
|                  | 25RB + 100RB                           | $0.0 < W_{gap} \leq 35.0$  | 25 <sup>1</sup>   | 0.5                    |             |
|                  | 50RB + 25RB                            | $0.0 < W_{gap} \leq 45.0$  | 50 <sup>1</sup>   | 0.5                    |             |
|                  | 50RB + 50RB                            | $0.0 < W_{gap} \leq 40.0$  | 50 <sup>1</sup>   | 0.5                    |             |
|                  | 50RB + 75RB                            | $0.0 < W_{gap} \leq 35.0$  | 50 <sup>1</sup>   | 0.5                    |             |
|                  | 50RB + 100RB                           | $0.0 < W_{gap} \leq 30.0$  | 50 <sup>1</sup>   | 0.5                    |             |
|                  | 75RB + 25RB                            | $0.0 < W_{gap} \leq 40.0$  | 75 <sup>1</sup>   | 0.5                    |             |
|                  | 75RB + 50RB                            | $0.0 < W_{gap} \leq 35.0$  | 75 <sup>1</sup>   | 0.5                    |             |
|                  | 75RB + 75RB                            | $0.0 < W_{gap} \leq 30.0$  | 75 <sup>1</sup>   | 0.5                    |             |
|                  | 75RB + 100RB                           | $0.0 < W_{gap} \leq 25.0$  | 75 <sup>1</sup>   | 0.5                    |             |
|                  | 100RB + 25RB                           | $20.0 < W_{gap} \leq 35.0$ | 90 <sup>1</sup>   | 0.5                    |             |
|                  |  | $0.0 < W_{gap} \leq 20.0$  | 100 <sup>1</sup>  | 0.5                    |             |
|                  | 100RB + 50RB                           | $15.0 < W_{gap} \leq 30.0$ | 90 <sup>1</sup>   | 0.5                    |             |
|                  |  | $0.0 < W_{gap} \leq 15.0$  | 100 <sup>1</sup>  | 0.5                    |             |
|                  | 100RB + 75RB                           | $10.0 < W_{gap} \leq 25.0$ | 90 <sup>1</sup>   | 0.5                    |             |
|                  |  | $0.0 < W_{gap} \leq 10.0$  | 100 <sup>1</sup>  | 0.5                    |             |
| 100RB + 100RB    | $5.0 < W_{gap} \leq 20.0$              | 90 <sup>1</sup>            | 0.5               |                        |             |
|                  | $0.0 < W_{gap} \leq 5.0$               | 100 <sup>1</sup>           | 0.5               |                        |             |



|             |                            |                            |           |     |     |
|-------------|----------------------------|----------------------------|-----------|-----|-----|
| CA_2A-2A    | 25RB+25RB                  | $30.0 < W_{gap} \leq 50.0$ | $12^1$    | 5.3 | FDD |
|             |                            | $0.0 < W_{gap} \leq 30.0$  | $25^1$    | 0   |     |
|             | 25RB+50RB                  | $25.0 < W_{gap} \leq 45.0$ | $12^1$    | 4.4 |     |
|             |                            | $0.0 < W_{gap} \leq 25.0$  | $25^1$    | 0   |     |
|             | 25RB+75RB                  | $20.0 < W_{gap} \leq 40.0$ | $12^1$    | 4.2 |     |
|             |                            | $0.0 < W_{gap} \leq 20.0$  | $25^1$    | 0   |     |
|             | 25RB+100RB                 | $15.0 < W_{gap} \leq 35.0$ | $12^1$    | 3.8 |     |
|             |                            | $0.0 < W_{gap} \leq 15.0$  | $25^1$    | 0   |     |
|             | 50RB+25RB                  | $15.0 < W_{gap} \leq 45.0$ | $12^1$    | 5.9 |     |
|             |                            | $0.0 < W_{gap} \leq 15.0$  | $32^1$    | 0   |     |
|             | 50RB+50RB                  | $10.0 < W_{gap} \leq 40.0$ | $12^1$    | 4.6 |     |
|             |                            | $0.0 < W_{gap} \leq 10.0$  | $32^1$    | 0   |     |
|             | 50RB+75RB                  | $5.0 < W_{gap} \leq 35.0$  | $12^1$    | 4.1 |     |
|             |                            | $0.0 < W_{gap} \leq 5.0$   | $32^1$    | 0   |     |
|             | 50RB+100RB                 | $0.0 < W_{gap} \leq 30.0$  | $12^1$    | 4.0 |     |
|             | 75RB+25RB                  | $10.0 < W_{gap} \leq 40.0$ | $12^{12}$ | 6.7 |     |
|             |                            | $0.0 < W_{gap} \leq 10.0$  | $36^1$    | 0   |     |
|             | 75RB+50RB                  | $5.0 < W_{gap} \leq 35.0$  | $12^{12}$ | 5.4 |     |
|             |                            | $0.0 < W_{gap} \leq 5.0$   | $36^1$    | 0   |     |
|             | 75RB+75RB                  | $0.0 < W_{gap} \leq 30.0$  | $12^{12}$ | 4.6 |     |
| 75RB+100RB  | $0.0 < W_{gap} \leq 25.0$  | $12^{12}$                  | 4.2       |     |     |
| 100RB+25RB  | $0.0 < W_{gap} \leq 35.0$  | $16^{13}$                  | 7.2       |     |     |
| 100RB+50RB  | $0.0 < W_{gap} \leq 30.0$  | $16^{13}$                  | 5.8       |     |     |
| 100RB+75RB  | $0.0 < W_{gap} \leq 25.0$  | $16^{13}$                  | 5.0       |     |     |
| 100RB+100RB | $0.0 < W_{gap} \leq 20.0$  | $16^{13}$                  | 4.6       |     |     |
| CA_3A-3A    | 15RB+25RB                  | $47.0 < W_{gap} \leq 67.0$ | $12^1$    | 4.5 | FDD |
|             |                            | $0.0 < W_{gap} \leq 47.0$  | $15^1$    | 0   |     |
|             | 25RB+15RB                  | $47.0 < W_{gap} \leq 67.0$ | $12^1$    | 4.9 |     |
|             |                            | $0.0 < W_{gap} \leq 47.0$  | $25^1$    | 0   |     |
|             | 25RB+25RB                  | $45.0 < W_{gap} \leq 65.0$ | $12^1$    | 4.7 |     |
|             |                            | $0.0 < W_{gap} \leq 45.0$  | $25^1$    | 0   |     |
|             | 25RB+50RB                  | $40.0 < W_{gap} \leq 60.0$ | $12^1$    | 3.8 |     |
|             |                            | $0.0 < W_{gap} \leq 40.0$  | $25^1$    | 0   |     |
|             | 25RB+75RB                  | $35.0 < W_{gap} \leq 55.0$ | $12^1$    | 3.6 |     |
|             |                            | $0.0 < W_{gap} \leq 35.0$  | $25^1$    | 0   |     |
|             | 25RB+100RB                 | $30.0 < W_{gap} \leq 50.0$ | $12^1$    | 3.4 |     |
|             |                            | $0.0 < W_{gap} \leq 30.0$  | $25^1$    | 0   |     |
|             | 50RB+25RB                  | $30.0 < W_{gap} \leq 60.0$ | $12^9$    | 5.1 |     |
|             |                            | $0.0 < W_{gap} \leq 30.0$  | $32^1$    | 0   |     |
|             | 50RB+50RB                  | $25.0 < W_{gap} \leq 55.0$ | $12^9$    | 4.3 |     |
|             |                            | $0.0 < W_{gap} \leq 25.0$  | $32^1$    | 0   |     |
|             | 50RB+75RB                  | $20.0 < W_{gap} \leq 50.0$ | $12^9$    | 3.8 |     |
|             |                            | $0.0 < W_{gap} \leq 20.0$  | $32^1$    | 0   |     |
|             | 50RB+100RB                 | $15.0 < W_{gap} \leq 45.0$ | $12^9$    | 3.4 |     |
|             |                            | $0.0 < W_{gap} \leq 15.0$  | $32^1$    | 0   |     |
| 75RB+25RB   | $25.0 < W_{gap} \leq 55.0$ | $12^{10}$                  | 6.0       |     |     |
|             | $0.0 < W_{gap} \leq 25.0$  | $32^1$                     | 0         |     |     |
| 75RB+50RB   | $20.0 < W_{gap} \leq 50.0$ | $12^{10}$                  | 4.7       |     |     |
|             | $0.0 < W_{gap} \leq 20.0$  | $32^1$                     | 0         |     |     |
| 75RB+75RB   | $15.0 < W_{gap} \leq 45.0$ | $12^{10}$                  | 4.2       |     |     |

|                          |                            |                            |           |     |     |
|--------------------------|----------------------------|----------------------------|-----------|-----|-----|
|                          |                            | $0.0 < W_{gap} \leq 15.0$  | $32^1$    | 0   |     |
|                          | 75RB+100RB                 | $10.0 < W_{gap} \leq 40.0$ | $12^{10}$ | 3.8 |     |
|                          |                            | $0.0 < W_{gap} \leq 10.0$  | $32^1$    | 0   |     |
|                          | 100RB+25RB                 | $15.0 < W_{gap} \leq 50.0$ | $16^{11}$ | 6.5 |     |
|                          |                            | $0.0 < W_{gap} \leq 15.0$  | $32^1$    | 0   |     |
|                          | 100RB+50RB                 | $10.0 < W_{gap} \leq 45.0$ | $16^{11}$ | 5.1 |     |
|                          |                            | $0.0 < W_{gap} \leq 10.0$  | $32^1$    | 0   |     |
|                          | 100RB+75RB                 | $5.0 < W_{gap} \leq 40.0$  | $16^{11}$ | 4.5 |     |
| $0.0 < W_{gap} \leq 5.0$ |                            | $32^1$                     | 0         |     |     |
| 100RB+100RB              | $0.0 < W_{gap} \leq 35.0$  | $16^{11}$                  | 4.1       |     |     |
| CA_4A-4A                 | NOTE 6                     | NOTE 7                     | NOTE 8    | 0.0 | FDD |
| CA_5A-5A                 | 25RB+25RB                  | NOTE 7                     | $12^1$    | 5.3 | FDD |
|                          | 25RB+50RB                  | NOTE 7                     | $12^1$    | 4.4 |     |
|                          | 50RB+25RB                  | NOTE 7                     | $12^1$    | 5.9 |     |
|                          | 50RB+50RB                  | NOTE 7                     | $12^1$    | 4.6 |     |
| CA_7A-7A                 | 25RB+25RB                  | $0 < W_{gap} \leq 60$      | 25        | 0.0 | FDD |
|                          | 25RB+50RB                  | $0 < W_{gap} \leq 55$      | 25        | 0.0 |     |
|                          | 25RB+75RB                  | $0 < W_{gap} \leq 50$      | 25        | 0.0 |     |
|                          | 25RB+100RB                 | $0 < W_{gap} \leq 45$      | 25        | 0.0 |     |
|                          | 50RB+25RB                  | $30 < W_{gap} \leq 55$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 30$      | 50        | 0.0 |     |
|                          | 50RB+50RB                  | $25.0 < W_{gap} \leq 50.0$ | $32^1$    | 0.0 |     |
|                          |                            | $0.0 < W_{gap} \leq 25.0$  | 50        | 0.0 |     |
|                          | 50RB+75RB                  | $20 < W_{gap} \leq 45$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 20$      | 50        | 0.0 |     |
|                          | 50RB+100RB                 | $15 < W_{gap} \leq 40$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 15$      | 50        | 0.0 |     |
|                          | 75RB+25RB                  | $20.0 < W_{gap} \leq 50.0$ | $32^1$    | 0.0 |     |
|                          |                            | $0.0 < W_{gap} \leq 20.0$  | $50^1$    | 0.0 |     |
|                          | 75RB+50RB                  | $20.0 < W_{gap} \leq 45.0$ | $32^1$    | 0.0 |     |
|                          |                            | $0.0 < W_{gap} \leq 20.0$  | $50^1$    | 0.0 |     |
|                          | 75RB+75RB                  | $15.0 < W_{gap} \leq 40.0$ | $32^1$    | 0.0 |     |
|                          |                            | $0.0 < W_{gap} \leq 15.0$  | $50^1$    | 0.0 |     |
|                          | 75RB+100RB                 | $10 < W_{gap} \leq 35$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 10$      | $50^1$    | 0.0 |     |
|                          | 100RB+25RB                 | $25 < W_{gap} \leq 45$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 25$      | $45^1$    | 0.0 |     |
|                          | 100RB+50RB                 | $20 < W_{gap} \leq 40$     | $32^1$    | 0.0 |     |
|                          |                            | $0 < W_{gap} \leq 20$      | $45^1$    | 0.0 |     |
| 100RB+75RB               | $15.0 < W_{gap} \leq 35.0$ | $36^1$                     | 0.0       |     |     |
|                          | $0.0 < W_{gap} \leq 15.0$  | $50^1$                     | 0.0       |     |     |
| 100RB+100RB              | $15.0 < W_{gap} \leq 30.0$ | $32^1$                     | 0.0       |     |     |
|                          | $0.0 < W_{gap} \leq 15.0$  | $45^1$                     | 0.0       |     |     |
| CA_12A-12A               | 25RB+25RB                  | $0.0 < W_{gap} \leq 7.0$   | $5^{18}$  | 3   | FDD |
| CA_23A-23A               | NOTE 6                     | NOTE 7                     | NOTE 8    | 0.0 | FDD |
| CA_25A-25A               | 25RB+25RB                  | $30.0 < W_{gap} \leq 55.0$ | $10^1$    | 5.0 | FDD |
|                          |                            | $0.0 < W_{gap} \leq 30.0$  | $25^1$    | 0.0 |     |
|                          | 25RB+50RB                  | $25.0 < W_{gap} \leq 50.0$ | $10^1$    | 4.5 |     |
|                          |                            | $0.0 < W_{gap} \leq 25.0$  | $25^1$    | 0.0 |     |
|                          | 25RB+75RB                  | $20 < W_{gap} \leq 45$     | $10^1$    | 4.3 |     |
|                          |                            | $0 < W_{gap} \leq 20$      | $25^1$    | 0   |     |
|                          | 25RB+100RB                 | $15 < W_{gap} \leq 40$     | $10^1$    | 4.1 |     |
|                          |                            | $0 < W_{gap} \leq 15$      | $25^1$    | 0   |     |
|                          | 50RB+25RB                  | $15.0 < W_{gap} \leq 50.0$ | $10^4$    | 5.5 |     |
|                          |                            | $0.0 < W_{gap} \leq 15.0$  | $32^1$    | 0.0 |     |
|                          | 50RB+50RB                  | $10.0 < W_{gap} \leq 45.0$ | $10^4$    | 5.0 |     |
|                          |                            | $0.0 < W_{gap} \leq 10.0$  | $32^1$    | 0.0 |     |
| 50RB+75RB                | $5 < W_{gap} \leq 40$      | $10^4$                     | 4.5       |     |     |
|                          | $0 < W_{gap} \leq 5$       | $32^1$                     | 0         |     |     |
| 50RB+100RB               | $0 < W_{gap} \leq 35$      | $10^4$                     | 4.2       |     |     |

|   |                              |   |                    |     |     |
|---|------------------------------|---|--------------------|-----|-----|
|   | 75RB+25RB                    | $10 < W_{\text{gap}} \leq 45$                       | $10^{14}$          | 7.6 |     |
|   |                              | $0 < W_{\text{gap}} \leq 10$                        | $32^1$             | 0   |     |
|   | 75RB+50RB                    | $5 < W_{\text{gap}} \leq 40$                        | $10^{14}$          | 6.7 |     |
|   |                              | $0 < W_{\text{gap}} \leq 5$                         | $32^1$             | 0   |     |
|   | 75RB+75RB                    | $0 < W_{\text{gap}} \leq 35$                        | $10^{14}$          | 5.6 |     |
|   | 75RB+100RB                   | $0 < W_{\text{gap}} \leq 30$                        | $10^{14}$          | 4.8 |     |
|   | 100RB+25RB                   | $0 < W_{\text{gap}} \leq 40$                        | $12^{15}$          | 8   |     |
|   | 100RB+50RB                   | $0 < W_{\text{gap}} \leq 35$                        | $12^{15}$          | 6.7 |     |
|   | 100RB+75RB                   | $0 < W_{\text{gap}} \leq 30$                        | $12^{15}$          | 6.1 |     |
| 100RB+100RB   | $0 < W_{\text{gap}} \leq 25$ | $12^{15}$   | 5.7                |     |     |
| CA_25A-25A-25A  | 25RB+25RB+25RB               | $W_{\text{gap}_L} = W_{\text{gap}_H} = 25$<br>MHz   | $10^1$             | 5.0 | FDD |
|   |                              | $W_{\text{gap}_L} = W_{\text{gap}_H} = 5$<br>MHz    | $25^1$             | 0.0 |     |
|   | 50RB+50RB+50RB               | $W_{\text{gap}_L} = W_{\text{gap}_H} =$<br>17.5 MHz | $10^4$             | 5.0 |     |
|   | 75RB+75RB+75RB               | $W_{\text{gap}_L} = W_{\text{gap}_H} = 10$<br>MHz   | $10^{14}$          | 5.6 |     |
|   | 100RB+100RB+100RB            | $W_{\text{gap}_L} = W_{\text{gap}_H} = 2.5$<br>MHz  | $12^{15}$          | 5.7 |     |
| CA_40A-40A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_40A-40C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_40C-40C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41A-41A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41A-41C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41A-41D  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41C-41C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41A-41A-41A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_41A-41A-41C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_42A-42A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_42A-42C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_42A-42D  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_42C-42C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48A-48A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48A-48A-48A  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48D  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48A-48E  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48C-48C  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_48C-48D  | NOTE 6                       | NOTE 7  | NOTE 8             | 0.0 | TDD |
| CA_66A-66A  | NOTE 6                       | NOTE 7  | NOTE 8,<br>NOTE 16 | 0.0 | FDD |
| CA_66A-66A-66A  | NOTE 6                       | NOTE 7  | NOTE 8,<br>NOTE 16 | 0.0 | FDD |
| CA_66A-66B  | NOTE 6                       | NOTE 7  | NOTE 8,<br>NOTE 16 | 0.0 | FDD |
| CA_66A-66C  | NOTE 6                       | NOTE 7  | NOTE 8,<br>NOTE 16 | 0.0 | FDD |
| NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission.  |                              |   |                    |     |     |
| NOTE 2: $W_{\text{gap}}$ is the sub-block gap between the two sub-blocks.   |                              |   |                    |     |     |
| NOTE 3: The carrier center frequency of PCC in the UL operating band is configured closer to the DL operating band.   |                              |   |                    |     |     |
| NOTE 4: <sup>4</sup> refers to the UL resource blocks shall be located at $RB_{\text{start}}=33$ .  |                              |   |                    |     |     |
| NOTE 5: For the TDD intra-band non-contiguous CA configurations, the minimum requirements apply only in synchronized operation between all component carriers.  |                              |   |                    |     |     |
| NOTE 6: All combinations of channel bandwidths defined in Table 5.6A.1-3.   |                              |   |                    |     |     |
| NOTE 7: All applicable sub-block gap sizes.   |                              |   |                    |     |     |
| NOTE 8: The PCC allocation is same as Transmission bandwidth configuration $N_{\text{RB}}$ as defined in Table 5.6-1. In case of uplink sub-block is TDD intra-band contiguous CA then the uplink PCC and SCC allocations are the same as $N_{\text{RB\_agg}}$ defined in Table 7.3.1A-1. |                              |   |                    |     |     |
| NOTE 9: <sup>9</sup> refers to the UL resource blocks shall be located at $RB_{\text{start}}=25$ .  |                              |   |                    |     |     |

NOTE 10: <sup>10</sup> refers to the UL resource blocks shall be located at  $RB_{start}=35$ .  
 NOTE 11: <sup>11</sup> refers to the UL resource blocks shall be located at  $RB_{start}=50$ .  
 NOTE 12: <sup>12</sup> refers to the UL resource blocks shall be located at  $RB_{start}=39$ .  
 NOTE 13: <sup>13</sup> refers to the UL resource blocks shall be located at  $RB_{start}=57$ .  
 NOTE 14: <sup>14</sup> refers to the UL resource blocks shall be located at  $RB_{start}=44$ .  
 NOTE 15: <sup>15</sup> refers to the UL resource blocks shall be located at  $RB_{start}=62$ .  
 NOTE 16: The carrier center frequency of PCC in the DL operating band is configured closer to the UL operating band.  
 NOTE 17: Void  
 NOTE 18: <sup>18</sup> refers to the UL resource blocks shall be located at  $RB_{start}=12$ .  
 NOTE 19: For operations with 4 antenna ports, the MSD in the applicable bands shall be modified by the absolute value of  $\Delta R_{IB,4R}$  in Table 7.3.1-1a when  $MSD > 0$ .

For intra-band non-contiguous carrier aggregation with two uplink and downlink carriers the reference sensitivity is defined to be met with both downlink and uplink carriers activated. The downlink PCC and SCC minimum requirements for reference sensitivity power level as specified in Table 7.3.1-1, Table 7.3.1-1a, Table 7.3.1-1A, Table 7.3.1-1B and Table 7.3.1-1C are increased by amount of  $\Delta R_{2UL\_PCC}$  and  $\Delta R_{2UL\_SCC}$  which are defined in Table 7.3.1A-4 when uplink PCC and SCC allocations are according to the Table 7.3.1A-4.

**Table 7.3.1A-4: Intra-band non-contiguous CA with two uplinks configuration for reference sensitivity**

| CA configuration   | Aggregated channel bandwidth (PCC+SCC) | $W_{gap}$ / [MHz] | UL PCC allocation | UL SCC allocation | $\Delta R_{2UL\_PCC}$ (dB) | $\Delta R_{2UL\_SCC}$ (dB) | Duplex mode |
|--|--|-------------------|-------------------|-------------------|----------------------------|----------------------------|-------------|
| CA_4A-4A   | NOTE 2                                 | NOTE 3            | NOTE 4            | NOTE 5            | 0.0                        | 0.0                        | FDD         |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.<br>NOTE 2: All combinations of channel bandwidths defined in Table 5.6A.1-3.<br>NOTE 3: All applicable sub-block gap sizes.<br>NOTE 4: The PCC allocation is same as Transmission bandwidth configuration $N_{RB}$ as defined in Table 5.6-1.<br>NOTE 5: The SCC allocation is same as Transmission bandwidth configuration $N_{RB}$ as defined in Table 5.6-1. |  |                   |                   |                   |                            |                            |             |

For combinations of intra-band and inter-band carrier aggregation, the requirement is defined with an uplink configuration in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink (up to two contiguously aggregated uplink carriers) is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when an uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. The carrier center frequency of PCC in the UL operating band is configured closer to the DL operating band when the uplink is active in band(s) supporting non-contiguous aggregation. For these uplink configurations, the UE shall meet the reference sensitivity requirements for intra-band non-contiguous carrier aggregation of two or more downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.3.1. For the two or more component carriers within the same band,  $\Delta R_{IBNC} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) when the uplink is active in another band. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with all uplink carriers active in each band capable of UL operation. For component carriers configured in Band 46, the said requirements for intra-band carrier aggregation of downlink carriers are replaced by the requirements in Table 7.3.1A-0eA for the uplink in any band other than band 46 with the uplink configuration specified in Table 7.3.1-2. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

For the UE that supports any of combinations of intra-band and inter-band carrier aggregation given in Table 7.3.1A-5, exceptions to the requirements for a band(s) specified in subclause 7.3.1 are allowed when the band(s) is impacted by harmonic interference from the uplink being active in a lower-frequency band of the same CA configuration. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-5 and Table 7.3.1A-6.

**Table 7.3.1A-5: Reference sensitivity for carrier aggregation QPSK  $P_{REFSENS, CA}$  (exceptions due to harmonic issues in the combinations of intra-band and inter-band CA)**

| EUTRA CA Configuration | EUTRA band | Channel bandwidth |             |             |              |              |              | Duplex mode |
|------------------------|------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|                        |            | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
|                        |            |                   |             |             |              |              |              |             |

|   |                  |  |  |       |       |       |       |     |
|---|------------------|--|--|-------|-------|-------|-------|-----|
| CA_1A-3A-3A-7A-8A <sup>4</sup><br>CA_1A-3A-7A-7A-8A <sup>4</sup><br>CA_1A-3A-3A-7A-7A-8A <sup>4</sup>   | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_1A-3A-3A-7A-8A <sup>5,6</sup><br>CA_1A-3A-7A-7A-8A <sup>5,6</sup><br>CA_1A-3A-3A-7A-7A-8A <sup>5,6</sup>   | 7 <sup>33</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_1A-1A-3A-7A-28A <sup>5,6</sup><br>CA_1A-1A-3A-7C-28A <sup>5,6</sup><br>CA_1A-1A-3C-7A-28A <sup>5,6</sup><br>CA_1A-1A-3C-7C-28A <sup>5,6</sup><br>CA_1A-1A-3A-3A-7A-28A <sup>5,6</sup><br>CA_1A-1A-3A-3A-7C-28A <sup>5,6</sup><br>CA_1A-3A-7C-28A <sup>5,6</sup><br>CA_1A-3C-7A-28A <sup>5,6</sup><br>CA_1A-3C-7C-28A <sup>5,6</sup><br>CA_1A-3A-3A-7A-28A <sup>5,6</sup><br>CA_1A-3A-3A-7C-28A <sup>5,6</sup><br>CA_1A-3A-7A-7A-28A <sup>5,6</sup> | 1 <sup>21</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-3C-8A <sup>4</sup>  | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_1A-3A-8A-42C <sup>4</sup>  | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_1A-3A-8A-42C <sup>8,9</sup>  | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-8A-42C <sup>10</sup>   | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-8A-42C <sup>15,16</sup>  | 42 <sup>21</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_1A-3A-18A-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-18A-42C <sup>10</sup>  | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-19A-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-19A-42C <sup>10</sup>  | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-3A-20A-28A   | 1 <sup>21</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-3A-21A-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-21A-42C <sup>10</sup>  | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3C-28A  | 1 <sup>21</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
| CA_1A-3A-28A-40C <sup>16,17</sup>   | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_1A-3A-28A-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-28A-42C <sup>10</sup>  | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-41A-42C <sup>8,9</sup><br>CA_1A-3A-41C-42A <sup>8,9</sup><br>CA_1A-3A-41C-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-41A-42C <sup>10</sup><br>CA_1A-3A-41C-42A <sup>10</sup><br>CA_1A-3A-41C-42C <sup>10</sup>  | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42C <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-3A-42D <sup>8,9</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_1A-7A-8A-40C <sup>5,6</sup>  | 7 <sup>33</sup>  |  |  |       | -87.1 | -86.7 | -86.4 | FDD |
| CA_1A-7C-28A <sup>5,6</sup>   | 1 <sup>21</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |

|                                      |                  |  |  |       |       |       |       |     |
|--------------------------------------|------------------|--|--|-------|-------|-------|-------|-----|
| CA_1A-7A-28A-40C <sup>16,17</sup>    | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_1A-8A-11A-42C <sup>15,16</sup>    | 42 <sup>21</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD |
| CA_1A-3A-42C <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-42D <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-3A-42C <sup>9,10</sup>      | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-3A-3A-42C <sup>11</sup>        | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_1A-21A-28A-42C <sup>4,14</sup>    | 21               |  |  | N/A   | N/A   | N/A   |       | FDD |
|                                      | 42               |  |  | N/A   | N/A   | N/A   | N/A   | TDD |
| CA_1A-28A-42C <sup>5,6,12,13</sup>   | 1 <sup>21</sup>  |  |  | -89.8 | -89.4 | -89   | -88.7 | FDD |
|                                      | 42               |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_2A-2A-4A-12A <sup>5,6</sup>       | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-2A-5A-12A-66A <sup>5,6</sup>   | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-2A-7A-12A-66A <sup>5,6</sup>   | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-2A-12A-66A-66A <sup>5,6</sup>  | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-13A-48A-48A <sup>8,9</sup>     | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48C <sup>8,9</sup>         |                  |  |  |       |       |       |       |     |
| CA_2A-13A-48A-48A <sup>10</sup>      | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-13A-48C <sup>10</sup>          |                  |  |  |       |       |       |       |     |
| CA_2A-7A-12B-66A <sup>5,6</sup>      | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-2A-12A-30A-66A <sup>5,6</sup>  | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-2A-12A-66A <sup>5,6</sup>      | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-2A-12B-66A <sup>5,6</sup>      | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-12A-30A-66A-66A <sup>5,6</sup> | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-12B-66A <sup>5,6</sup>         | 16 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-12B-66A-66A <sup>5,6</sup>     | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-4A-4A-12A <sup>5,6</sup>       | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-12A-12A <sup>5,6</sup>      | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-4A-12B <sup>5,6</sup>          | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_2A-48A-48C <sup>9,22</sup>        | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48C <sup>1</sup>           | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48A-48D <sup>8,9</sup>         | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48D <sup>10</sup>          | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48C-48C <sup>8,9</sup>         | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48C-48C <sup>10</sup>          | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48D <sup>9,22</sup>            | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48D <sup>10</sup>              | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48E <sup>8,9</sup>             | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48E <sup>10</sup>              | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-12A-66A-66A <sup>5,6</sup>     | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-12A-66C <sup>5,6</sup>         | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD |
| CA_2A-13A-48D <sup>8,9</sup>         | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48D <sup>10</sup>          | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-13A-48A-48C <sup>8,9</sup>     | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48A-48C <sup>10</sup>      | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-13A-48C-66A <sup>8,9</sup>     | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |

|                                       |                  |  |  |       |       |       |       |     |
|---------------------------------------|------------------|--|--|-------|-------|-------|-------|-----|
| CA_2A-13A-48C-66A <sup>10</sup>       | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-13A-48A-48A-66A <sup>8,9</sup>  | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-13A-48A-48A-66A <sup>10</sup>   | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48D-66A <sup>8,9</sup>          | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48D-66A <sup>10</sup>           | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48E-66A <sup>8,9</sup>          | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48E-66A <sup>10</sup>           | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48A-48A-66A <sup>8,9</sup>      | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48A-66A <sup>10</sup>       | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_2A-48A-48C-66A <sup>8,9</sup>      | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_2A-48A-48C-66A <sup>10</sup>       | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-3A-7A-7A-8A <sup>4</sup>        | 3                |  |  | N/A   | N/A   | N/A   | N/A   |     |
| CA_3A-3A-7A-7A-8A <sup>5,6</sup>      | 7 <sup>21</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_3A-3A-7A-8A <sup>4</sup>           | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-3A-7A-8A <sup>5,6</sup>         | 7 <sup>21</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD |
| CA_3A-3A-8A <sup>4</sup>              | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_3A-7A-7A-8A <sup>4</sup>           | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
|                                       | 7                |  |  | N/A   | N/A   | N/A   | N/A   |     |
| CA_3A-7A-7A-8A <sup>4,5,6</sup>       | 3                |  |  | -97   | -94   | -92.2 | -91   | FDD |
|                                       | 7 <sup>21</sup>  |  |  | -88   | -87.4 | -87   | -86.7 |     |
| CA_3C-7A-8A-38A <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
|                                       | 7                |  |  | N/A   | N/A   | N/A   | N/A   |     |
| CA_3A-7A-8A-40C <sup>4</sup>          | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
|                                       | 7                |  |  |       | N/A   | N/A   | N/A   |     |
| CA_3A-7A-8A-40C <sup>5,6</sup>        | 7 <sup>33</sup>  |  |  |       | -87.1 | -86.7 | -86.4 | FDD |
| CA_3A-7A-28A-40C <sup>16,17</sup>     | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_3A-19A-42C <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-19A-42C <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 |     |
| CA_3A-19A-42D <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-19A-42D <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-21A-42C <sup>1,2</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-21A-42C <sup>3</sup>            | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-21A-42D <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-21A-42D <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-40C <sup>8,9</sup>          | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_3A-28A-40D <sup>8,9</sup>          | 28               |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD |
| CA_3A-28A-41A-42C <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  |       | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-41A-42C <sup>10,20</sup>    | 42 <sup>21</sup> |  |  |       | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-41A-42C <sup>12,13,20</sup> | 42 <sup>21</sup> |  |  |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-41C-42A <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  |       | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-41C-42A <sup>10,20</sup>    | 42 <sup>21</sup> |  |  |       | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-41C-42A <sup>12,13,20</sup> | 42 <sup>21</sup> |  |  |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-41C-42C <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  |       | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-41C-42C <sup>10,20</sup>    | 42 <sup>21</sup> |  |  |       | -94.7 | -93.2 | -92.5 | TDD |

|                                       |                  |  |  |       |       |       |       |     |
|---------------------------------------|------------------|--|--|-------|-------|-------|-------|-----|
| CA_3A-28A-41C-42C <sup>12,13,20</sup> | 42 <sup>21</sup> |  |  |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-42C <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42C <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42C <sup>12,13</sup>        | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-42D <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42D <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42D <sup>12,13</sup>        | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-42A-42A <sup>8,9</sup>      | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42A-42A <sup>10</sup>       | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42A-42A <sup>12,13</sup>    | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-42A-42C <sup>8,9</sup>      | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42A-42C <sup>10</sup>       | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42A-42C <sup>12,13</sup>    | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-28A-42C-42C <sup>8,9</sup>      | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-28A-42C-42C <sup>10</sup>       | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-28A-42C-42C <sup>12,13</sup>    | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD |
| CA_3A-41A-42A-42A <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-41A-42A-42A <sup>10,20</sup>    | 42 <sup>21</sup> |  |  | -94.7 | -93.2 | -92.5 | -92.5 | TDD |
| CA_3A-41A-42A-42C <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-41A-42A-42C <sup>10,20</sup>    | 42 <sup>21</sup> |  |  | -94.7 | -93.2 | -92.5 | -92.5 | TDD |
| CA_3A-41A-42C-42C <sup>8,9,20</sup>   | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-41A-42C-42C <sup>10,20</sup>    | 42 <sup>21</sup> |  |  | -94.7 | -93.2 | -92.5 | -92.5 | TDD |
| CA_3A-42C <sup>8,9</sup>              | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42C <sup>10</sup>               | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42D <sup>8,9</sup>              | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42D <sup>10</sup>               | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-3A-42C <sup>8,9</sup>           | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-3A-42C <sup>10</sup>            | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-3A-42D <sup>9,10</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-3A-42D <sup>11</sup>            | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42A-42C <sup>8,9</sup>          | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42A-42C <sup>10</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42C-42C <sup>8,9,10</sup>       | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42C-42C <sup>11</sup>           | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3A-42E <sup>9,10</sup>             | 42 <sup>21</sup> |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42E <sup>11</sup>               | 42 <sup>21</sup> |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_3C-8A <sup>4</sup>                 | 3                |  |  | N/A   | N/A   | N/A   | N/A   | FDD |
| CA_4A-4A-5A-12A <sup>5,6</sup>        | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-4A-12A <sup>5,6</sup>           | 4                |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-4A-12A-12A <sup>5,6</sup>       | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-4A-12A-30A <sup>5,6</sup>       | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-4A-12B <sup>5,6</sup>           | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-5A-12B <sup>5,6</sup>           | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-12A-12A <sup>5,6</sup>          | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |
| CA_4A-12B <sup>5,6</sup>              | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD |



|                                     |                  |  |  |       |       |       |       |       |     |
|-------------------------------------|------------------|--|--|-------|-------|-------|-------|-------|-----|
| CA_4A-5A-12A-12A <sup>5,6</sup>     | 4 <sup>21</sup>  |  |  | -90   | -89.5 | -89   | -88.5 | FDD   |     |
| CA_7A-7A-8A <sup>5,6</sup>          | 7 <sup>21</sup>  |  |  | -88   | -87.4 | -87   | -86.7 | FDD   |     |
| CA_8A-41C <sup>7</sup>              | 41               |  |  |       | N/A   | N/A   | N/A   | TDD   |     |
| CA_8A-42C <sup>15,16</sup>          | 42 <sup>21</sup> |  |  | -84.8 | -84.7 | -84.6 | -84.5 | TDD   |     |
| CA_12A-30A-66A-66A <sup>5,6</sup>   | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD   |     |
| CA_12A-66A-66A <sup>5,6</sup>       | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD   |     |
| CA_12A-66C <sup>5,6</sup>           | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD   |     |
| CA_12B-66A <sup>5,6</sup>           | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD   |     |
| CA_12B-66A-66A <sup>5,6</sup>       | 66 <sup>21</sup> |  |  | -89.5 | -89   | -88.5 | -88   | FDD   |     |
| CA_20A-38A-40A-40A <sup>15,16</sup> | 20               |  |  | -60.7 | -60.7 | -60.7 |       | FDD   |     |
| CA_20A-38A-40C <sup>15,16</sup>     | 20               |  |  | -60.7 | -60.7 | -60.7 |       | FDD   |     |
| CA_20A-40D <sup>7</sup>             | 20               |  |  | -60.7 | -60.7 | -60.7 |       | FDD   |     |
| CA_21A-28A-42C <sup>4,14</sup>      | 21               |  |  | N/A   | N/A   | N/A   | N/A   | FDD   |     |
|                                     | 42               |  |  | N/A   | N/A   |       |       | TDD   |     |
| CA_25A-25A-26A-41C <sup>7</sup>     | 41               |  |  | N/A   | N/A   | N/A   | N/A   | TDD   |     |
| CA_26A-41C <sup>7</sup>             | 41               |  |  | N/A   | N/A   | N/A   | N/A   | TDD   |     |
| CA_28A-40C <sup>16,17</sup>         | 28 <sup>21</sup> |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD   |     |
| CA_28A-40D <sup>16,17</sup>         | 28 <sup>21</sup> |  |  | -60.7 | -60.7 | -60.7 | -60.7 | FDD   |     |
| CA_28A-41A-42C <sup>12,13</sup>     | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-41C-42A <sup>12,13</sup>     | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-41C-42C <sup>12,13</sup>     | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-42C <sup>12,13</sup>         | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD   |     |
| CA_28A-42D <sup>12,13</sup>         | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-41A-42A-42A <sup>12,13</sup> | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-41A-42A-42C <sup>12,13</sup> | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-41A-42A-42C <sup>12,13</sup> | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-42A-42A <sup>12,13</sup>     | 42 <sup>21</sup> |  |  | -85.7 | -85.4 | -85.1 | -84.9 | TDD   |     |
| CA_28A-42A-42C <sup>12,13</sup>     | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_28A-42C-42C <sup>12,13</sup>     | 42 <sup>21</sup> |  |  |       |       | -85.4 | -85.1 | -84.9 | TDD |
| CA_48A-48C-66A <sup>8,9</sup>       | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48A-48C-66A <sup>10</sup>        | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |
| CA_48A-48C-66B <sup>8,9</sup>       | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48A-48C-66B <sup>10</sup>        | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |
| CA_48A-48C-66C <sup>8,9</sup>       | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48A-48C-66C <sup>10</sup>        | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |
| CA_48A-48D-66A <sup>8,9</sup>       | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48A-48D-66A <sup>10</sup>        | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |
| CA_48C-48C-66A <sup>8,9</sup>       | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48C-48C-66A <sup>10</sup>        | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |
| CA_48D-66A <sup>8,9</sup>           | 48               |  |  | -71.7 | -71.7 | -71.7 | -71.7 | TDD   |     |
| CA_48D-66A <sup>10</sup>            | 48               |  |  | -97.1 | -94.7 | -93.2 | -92.5 | TDD   |     |

NOTE 1: The transmitter shall be set to P<sub>UMAX</sub> as defined in subclause 6.2.5A.

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCN Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

NOTE 3: The signal power is specified per port

NOTE 4: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity for all active downlink component carriers is only verified when this is not the case (the requirements specified in clause 7.3.1 apply unless otherwise specified).

NOTE 5: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 6: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.3 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the

carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.

- NOTE 7: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).
- NOTE 8: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_3A-42C, CA\_3A-42D, CA\_3A-3A-42C, CA\_3A-42A-42C, CA\_3A-42C-42C, CA\_1A-3A-18A-42C, CA\_1A-3A-19A-42C, CA\_1A-3A-21A-42C, CA\_1A-3A-41A-42C, CA\_1A-3A-41C-42A, CA\_1A-3A-41C-42C, CA\_1A-3A-42C, CA\_3A-28A-42C, CA\_3A-28A-42D, CA\_3A-19A-42C, CA\_3A-19A-42D, CA\_3A-21A-42D, CA\_3A-28A-40C, CA\_3A-28A-40D, CA\_3A-28A-41A-42C, CA\_3A-28A-41C-42A, CA\_3A-28A-41C-42C, CA\_3A-28A-42A-42A, CA\_3A-28A-42A-42C, CA\_3A-28A-42C-42C, CA\_3A-41A-42A-42A, CA\_3A-41A-42A-42C, CA\_3A-41A-42C-42C, CA\_2A-48C-48C, CA\_2A-48A-48D, CA\_48A-48C-66C, CA\_48A-48C-66B, CA\_48A-48D-66A, CA\_48C-48C-66A, CA\_48D-66A, CA\_48A-48C-66A, CA\_2A-13A-48D, CA\_2A-13A-48A-48C, CA\_2A-13A-48C-66A, CA\_2A-13A-48A-48A-66A, CA\_2A-48D-66A, CA\_2A-48E-66A, CA\_2A-48A-48C-66A and CA\_2A-48E.
- NOTE 9: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  carrier frequency in the victim (higher) band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the lower band.
- NOTE 10: The requirements are only applicable to channel bandwidths with a carrier frequency at  $\pm (20 + BW_{Channel}^{HB} / 2)$  MHz offset from  $2f_{UL}^{LB}$  in the victim (higher) band) with  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ , where  $BW_{Channel}^{LB}$  and  $BW_{Channel}^{HB}$  are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.
- NOTE 11: Void
- NOTE 12: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 5<sup>th</sup> transmitter harmonic is within the downlink transmission bandwidth of a high band.
- NOTE 13: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.5 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.
- NOTE 14: No requirements apply when there is at least one individual RE on band 28 uplink outside frequencies 728 – 738 MHz. The reference sensitivity is only verified when all configured RE's are confined within frequencies 728 – 738 MHz (the requirements specified in clause 7.3.1 of [6] apply).
- NOTE 15: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 4<sup>th</sup> transmitter harmonic is within the downlink transmission bandwidth of a high band.
- NOTE 16: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that  $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.4 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{HB}$  the carrier frequency of a high band in MHz and  $BW_{Channel}^{LB}$  the channel bandwidth configured in the low band.
- NOTE 17: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3<sup>rd</sup> harmonic is within the uplink transmission bandwidth or the uplink adjacent channel's transmission bandwidth of an aggressor (higher) band.
- NOTE 18: The requirements should be verified for UL EARFCN of the aggressor (higher) band (superscript HB) such that  $f_{DL}^{LB} = \lfloor f_{UL}^{HB} / 0.3 \rfloor 0.1$  in MHz and  $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$  with  $f_{DL}^{LB}$  the carrier frequency in the victim (lower) band and  $BW_{Channel}^{HB}$  the channel bandwidth configured in the higher band.
- NOTE 19: The requirement for B46 does not apply when there is at least one individual RE within the B46 downlink transmission bandwidth which falls into the reference sensitivity exclusion region as specified in Table 6.2.4-3.
- NOTE 20: The B41 requirements are modified by -0.1dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2545-2690 MHz.

NOTE 21: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured.  
 NOTE 22: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range  $\Delta F_{HD}$  above and below the edge of this downlink transmission bandwidth. The value  $\Delta F_{HD}$  depends on the E-UTRA configuration:  $\Delta F_{HD} = 10$  MHz for CA\_2A-48A-48C

**Table 7.3.1A-6: Uplink configuration for the low band (exceptions due to harmonic issues in the combinations of intra-band and inter-band CA)**

| E-UTRA Band / Channel bandwidth of the high band / $N_{RB}$ / Duplex mode  |         |         |       |       |        |        |        |             |
|--|---------|---------|-------|-------|--------|--------|--------|-------------|
| EUTRA CA Configuration   | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA_1A-3A-3A-7A-8A<br>CA_1A-3A-7A-7A-8A<br>CA_1A-3A-3A-7A-7A-8A   | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-1A-3A-7A-28A<br>CA_1A-1A-3A-7C-28A<br>CA_1A-1A-3C-7A-28A<br>CA_1A-1A-3C-7C-28<br>CA_1A-1A-3A-3A-7A-28A<br>CA_1A-1A-3A-3A-7C-28A<br>CA_1A-3A-7C-28A<br>CA_1A-3C-7A-28A<br>CA_1A-3C-7C-28A<br>CA_1A-3A-3A-7A-28A<br>CA_1A-3A-3A-7C-28A<br>CA_1A-3A-7A-7A-28A | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-8A-42C  | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-8A-42C  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-18A-42C   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-19A-42C   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-3A-20A-28A  | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-21A-42C   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3C-28A   | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-3A-28A-40C   | 40      |         |       | 25    | 50     | 75     | 100    | TDD         |
| CA_1A-3A-28A-42C   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-42C   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-42D   | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-3A-3A-42C  | 3       |         |       | 12    | 25     | 36     | 50     | FDD         |
| CA_1A-7A-8A-40C  | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-7C-28A   | 28      |         |       |       | 16     | 25     | 25     | FDD         |
| CA_1A-7A-28A-40C   | 40      |         |       | 25    | 50     | 75     | 100    | TDD         |
| CA_1A-8A-11A-42C   | 8       |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_1A-28A-42C  | 28      |         |       | 8     | 16     | 25     | 25     | FDD         |
| CA_2A-2A-4A-12A  | 12      |         |       | 8     | 16     | 20     | 20     | FDD         |

|                       |    |  |  |                 |                 |                 |                 |     |
|-----------------------|----|--|--|-----------------|-----------------|-----------------|-----------------|-----|
| CA_2A-2A-5A-12A-66A   | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-2A-7A-12A-66A   | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-2A-12A-30A-66A  | 12 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_2A-2A-12A-66A      | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-2A-12A-66A-66A  | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-2A-12B-66A      | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-4A-4A-12A       | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-4A-12A-12A      | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-4A-12B          | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-7A-12B-66A      | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-12A-30A-66A-66A | 12 |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_2A-12A-66A-66A     | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-12A-66C         | 12 |  |  | 8               | 16              |                 |                 | FDD |
| CA_2A-12B-66A         | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-12B-66A-66A     | 12 |  |  | 8               | 16              | 20              | 20              | FDD |
| CA_2A-13A-48A-48A     | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-13A-48C         |    |  |  |                 |                 |                 |                 |     |
| CA_2A-13A-48D         | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-13A-48A-48C     | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-13A-48C-66A     | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-13A-48A-48A-66A | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48A-48D         | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48C-48C         | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48D             | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48E             | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48A-48A-66A     | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48D-66A         | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48E-66A         | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_2A-48A-48C-66A     | 2  |  |  | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD |
|                       | 66 |  |  | 12 <sup>1</sup> | 25 <sup>1</sup> | 36 <sup>1</sup> | 50 <sup>1</sup> | FDD |
| CA_3A-3A-7A-7A-8A     | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_3A-3A-7A-8A        | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_3A-7A-7A-8A        | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_3A-7A-8A-40C       | 8  |  |  | 8               | 16              | 25              | 25              | FDD |
| CA_3A-19A-42C         | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-19A-42D         | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-7A-28A-40C      | 40 |  |  | 25              | 50              | 75              | 100             | TDD |
| CA_3A-42C             | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-3A-42D          | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-42C-42C         | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-42E             | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-21A-42C         | 3  |  |  | 12              | 25              | 36              | 50              | FDD |
| CA_3A-21A-42D         | 3  |  |  | 12              | 25              | 36              | 50              | FDD |

|                                 |    |  |  |    |    |    |     |     |
|---------------------------------|----|--|--|----|----|----|-----|-----|
| CA_3A-28A-40C                   | 40 |  |  | 25 | 50 | 75 | 100 | TDD |
| CA_3A-28A-40D                   | 40 |  |  |    | 50 | 75 | 100 | TDD |
| CA_3A-28A-41A-42C               | 3  |  |  |    | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_3A-28A-41C-42A               | 3  |  |  |    | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_3A-28A-41C-42C               | 3  |  |  |    | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_3A-28A-42C                   | 3  |  |  | 12 | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_3A-28A-42A-42A               | 3  |  |  | 12 | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_3A-28A-42A-42C               | 3  |  |  | 12 | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_3A-28A-42C-42C               | 3  |  |  | 12 | 25 | 36 | 50  | FDD |
|                                 | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_3A-41A-42A-42A               | 3  |  |  |    | 25 | 36 | 50  | FDD |
| CA_3A-41A-42A-42C               | 3  |  |  |    | 25 | 36 | 50  | FDD |
| CA_3A-41A-42C-42C               | 3  |  |  |    | 25 | 36 | 50  | FDD |
| CA_4A-4A-5A-12A                 | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-4A-12A                    | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-4A-12A-12A                | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-4A-12A-30A                | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-4A-12B                    | 12 |  |  | 8  | 16 |    |     | FDD |
| CA_4A-12A-12A                   | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-12B                       | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-5A-12A-12A                | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_4A-5A-12B                    | 12 |  |  | 8  | 16 |    |     | FDD |
| CA_7A-7A-8A                     | 8  |  |  | 8  | 16 | 25 | 25  | FDD |
| CA_8A-42C                       | 8  |  |  | 8  | 16 | 25 | 25  | FDD |
| CA_12A-30A-66A-66A              | 12 |  |  | 8  | 16 |    |     | FDD |
| CA_12A-66A-66A                  | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_12A-66C                      | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_12B-66A                      | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_12B-66A-66A                  | 12 |  |  | 8  | 16 | 20 | 20  | FDD |
| CA_20A-38A-40A-40A <sup>3</sup> | 40 |  |  | 25 | 50 | 75 |     | TDD |
| CA_20A-38A-40C <sup>3</sup>     | 40 |  |  | 25 | 50 | 75 |     | TDD |
| CA_20A-40D <sup>3</sup>         | 40 |  |  | 25 | 50 | 75 |     | TDD |
| CA_28A-40C                      | 40 |  |  | 25 | 50 | 75 | 100 | TDD |
| CA_28A-40D                      | 40 |  |  | 25 | 50 | 75 | 100 | TDD |
| CA_28A-41A-42C                  | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-41C-42A                  | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-41C-42C                  | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-41A-42A-42A              | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-41A-42A-42C              | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-41A-42C-42C              | 28 |  |  |    | 10 | 15 | 20  | FDD |
| CA_28A-42C                      | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_28A-42D                      | 28 |  |  | 5  | 10 | 15 | 20  | FDD |
| CA_28A-42A-42A                  | 28 |  |  | 5  | 10 | 15 | 20  | FDD |

|   |    |  |  |    |    |    |    |     |
|---|----|--|--|----|----|----|----|-----|
| CA_28A-42A-42C  |    |  |  |    |    |    |    |     |
| CA_28A-42C-42C  |    |  |  |    |    |    |    |     |
| CA_48A-48C-66A  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| CA_48A-48C-66B  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| CA_48A-48C-66C  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| CA_48A-48D-66A  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| CA_48C-48C-66A  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| CA_48D-66A  | 66 |  |  | 12 | 25 | 36 | 50 | FDD |
| NOTE 1: refers to the UL resource blocks, which shall be centred within the transmission bandwidth configuration for the channel bandwidth.   |    |  |  |    |    |    |    |     |
| NOTE 2: the UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.1-2 for the uplink bandwidth in which case the allocation according to Table 7.3.1-2 applies. |    |  |  |    |    |    |    |     |
| NOTE 3: refers to the UL resource blocks shall be located between 2373-2400MHz.   |    |  |  |    |    |    |    |     |

### 7.3.1B Minimum requirements (QPSK) for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.3.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter  $P_{UMAX}$  is the total transmitter power over the two transmits power over the two transmit antenna connectors.

### 7.3.1D Minimum requirements (QPSK) for ProSe

When UE is configured for E-UTRA ProSe reception non-concurrent with E-UTRA uplink transmissions for E-UTRA ProSe operating bands specified in Table 5.5D-1, the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.6.2 with parameters specified in Table 7.3.1D-1 and Table 7.3.1D-2.

**Table 7.3.1D-1: Reference sensitivity for ProSe Direct Discovery QPSK  $P_{REFSENS}$**

| E-UTRA ProSe Band   | Channel bandwidth |             |                     |                     |                     |              | Duplex Mode |
|---|-------------------|-------------|---------------------|---------------------|---------------------|--------------|-------------|
|   | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm)         | 10 MHz (dBm)        | 15 MHz (dBm)        | 20 MHz (dBm) |             |
| 2   |                   |             | -104.1              | -104.1              | -104.1              | -104.1       | HD          |
| 3   |                   |             | -103.1              | -103.1              | -103.1              | -103.1       | HD          |
| 4   |                   |             | -106.1              | -106.1              | -106.1              | -106.1       | HD          |
| 7   |                   |             | -103.8              | -103.8              | -103.8              | -103.8       | HD          |
| 14  |                   |             | -103.1              | -103.1              |                     |              | HD          |
| 20  |                   |             | -103.2              | -103.2              | -102.2              | -102.2       | HD          |
| 26  |                   |             | -103.5 <sup>5</sup> | -103.5 <sup>5</sup> | -103.5 <sup>5</sup> |              | HD          |
| 28  |                   |             | -104.4              | -104.4              | -104.4              | -102.9       | HD          |
| 31  |                   |             | -99.5               |                     |                     |              | HD          |
| 68  |                   |             | -104.4              | -104.4              | -104.4              |              | HD          |
| 72  |                   |             | -99.5               |                     |                     |              | HD          |
| NOTE 1: Reference measurement channel is A.6.2  |                   |             |                     |                     |                     |              |             |
| NOTE 2: The signal power is specified per port  |                   |             |                     |                     |                     |              |             |
| NOTE 3: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.  |                   |             |                     |                     |                     |              |             |
| NOTE 4: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.  |                   |             |                     |                     |                     |              |             |
| NOTE 5: <sup>5</sup> indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz. |                   |             |                     |                     |                     |              |             |
| NOTE 6: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.                    |                   |             |                     |                     |                     |              |             |

**Table 7.3.1D-2: Reference sensitivity for ProSe Direct Communication QPSK  $P_{\text{REFSENS}}$** 

| E-UTRA ProSe Band   | Channel bandwidth |             |             |                    |              |              | Duplex Mode |
|---|-------------------|-------------|-------------|--------------------|--------------|--------------|-------------|
|   | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm)       | 15 MHz (dBm) | 20 MHz (dBm) |             |
| 3   |                   |             |             | -97.6              |              |              | HD          |
| 7   |                   |             |             | -98.3              |              |              | HD          |
| 14  |                   |             |             | -97.6              |              |              | HD          |
| 20  |                   |             |             | -97.7              |              |              | HD          |
| 26  |                   |             |             | -98.0 <sup>5</sup> |              |              | HD          |
| 28  |                   |             |             | -98.9              |              |              | HD          |
| 31  |                   |             | -96.7       |                    |              |              | HD          |
| 68  |                   |             | -101.7      | -98.9              |              |              | HD          |
| 72  |                   |             | -96.7       |                    |              |              | HD          |
| NOTE 1: Reference measurement channel is A.6.2<br>NOTE 2: The signal power is specified per port<br>NOTE 3: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.<br>NOTE 4: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.<br>NOTE 5: <sup>5</sup> indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.<br>NOTE 6: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths. |                   |             |             |                    |              |              |             |

NOTE: Table 7.3.1D-1/ Table 7.3.1D-2 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of allocated resource blocks will be practically constrained by other factors.

For the UE which supports ProSe in an operating band as specified in Section 5.5D, and the UE also supports a E-UTRA downlink inter-band carrier aggregation configuration in Table 7.3.1-1A or Table 7.3.1-1B, the minimum requirement for reference sensitivity in Table 7.3.1D-1 and Table 7.3.1D-2 shall be increased by the amount given in  $\Delta R_{\text{B,c}}$  in Table 7.3.1-1A and Table 7.3.1-1B for the corresponding E-UTRA ProSe band.

When UE is configured for E-UTRA ProSe reception on PCC for the inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, there are no further requirements for reference sensitivity beyond those specified above when only PCC is configured in Table 7.3.1D-1 and Table 7.3.1D-2.

When UE is configured for E-UTRA ProSe reception on SCC or a non-serving carrier concurrent with E-UTRA uplink for inter-band E-UTRA ProSe / E-UTRA bands specified in Table 5.5D-2, E-UTRA ProSe throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.6.2 with parameters specified in Table 7.3.1D-1 and Table 7.3.1D-2. The reference sensitivity is defined to be met with E-UTRA uplink assigned to one band (that differs from the ProSe operating band) and all E-UTRA downlink carriers active. The E-UTRA uplink resource blocks shall be located as close as possible to E-UTRA ProSe operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). The uplink configuration for the E-UTRA operating band is specified in Table 7.3.1D-3.

NOTE: The E-UTRA uplink channel bandwidth and transmission bandwidth specified in this Table 7.3.1D-3 are intended for conformance tests and does not restrict the operating conditions of the network.

**Table 7.3.1D-3: Uplink configuration for E-UTRA band / E-UTRA CA band**

| Inter-band E-UTRA ProSe/E-UTRA configuration |                              | E-UTRA UL band / Channel BW / $N_{\text{RB}}$ / Duplex mode |                         |                 |             |
|--|------------------------------|---|-------------------------|-----------------|-------------|
| E-UTRA ProSe band                            | E-UTRA band / E-UTRA CA band | E-UTRA UL band  | Channel Bandwidth (MHz) | $N_{\text{RB}}$ | Duplex Mode |
| 2  | 4                            | 4   | 5                       | 25              | FDD         |
| 2  | CA_2-4                       | 4   | 5                       | 25              | FDD         |
| 28   | 1                            | 1   | 5                       | 25              | FDD         |
| 28   | CA_1-28                      | 1   | 5                       | 25              | FDD         |

NOTE 1: For E-UTRA ProSe reception on SCC, the channel bandwidth of the E-UTRA downlink SCC is set same as the ProSe channel bandwidth for which reference sensitivity is being measured.

### 7.3.1E Minimum requirements (QPSK) for UE category 0, M1, M2 and 1bis

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1E-1A/Table 7.3.1E-1B and Table 7.3.1E-2 for category 0, Table 7.3.1E-3/Table 7.3.1E-4 for category M1, and Table 7.3.1E-6/Table 7.3.1E-7 for category 1bis, and Table 7.3.1E-8/Table 7.3.1E-9 for category M2.

**Table 7.3.1E-1A: Reference sensitivity for FDD and TDD UE category 0 QPSK  $P_{\text{REFSENS}}$**

| Channel bandwidth |               |             |                  |                  |                    |              |             |
|-------------------|---------------|-------------|------------------|------------------|--------------------|--------------|-------------|
| E-UTRA Band       | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm)      | 10 MHz (dBm)     | 15 MHz (dBm)       | 20 MHz (dBm) | Duplex Mode |
| 2                 | -100.2        | -97.2       | -95.5            | -92.5            | -90.7              | -89.5        | FDD         |
| 3                 | -99.2         | -96.2       | -94.5            | -91.5            | -89.7              | -88.5        | FDD         |
| 4                 | -102.2        | -99.2       | -97.5            | -94.5            | -92.7              | -91.5        | FDD         |
| 5                 | -100.7        | -97.7       | -95.5            | -92.5            |                    |              | FDD         |
| 8                 | -99.7         | -96.7       | -94.5            | -91.5            |                    |              | FDD         |
| 13                |               |             | -94              | -91              |                    |              | FDD         |
| 20                |               |             | -94.5            | -91.5            | -88.2              | -87          | FDD         |
| 25                | -98.7         | -95.7       | -94              | -91              | -89.2              | -88          | FDD         |
| 26                | -100.2        | -97.2       | -95 <sup>3</sup> | -92 <sup>3</sup> | -90.2 <sup>3</sup> |              | FDD         |
| 28                |               | -97.7       | -96              | -93              | -91.2              | -88.5        | FDD         |
| 39                |               |             | -97.5            | -94.5            | -92.7              | -91.5        | TDD         |
| 40                |               |             | -97.5            | -94.5            | -92.7              | -91.5        | TDD         |
| 41                |               |             | -95.5            | -92.5            | -90.7              | -89.5        | TDD         |

NOTE 1: The transmitter shall be set to  $P_{\text{UMAX}}$  as defined in subclause 6.2.5  
NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1  
NOTE 3: The requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz

**Table 7.3.1E-1B: Reference sensitivity for HD-FDD UE category 0 QPSK  $P_{\text{REFSENS}}$**

| Channel bandwidth |               |             |             |              |              |              |             |
|-------------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
| E-UTRA Band       | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex Mode |
| 2                 | -101          | -98         | -96.3       | -93.3        | -91.5        | -90.3        | HD-FDD      |
| 3                 | -100          | -97         | -95.3       | -92.3        | -90.5        | -89.3        | HD-FDD      |
| 4                 | -103          | -100        | -98.3       | -95.3        | -93.5        | -92.3        | HD-FDD      |
| 5                 | -101.5        | -98.5       | -96.3       | -93.3        |              |              | HD-FDD      |
| 8                 | -100.5        | -97.5       | -95.3       | -92.3        |              |              | HD-FDD      |
| 13                |               |             | -95.3       | -92.3        |              |              | HD-FDD      |
| 20                |               |             | -95.3       | -92.3        | -89.5        | -88.3        | HD-FDD      |
| 25                | -99.5         | -96.5       | -94.8       | -91.8        | -90          | -88.8        | HD-FDD      |
| 26                | -101          | -98         | -95.8       | -92.8        |              |              | HD-FDD      |
| 28                |               | -98.5       | -96.8       | -93.8        | -92          | -89.3        | HD-FDD      |

NOTE 1: The transmitter shall be set to  $P_{\text{UMAX}}$  as defined in subclause 6.2.5  
NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.1E-1A/Table 7.3.1E-1B shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.1E-2.

Unless given by Table 7.3.1-3, the minimum requirements specified in Table 7.3.1E-1A/Table 7.3.1E-1B shall be verified with the network signalling value NS\_01 (Table 6.2.4E-1) configured.



NOTE: Table 7.3.1E-2 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex G (informative).

**Table 7.3.1E-2: FDD and TDD UE category 0 Uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |         |       |                 |                 |                 |                 |                |
|---|---------|-------|-----------------|-----------------|-----------------|-----------------|----------------|
| E-UTRA Band   | 1.4 MHz | 3 MHz | 5 MHz           | 10 MHz          | 15 MHz          | 20 MHz          | Duplex Mode    |
| 2   | 6       | 15    | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | FDD and HD-FDD |
| 3   | 6       | 15    | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | FDD and HD-FDD |
| 4   | 6       | 15    | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | FDD and HD-FDD |
| 5   | 6       | 15    | 25              | 25 <sup>1</sup> |                 |                 | FDD and HD-FDD |
| 8   | 6       | 15    | 25              | 25 <sup>1</sup> |                 |                 | FDD and HD-FDD |
| 13  |         |       | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD and HD-FDD |
| 20  |         |       | 25              | 20 <sup>1</sup> | 20 <sup>2</sup> | 20 <sup>2</sup> | FDD and HD-FDD |
| 25  | 6       | 15    | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | FDD and HD-FDD |
| 26  | 6       | 15    | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD and HD-FDD |
| 28  |         | 15    | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD and HD-FDD |
| 39  |         |       | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | TDD            |
| 40  |         |       | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | TDD            |
| 41  |         |       | 25              | 36 <sup>1</sup> | 36 <sup>1</sup> | 36 <sup>1</sup> | TDD            |

NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).

NOTE 2: <sup>2</sup> refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 16.

**Table 7.3.1E-3: Reference sensitivity for FDD and TDD UE category M1 QPSK P<sub>REFSENS</sub>**

| E-UTRA Band | REFSENS (dBm)       | Duplex Mode |
|-------------|---------------------|-------------|
| 1           | -102.2              | FDD         |
| 2           | -100.2              | FDD         |
| 3           | -99.2               | FDD         |
| 4           | -102.2              | FDD         |
| 5           | -100.7              | FDD         |
| 7           | -100.2              | FDD         |
| 8           | -99.7               | FDD         |
| 11          | -102.2 <sup>3</sup> | FDD         |
| 12          | -99.2               | FDD         |
| 13          | -98.7               | FDD         |
| 14          | -98.7               | FDD         |
| 18          | -102.2 <sup>4</sup> | FDD         |
| 19          | -102.2              | FDD         |
| 20          | -99.7               | FDD         |
| 21          | -102.2 <sup>3</sup> | FDD         |
| 25          | -98.7               | FDD         |
| 26          | -100.2              | FDD         |
| 27          | -100.7              | FDD         |
| 28          | -100.7              | FDD         |
| 31          | -96.5               | FDD         |
| ...         |                     |             |
| 39          | -103.7              | TDD         |
| 40          | -103.7              | TDD         |
| 41          | -101.7              | TDD         |

|  |                     |     |
|--|---------------------|-----|
| 42   | -102.7              | TDD |
| 43   | -102.7              | TDD |
| ...  |                     |     |
| 71   | 99.4                | FDD |
| 72   | -96.5               | FDD |
| 73   | -96.5               | FDD |
| 74   | -101.7 <sup>8</sup> | FDD |
| 85   | -99.2               | FDD |
| 87   | -96.5               | FDD |
| 88   | -96.5               | FDD |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5   |                     |     |
| NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCN Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1   |                     |     |
| NOTE 3: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.   |                     |     |
| NOTE 4: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.   |                     |     |
| NOTE 5: For cat M1 the same reference sensitivity requirement applies for all applicable channel bandwidths (Table 5.6.1-1)  |                     |     |
| NOTE 6: The reference receive sensitivity shall be met for an uplink transmission bandwidth less than or equal to 6 RB except for band 31 and 72. For band 31 and 72; in the case of 3 MHz channel bandwidth 5 RB applies and the UL resource blocks shall be located at $RB_{start}$ 9. In case of 5 MHz channel bandwidth 5 RB applies and the UL resource blocks shall be located at $RB_{start}$ 10. |                     |     |
| NOTE 7: The UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth.  |                     |     |
| NOTE 8: <sup>8</sup> indicates that the requirement is modified by -0.5 dB when the assigned E-UTRA channel bandwidth is confined within 1475.9-1510.9 MHz.  |                     |     |

Table 7.3.1E-4: Reference sensitivity for HD-FDD UE category M1 QPSK  $P_{REFSENS}$ 

| E-UTRA Band | REFSENS (dBm)     | Duplex Mode |
|-------------|-------------------|-------------|
| 1           | -103              | HD-FDD      |
| 2           | -101              | HD-FDD      |
| 3           | -100              | HD-FDD      |
| 4           | -103              | HD-FDD      |
| 5           | -101.5            | HD-FDD      |
| 7           | -101              | HD-FDD      |
| 8           | -100.5            | HD-FDD      |
| 11          | -103 <sup>3</sup> | HD-FDD      |
| 12          | -100              | HD-FDD      |
| 13          | -100              | HD-FDD      |
| 14          | -100              | HD-FDD      |
| 18          | -103 <sup>4</sup> | HD-FDD      |
| 19          | -103              | HD-FDD      |
| 20          | -100.5            | HD-FDD      |
| 21          | -103 <sup>3</sup> | HD-FDD      |
| 25          | -99.5             | HD-FDD      |
| 26          | -101              | HD-FDD      |
| 27          | -101.5            | HD-FDD      |
| 28          | -101.5            | HD-FDD      |
| 31          | -97.3             | HD-FDD      |
| ...         |                   |             |
| 71          | -100.2            | HD-FDD      |
| 72          | -97.3             | HD-FDD      |
| 73          | -97.3             | HD-FDD      |

|  |       |        |
|--|-------|--------|
| 74   | -103  | HD-FDD |
| 85   | -100  | HD-FDD |
| 87   | -97.3 | HD-FDD |
| 88   | -97.3 | HD-FDD |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5   |       |        |
| NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1              |       |        |
| NOTE 3: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.   |       |        |
| NOTE 4: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths. |       |        |
| NOTE 5: For cat M1 the same reference sensitivity requirement applies for all applicable channel bandwidths (Table 5.6.1-1)                        |       |        |

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.1E-3/Table 7.3.1E-4 shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.1E-5.

NOTE: Table 7.3.1E-5 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex G (informative).

**Table 7.3.1E-5: FDD and TDD UE category M1 Uplink configuration for reference sensitivity**

| E-UTRA Band | $N_{RB}$       | Duplex Mode    |
|-------------|----------------|----------------|
| 1           | 6 <sup>1</sup> | FDD and HD-FDD |
| 2           | 6 <sup>1</sup> | FDD and HD-FDD |
| 3           | 6 <sup>1</sup> | FDD and HD-FDD |
| 4           | 6 <sup>1</sup> | FDD and HD-FDD |
| 5           | 6 <sup>1</sup> | FDD and HD-FDD |
| 7           | 6 <sup>1</sup> | FDD and HD-FDD |
| 8           | 6 <sup>1</sup> | FDD and HD-FDD |
| 11          | 6 <sup>1</sup> | FDD and HD-FDD |
| 12          | 6 <sup>1</sup> | FDD and HD-FDD |
| 13          | 6 <sup>1</sup> | FDD and HD-FDD |
| 14          | 6 <sup>1</sup> | FDD and HD-FDD |
| 18          | 6 <sup>1</sup> | FDD and HD-FDD |
| 19          | 6 <sup>1</sup> | FDD and HD-FDD |
| 20          | 6 <sup>1</sup> | FDD and HD-FDD |
| 21          | 6 <sup>1</sup> | FDD and HD-FDD |
| 25          | 6 <sup>1</sup> | FDD and HD-FDD |
| 26          | 6 <sup>1</sup> | FDD and HD-FDD |
| 27          | 6 <sup>1</sup> | FDD and HD-FDD |
| 28          | 6 <sup>1</sup> | FDD and HD-FDD |
| 31          | 6 <sup>1</sup> | FDD and HD-FDD |
| ...         |                |                |
| 39          | 6 <sup>1</sup> | TDD            |
| 40          | 6 <sup>1</sup> | TDD            |
| 41          | 6 <sup>1</sup> | TDD            |
| 42          | 6 <sup>1</sup> | TDD            |
| 43          | 6 <sup>1</sup> | TDD            |
| ...         |                |                |
| 71          | 6 <sup>1</sup> | FDD and HD-FDD |
| 72          | 6 <sup>1</sup> | FDD and HD-FDD |
| 73          | 6 <sup>1</sup> | FDD and HD-FDD |

|  |                |                |
|--|----------------|----------------|
| 74   | 6 <sup>1</sup> | FDD and HD-FDD |
| 85   | 6 <sup>1</sup> | FDD and HD-FDD |
| 87   | 6 <sup>1</sup> | FDD and HD-FDD |
| 88   | 6 <sup>1</sup> | FDD and HD-FDD |
| NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). |                |                |

Table 7.3.1E-6: Reference sensitivity for FDD and TDD UE category 1bis QPSK P<sub>REFSENS</sub>

| Channel bandwidth   |               |             |                    |                    |                    |              |             |
|---|---------------|-------------|--------------------|--------------------|--------------------|--------------|-------------|
| E-UTRA Band   | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm)        | 10 MHz (dBm)       | 15 MHz (dBm)       | 20 MHz (dBm) | Duplex Mode |
| 1   |               |             | -97.5              | -94                | -92.2              | -91          | FDD         |
| 2   | -100.2        | -97.2       | -95.5              | -92                | -90.2              | -89          | FDD         |
| 3   | -99.2         | -96.2       | -94.5              | -91                | -89.2              | -88          | FDD         |
| 4   | -102.2        | -99.2       | -97.5              | -94                | -92.2              | -91          | FDD         |
| 5   | -100.7        | -97.7       | -95.5              | -92.5              |                    |              | FDD         |
| 7   |               |             | -95.5              | -92                | -90.2              | -89          | FDD         |
| 8   | -99.7         | -96.7       | -94.5              | -91.5              |                    |              | FDD         |
| 12  | -98.7         | -95.7       | -94                | -91                |                    |              | FDD         |
| 13  |               |             | -94                | -91                |                    |              | FDD         |
| 18  |               |             | -97.5              | -94.5              | -92.7              |              | FDD         |
| 20  |               |             | -94.5              | -91.5              | -88.2              | -87          | FDD         |
| 26  | -100.2        | -97.2       | -95.0 <sup>3</sup> | -92.0 <sup>3</sup> | -90.2 <sup>3</sup> |              | FDD         |
| 28  |               | -97.7       | -96.0              | -93.0              | -91.2              | -88.5        | FDD         |
| 31  | -96.5         | -92.5       | -90.5              |                    |                    |              | FDD         |
| 34  |               |             | -97.5              | -94.5              | -92.7              |              |             |
| 39  |               |             | -97.5              | -94.5              | -92.7              | -91.5        | TDD         |
| 40  |               |             | -97.5              | -94.5              | -92.7              | -91.5        | TDD         |
| 41  |               |             | -95.5              | -92.5              | -90.7              | -89.5        | TDD         |
| 66  | -101.7        | -98.7       | -97                | -93.5              | -91.7              | -90.5        | FDD         |
| 72  | -96.5         | -92.5       | -90.5              |                    |                    |              | FDD         |
| NOTE 1: The transmitter shall be set to P <sub>UMAX</sub> as defined in subclause 6.2.5   |               |             |                    |                    |                    |              |             |
| NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1                                 |               |             |                    |                    |                    |              |             |
| NOTE 3: <sup>3</sup> indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz. |               |             |                    |                    |                    |              |             |

Table 7.3.1E-7: FDD and TDD UE category 1bis Uplink configuration for reference sensitivity

| E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |         |                |                 |                 |                 |                 |             |
|---|---------|----------------|-----------------|-----------------|-----------------|-----------------|-------------|
| E-UTRA Band   | 1.4 MHz | 3 MHz          | 5 MHz           | 10 MHz          | 15 MHz          | 20 MHz          | Duplex Mode |
| 1   |         |                | 25              | 50              | 75              | 100             | FDD         |
| 2   | 6       | 15             | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| 3   | 6       | 15             | 25              | 50              | 50 <sup>1</sup> | 50 <sup>1</sup> | FDD         |
| 4   | 6       | 15             | 25              | 50              | 75              | 100             | FDD         |
| 5   | 6       | 15             | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 7   |         |                | 25              | 50              | 75              | 75 <sup>1</sup> | FDD         |
| 8   | 6       | 15             | 25              | 25 <sup>1</sup> |                 |                 | FDD         |
| 12  | 6       | 15             | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD         |
| 13  |         |                | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD         |
| 18  |         |                | 25              | 25              | 25              |                 | FDD         |
| 20  |         |                | 25              | 20 <sup>1</sup> | 20 <sup>2</sup> | 20 <sup>2</sup> | FDD         |
| 26  | 6       | 15             | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> |                 | FDD         |
| 28  |         | 15             | 25              | 25 <sup>1</sup> | 25 <sup>1</sup> | 25 <sup>1</sup> | FDD         |
| 31  | 6       | 5 <sup>3</sup> | 5 <sup>3</sup>  |                 |                 |                 | FDD         |
| 34  |         |                | 25              | 50              | 75              |                 |             |
| 39  |         |                | 25              | 50              | 75              | 100             | TDD         |
| 40  |         |                | 25              | 50              | 75              | 100             | TDD         |

|    |   |                |                |    |    |     |     |
|----|---|----------------|----------------|----|----|-----|-----|
| 41 |   |                | 25             | 50 | 75 | 100 | TDD |
| 66 | 6 | 15             | 25             | 50 | 75 | 100 | FDD |
| 72 | 6 | 5 <sup>3</sup> | 5 <sup>3</sup> |    |    |     | FDD |

NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).

NOTE 2: <sup>2</sup> refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 16.

NOTE 3: <sup>3</sup> refers to Bands 31 and 72; in the case of 3 MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 9 and in the case of 5 MHz channel bandwidth, the UL resource blocks shall be located at RB<sub>start</sub> 10.

**Table 7.3.1E-8: Reference sensitivity for FDD /TDD UE category M2 QPSK P<sub>REFSENS</sub>**

| E-UTRA Band | Channel bandwidth |             |             |              |              |              | Duplex Mode |
|-------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|             | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| 1           |                   |             | -97.7       | -97.7        | -97.7        | -97.7        | FDD         |
| 2           | -100.2            | -97.2       | -95.7       | -95.7        | -95.7        | -95.7        | FDD         |
| 3           | -99.2             | -96.2       | -94.7       | -94.7        | -94.7        | -94.7        | FDD         |
| 4           | -102.2            | -99.2       | -97.7       | -97.7        | -97.7        | -97.7        | FDD         |
| 5           | -100.7            | -97.7       | -95.7       | -95.7        |              |              | FDD         |
| 7           |                   |             | -95.7       | -95.7        | -95.7        | -95.7        | FDD         |
| 8           | -99.7             | -96.7       | -94.7       | -94.7        |              |              | FDD         |
| 11          |                   |             | -97.7       | -97.7        |              |              |             |
| 12          | -99.2             | -96.2       | -94.7       | -94.7        |              |              | FDD         |
| 13          |                   |             | -94.2       | -94.2        |              |              | FDD         |
| ...         |                   |             |             |              |              |              |             |
| 18          |                   |             | -97.7       | -97.7        | -97.7        |              | FDD         |
| 19          |                   |             | -97.7       | -97.7        | -97.7        |              | FDD         |
| 20          |                   |             | -94.7       | -94.7        | -94.7        | -94.7        | FDD         |
| 21          |                   |             | -97.7       | -97.7        | -97.7        |              | FDD         |
| 25          | -98.7             | -95.7       | -94.2       | -94.2        | -94.2        | -94.2        | FDD         |
| 26          | -100.2            | -97.2       | -95.2       | -95.2        | -95.2        |              | FDD         |
| 27          | -100.7            | -97.7       | -95.7       | -95.7        |              |              | FDD         |
| 28          |                   | -97.7       | -96.2       | -96.2        | -96.2        | -96.2        | FDD         |
| 31          | -96.5             | -93.2       | -91.2       |              |              |              | FDD         |
| ...         |                   |             |             |              |              |              |             |
| 39          |                   |             | -97.7       | -97.7        | -97.7        | -97.7        | TDD         |
| 40          |                   |             | -97.7       | -97.7        | -97.7        | -97.7        | TDD         |
| 41          |                   |             | -95.7       | -95.7        | -95.7        | -95.7        | TDD         |
| 42          |                   |             | -96.7       | -96.7        | -96.7        | -96.7        | TDD         |
| 43          |                   |             | -96.7       | -96.7        | -96.7        | -96.7        | TDD         |
| 66          | -101.7            | -98.7       | -97.2       | -97.2        | -97.2        | -97.2        | FDD         |
| ...         |                   |             |             |              |              |              |             |
| 71          |                   |             | [-93.4]     | [-93.4]      | [-93.4]      | [-93.4]      | FDD         |
| 72          | [-96.5]           | [-92.5]     | [-90.5]     |              |              |              | FDD         |
| 73          | [-96.5]           | [-92.5]     | [-90.5]     |              |              |              | FDD         |
| 85          |                   |             | -94.7       | -94.7        |              |              | FDD         |
| 87          | -96.5             | -92.5       | -90.5       |              |              |              | FDD         |
| 88          | -96.5             | -92.5       | -90.5       |              |              |              | FDD         |

NOTE 1: The transmitter shall be set to PUMAX as defined in subclause 6.2.5

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

NOTE 3: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.

NOTE 4: For a UE that supports both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.  
 NOTE 5: The UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth.

**Table 7.3.1E-9: Reference sensitivity for HD-FDD category M2 QPSK P<sub>REFSENS</sub>**

| E-UTRA Band | Channel bandwidth |             |             |              |              |              | Duplex Mode |
|-------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|             | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| 1           |                   |             | -97         | -97          | -97          | -97          | HD-FDD      |
| 2           | -101              | -97         | -95         | -95          | -95          | -95          | HD-FDD      |
| 3           | -100              | -96         | -94         | -94          | -94          | -94          | HD-FDD      |
| 4           | -103              | -99         | -97         | -97          | -97          | -97          | HD-FDD      |
| 5           | -101.5            | -97.5       | -95.5       | -95.5        |              |              | HD-FDD      |
| 7           |                   |             | -95         | -95          | -95          | -95          | HD-FDD      |
| 8           | -100.5            | -96.5       | -94.5       | -94.5        |              |              | HD-FDD      |
| 11          |                   |             | -97         | -97          |              |              | HD-FDD      |
| 12          | -100              | -96         | -94         | -94          |              |              | HD-FDD      |
| 13          |                   |             | -94         | -94          |              |              | HD-FDD      |
| 14          |                   |             | -94         | -94          |              |              | HD-FDD      |
| 18          |                   |             | -97         | -97          | -97          |              | HD-FDD      |
| 19          |                   |             | -97         | -97          | -97          |              | HD-FDD      |
| 20          |                   |             | -94.5       | -94.5        | -94.5        | -94.5        | HD-FDD      |
| 21          |                   |             | -97         | -97          | -97          |              | HD-FDD      |
| 25          | -99.5             | -95.5       | -93.5       | -93.5        | -93.5        | -93.5        | HD-FDD      |
| 26          | -101              | -97         | -95         | -95          | -95          |              | HD-FDD      |
| 27          | -101.5            | -97.5       | -95.5       | -95.5        |              |              | HD-FDD      |
| 28          |                   | -97.5       | -95.5       | -95.5        | -95.5        | -95.5        | HD-FDD      |
| 31          | -97.3             | -93.3       | -91.3       |              |              |              | HD-FDD      |
| 71          |                   |             | -94.2       | -94.2        | -94.2        | -94.2        | HD-FDD      |
| 72          | -97.3             | -93.3       | -91.3       |              |              |              | HD-FDD      |
| 73          | -97.3             | -93.3       | -91.3       |              |              |              | HD-FDD      |
| 85          |                   |             | -94         | -94          |              |              | HD-FDD      |
| 87          | -97.3             | -93.3       | -91.3       |              |              |              | HD-FDD      |
| 88          | -97.3             | -93.3       | -91.3       |              |              |              | HD-FDD      |

NOTE 1: The transmitter shall be set to PUMAX as defined in subclause 6.2.5  
 NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1  
 NOTE 3: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.  
 NOTE 4: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.

**Table 7.3.1E-10: FDD/HD-FDD and TDD UE category M2 Uplink configuration for reference sensitivity**

| E-UTRA Band | E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |       |                 |                 |        |        | Duplex Mode |
|-------------|---|-------|-----------------|-----------------|--------|--------|-------------|
|             | 1.4 MHz   | 3 MHz | 5 MHz           | 10 MHz          | 15 MHz | 20 MHz |             |
| 1           |   |       | 24              | 24              | 24     | 24     | FDD/HD-FDD  |
| 2           | 6   | 15    | 24              | 24              | 24     | 24     | FDD/HD-FDD  |
| 3           | 6   | 15    | 24              | 24              | 24     | 24     | FDD/HD-FDD  |
| 4           | 6   | 15    | 24              | 24              | 24     | 24     | FDD/HD-FDD  |
| 5           | 6   | 15    | 24              | 24              |        |        | FDD/HD-FDD  |
| 7           |   |       | 24              | 24              | 24     | 24     | FDD/HD-FDD  |
| 8           | 6   | 15    | 24              | 24              |        |        | FDD/HD-FDD  |
| 11          |   |       | 24              | 24              |        |        | FDD/HD-FDD  |
| 12          | 6   | 15    | 20 <sup>1</sup> | 20 <sup>1</sup> |        |        | FDD/HD-FDD  |

|   |   |                |                 |                 |                 |                 |            |
|---|---|----------------|-----------------|-----------------|-----------------|-----------------|------------|
| 13  |   |                | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD/HD-FDD |
| 14  |   |                | 15 <sup>1</sup> | 15 <sup>1</sup> |                 |                 | FDD/HD-FDD |
| 18  |   |                | 24              | 24              | 24              |                 | FDD/HD-FDD |
| 19  |   |                | 24              | 24              | 24              |                 | FDD/HD-FDD |
| 20  |   |                | 24              | 20 <sup>1</sup> | 20 <sup>3</sup> | 20 <sup>3</sup> | FDD/HD-FDD |
| 21  |   |                | 24              | 24 <sup>1</sup> | 24 <sup>1</sup> |                 | FDD/HD-FDD |
| 25  | 6 | 15             | 24              | 24              | 24              | 24              | FDD/HD-FDD |
| 26  | 6 | 15             | 24              | 24              | 24              |                 | FDD/HD-FDD |
| 27  | 6 | 15             | 24              | 24              |                 |                 | FDD/HD-FDD |
| 28  |   | 15             | 24              | 24              | 24              | 24              | FDD/HD-FDD |
| 31  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD/HD-FDD |
| ...   |   |                |                 |                 |                 |                 |            |
| 39  |   |                |                 | 24              | 24              | 24              | TDD        |
| 40  |   |                |                 | 24              | 24              | 24              | TDD        |
| 41  |   |                |                 | 24              | 24              | 24              | TDD        |
| 42  |   |                |                 | 24              | 24              | 24              | TDD        |
| 43  |   |                |                 | 24              | 24              | 24              | TDD        |
| ...   |   |                |                 |                 |                 |                 |            |
| 71  |   |                | 24              | 24              | 24              | 24              | FDD/HD-FDD |
| 72  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD/HD-FDD |
| 73  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD/HD-FDD |
| 85  |   |                | 20 <sup>1</sup> | 20 <sup>1</sup> |                 |                 | FDD/HD-FDD |
| 87  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD/HD-FDD |
| 88  | 6 | 5 <sup>4</sup> | 5 <sup>4</sup>  |                 |                 |                 | FDD/HD-FDD |
| NOTE 1: <sup>1</sup> refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).                    |   |                |                 |                 |                 |                 |            |
| NOTE 2: For the UE which supports both Band 11 and Band 21 the uplink configuration for reference sensitivity is FFS.   |   |                |                 |                 |                 |                 |            |
| NOTE 3: <sup>3</sup> refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RBstart 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RBstart 16             |   |                |                 |                 |                 |                 |            |
| NOTE 4: <sup>4</sup> refers to Bands 31, 72 and 73; in the case of 3 MHz channel bandwidth, the UL resource blocks shall be located at RBstart 9 and in the case of 5 MHz channel bandwidth, the UL resource blocks shall be located at RBstart 10. |   |                |                 |                 |                 |                 |            |

## 7.3.1F Minimum requirements for UE category NB1 and NB2

### 7.3.1F.1 Reference sensitivity for UE category NB1 and NB2

The category NB1 and NB2 UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with received signal level as specified in Table 7.3.1F.1-1. Requirement in Table 7.3.1F.1-1 applies for any uplink configuration.

**Table 7.3.1F.1-1: Reference sensitivity for UE category NB1 and NB2**

| Operating band              | REFSENS [dBm] |
|-----------------------------|---------------|
| According to subclause 5.5F | - 108.2       |

### 7.3.1F.2 Void

## 7.3.1G Minimum requirements (QPSK) for V2X

When UE is configured for E-UTRA V2X reception non-concurrent with E-UTRA uplink transmissions for E-UTRA V2X operating bands specified in Table 5.5G-1, the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.8.2 with parameters specified in Table 7.3.1G-1.

**Table 7.3.1G-1: Reference sensitivity of E-UTRA V2X Bands (PC5)**

| Channel bandwidth  |               |             |             |              |              |              |             |
|--|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
| E-UTRA V2X Band  | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex Mode |
| 47   |               |             |             | -90.4        |              | -87.5        | HD          |
| NOTE 1: Reference measurement channel is defined in A.8.2. |               |             |             |              |              |              |             |
| NOTE 2: The signal power is specified per port.            |               |             |             |              |              |              |             |

**Table 7.3.1.G-1a: Sidelink TX configuration for reference sensitivity of E-UTRA V2X Bands (PC5)**

| E-UTRA Band / Channel bandwidth / N <sub>RB</sub> / Duplex mode |         |       |       |        |        |        |             |
|---|---------|-------|-------|--------|--------|--------|-------------|
| E-UTRA V2X Band   | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex Mode |
| 47  |         |       |       | 50     |        | 98     | HD          |

When UE is configured for E-UTRA V2X reception on V2X carrier con-current with E-UTRA uplink and downlink for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2 with one or multiple contiguous carriers in V2X sidelink, E-UTRA V2X sidelink throughput for each component carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.8.2 with parameters specified in Table 7.3.1G-2. Also the E-UTRA downlink throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.3.3.2.

For the UE which supports V2X in an operating band as specified in Table 5.5G-2, and the UE also supports a E-UTRA downlink inter-band con-current configuration in Table 7.3.1G-2A, the minimum requirement for reference sensitivity in Table 7.3.1G-1 and Table 7.3.1G-2 shall be increased by the amount given in ΔR<sub>IB,c</sub> in Table 7.3.1G-2A for the corresponding E-UTRA V2X band.

**Table 7.3.1G-2: Reference sensitivity for V2X Communication QPSK P<sub>REFSENS</sub>**

| Inter-band V2X reception |                    | Channel bandwidth |               |             |             |              |              |              |             |
|--------------------------|--------------------|-------------------|---------------|-------------|-------------|--------------|--------------|--------------|-------------|
| E-UTRA V2X Band          | E-UTRA or V2X band | E-UTRA band       | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex Mode |
| Band 47                  | Band 3             | 3                 | -101.7        | -98.7       | -97         | -94          | -92.2        | -91          | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 5             | 5                 |               |             | -98         | -95          |              |              | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 7             | 7                 |               |             | -98         | -95          | -93.2        | -92          | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 8             | 8                 | -102.2        | -99.2       | -97         | -94          |              |              | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 20            | 20                |               |             | -97         | -94          | -91.2        | -90          | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 28            | 28                |               | -100.2      | -98.5       | -95.5        | -93.7        | -91          | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 34            | 34                |               |             | -100        | -97          | -95.2        |              | TDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 39            | 39                |               |             | -100        | -97          | -95.2        | -94          | TDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 41            | 41                |               |             | -98         | -95          | -93.2        | -92          | TDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |
| Band 47                  | Band 71            | 71                |               |             | -97.2       | -94.2        | -92          | -87.5        | FDD         |
|                          |                    | 47                |               |             |             | -90.4        |              | -87.5        | HD          |

**Table 7.3.1G-2A: ΔR<sub>IB,c</sub> (two bands)**

| V2X inter-band con-current band Combination | E-UTRA Band | ΔR <sub>IB,c</sub> [dB] |
|---|-------------|-------------------------|
|---|-------------|-------------------------|



|             |    |     |
|-------------|----|-----|
| V2X_3-47    | 3  | 0   |
| V2X_5-47    | 5  | 0.2 |
| V2X_7-47    | 7  | 0   |
| V2X_8-47    | 8  | 0   |
| V2X_20-47   | 20 | 0.2 |
| V2X_28A-47A | 28 | 0.2 |
| V2X_34-47   | 34 | 0   |
| V2X_39-47   | 39 | 0   |
| V2X_41-47   | 41 | 0   |
| V2X_71A-47A | 71 | 0   |

The reference sensitivity is defined to be met with E-UTRA uplink assigned to one band (that differs from the V2X operating band) and all E-UTRA downlink carriers active. The E-UTRA uplink resource blocks shall be located as close as possible to E-UTRA V2X operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). The uplink configuration for the E-UTRA operating band is specified in Table 7.3.1G-3 and 7.3.1G-4. The REFSENS of Uu downlink and PC5 sidelink will be tested at the same time.

**Table 7.3.1G-3: Uplink configuration for REFSENS of E-UTRA V2X Bands**

| Inter-band E-UTRA V2X /E-UTRA configuration |                                   | E-UTRA UL band / Channel BW / N <sub>RB</sub> / Duplex mode |                         |                 |             |
|---|-----------------------------------|---|-------------------------|-----------------|-------------|
| E-UTRA V2X band (PC5)                       | E-UTRA or V2X operating band (Uu) | E-UTRA or V2X UL band (Uu)                                  | Channel Bandwidth (MHz) | N <sub>RB</sub> | Duplex Mode |
| 47  | 3                                 | 3   | 10                      | 50              | FDD         |
| 47  | 5                                 | 5   | 10                      | 50              | FDD         |
| 47  | 7                                 | 7   | 10                      | 50              | FDD         |
| 47  | 8                                 | 8   | 10                      | 50              | FDD         |
| 47  | 20                                | 20  | 10                      | 50              | FDD         |
| 47  | 28                                | 28  | 10                      | 50              | FDD         |
| 47  | 34                                | 34  | 10                      | 50              | TDD         |
| 47  | 39                                | 39  | 10                      | 50              | TDD         |
| 47  | 41                                | 41  | 10                      | 50              | TDD         |
| 47  | 71                                | 71  | 10                      | 50              | FDD         |

**Table 7.3.1G-4: Sidelink TX configuration for REFSENS of E-UTRA V2X Bands**

| Inter-band E-UTRA V2X /E-UTRA configuration |                                   | E-UTRA UL band / Channel BW / N <sub>RB</sub> / Duplex mode |                         |                 |             |
|---|-----------------------------------|---|-------------------------|-----------------|-------------|
| E-UTRA V2X band (PC5)                       | E-UTRA or V2X operating band (Uu) | E-UTRA or V2X band (PC5)                                    | Channel Bandwidth (MHz) | N <sub>RB</sub> | Duplex Mode |
| 47  | 3                                 | 47  | 10                      | 50              | HD          |
| 47  | 5                                 | 47  | 10                      | 50              | HD          |
| 47  | 7                                 | 47  | 10                      | 50              | HD          |
| 47  | 8                                 | 47  | 10                      | 50              | HD          |
| 47  | 20                                | 47  | 10                      | 50              | HD          |
| 47  | 28                                | 47  | 10                      | 50              | HD          |
| 47  | 34                                | 47  | 10                      | 50              | HD          |
| 47  | 39                                | 47  | 10                      | 50              | HD          |
| 47  | 41                                | 47  | 10                      | 50              | HD          |
| 47  | 71                                | 47  | 10                      | 50              | HD          |

For intra-band contiguous multi-carrier operation, the reference sensitivity requirement specified in Table 7.3.1G-1 shall apply for each component carrier with all carriers active. The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.

**Table 7.3.1G-5: Sidelink TX configuration for REFSENS of E-UTRA V2X Bands for intra-band multi-carrier operation**

| V2X configuration | 50RB+50RB |     | 100RB+50RB |     | Duplex Mode |
|-------------------|-----------|-----|------------|-----|-------------|
|                   | PCC       | SCC | PCC        | SCC |             |
| V2X_47B           | 50        | 50  | N/A        | N/A | HD          |
| V2X_47C           | N/A       | N/A | 100        | 50  | HD          |

### 7.3.2 Void

## 7.4 Maximum input level

This is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

### 7.4.1 Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4.1-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.4.1-1: Maximum input level**

| Rx Parameter   | Units | Channel bandwidth |       |       |        |        |        |
|--|-------|-------------------|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission  | dBm   | $-25^2$           |       |       |        |        |        |
| Bandwidth Configuration  |       | $-27^3$           |       |       |        |        |        |
|  |       | $-27^4$           |       |       |        |        |        |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX,L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX,L}}$ as defined in subclause 6.2.5. |       |                   |       |       |        |        |        |
| NOTE 2: Reference measurement channel is Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.                           |       |                   |       |       |        |        |        |
| NOTE 3: Reference measurement channel is Annex A.3.2: 256QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.                          |       |                   |       |       |        |        |        |
| NOTE 4: Reference measurement channel is Annex A.3.2: 1024QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.                         |       |                   |       |       |        |        |        |

### 7.4.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the maximum input level is defined with the uplink active on the band(s) other than the band whose downlink is being tested. For E-UTRA CA configurations including an operating band without uplink band or an operating band with an unpaired DL part, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. The UE shall meet the requirements specified in subclause 7.4.1 for each component carrier while all downlink carriers are active.

For intra-band contiguous carrier aggregation maximum input level is defined as the powers received at the UE antenna port over the Transmission bandwidth configuration of each CC, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel over each component carrier.

The downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.4.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2.

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels over each component carrier as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4.1A-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Table 7.4.1A-1.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, each larger than or equal to 5 MHz, the maximum input level requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in Table 7.4.1-1 and Table 7.4.1A-1 for one component carrier and two component carriers per sub-block, respectively. The throughput of each downlink component carrier shall be  $\geq 95\%$  of the maximum throughput of the specified reference measurement channel as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1). The requirements apply with all downlink carriers active.

**Table 7.4.1A-1: Maximum input level for intra-band contiguous CA**

| Rx Parameter   | Units | CA Bandwidth Class |   |   |   |   |   |
|--|-------|--------------------|---|---|---|---|---|
|  |       | A                  | B   | C   | D   | E   | F   |
| Power in largest Transmission Bandwidth Configuration CC   | dBm   |                    | -28 <sup>2</sup>                                  | -25 <sup>2</sup>                                  | -25 <sup>2</sup>                                  | -26 <sup>2</sup>                                    | -27 <sup>2</sup>                                    |
|  |       |                    | -30 <sup>3</sup>                                  | -27 <sup>3</sup>                                  | -27 <sup>3</sup>                                  | [-28] <sup>3</sup>                                  | [-29] <sup>3</sup>                                  |
|  |       |                    | -30 <sup>4</sup>                                  | -27 <sup>4</sup>                                  | -27 <sup>4</sup>                                  | [-28] <sup>4</sup>                                  | [-29] <sup>4</sup>                                  |
| Power in each other CC   | dBm   |                    | -28+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$ | -25+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$ | -25+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$ | -26+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$   | -27+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$   |
|  |       |                    | -30+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^3$ | -27+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^3$ | -27+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^3$ | [-28]+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^3$ | [-29]+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^3$ |
|  |       |                    | -30+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^4$ | -27+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^4$ | -27+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^4$ | [-28]+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^4$ | [-29]+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^4$ |
| NOTE 1: The transmitter shall be set to 4dB below P <sub>CMAX_L,c</sub> or P <sub>CMAX_L</sub> as defined in subclause 6.2.5A.                                       |       |                    |   |   |   |   |   |
| NOTE 2: Reference measurement channel is Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.   |       |                    |   |   |   |   |   |
| NOTE 3: Reference measurement channel is Annex A.3.2: 256QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.  |       |                    |   |   |   |   |   |
| NOTE 4: Reference measurement channel is Annex A.3.2: 1024QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. |       |                    |   |   |   |   |   |

For combinations of intra-band and inter-band carrier aggregation and one uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in a band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For these uplink configurations, the UE shall meet the maximum input-level requirements for intra-band non-contiguous carrier aggregation of two or more downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.4.1. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

## 7.4.1B Minimum requirements for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing, the minimum requirements in Clause 7.4.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter P<sub>CMAX\_L</sub> is defined as the total transmitter power over the two transmit antenna connectors.

## 7.4.1D Minimum requirements for ProSe

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.6.2.

**Table 7.4.1D-1: Maximum input level for ProSe**

| Rx Parameter   | Units | Channel bandwidth |       |       |        |        |        |
|--|-------|-------------------|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration        | dBm   | -22               |       |       |        |        |        |
| NOTE 1: Reference measurement channel is Annex A.6.2 |       |                   |       |       |        |        |        |

## 7.4.1F Minimum requirements for category NB1 and NB2

Category NB1 and NB2 UE maximum input level requirement is  $-25$  dBm. For this input level the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2.

## 7.4.1G Minimum requirements for V2X

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.8.2 with parameters specified in Table 7.4.1G-1.

**Table 7.4.1G-1: Maximum input level**

| Rx Parameter   | Units | Channel bandwidth |       |       |                  |        |                  |
|--|-------|-------------------|-------|-------|------------------|--------|------------------|
|  |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz           | 15 MHz | 20 MHz           |
| Power in Transmission Bandwidth Configuration                    | dBm   |                   |       |       | -22 <sup>2</sup> |        | -22 <sup>2</sup> |
|  |       |                   |       |       | -23 <sup>3</sup> |        | -23 <sup>3</sup> |
| NOTE 1: Reference measurement channel is defined in Annex A.8.2. |       |                   |       |       |                  |        |                  |
| NOTE 2: This requirement is applicable for 16QAM.                |       |                   |       |       |                  |        |                  |
| NOTE 3: This requirement is applicable for 64QAM.                |       |                   |       |       |                  |        |                  |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.4.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.4.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, maximum input level is defined as the powers received at the UE antenna port over the Transmission bandwidth configuration of each CC, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel over each component carrier.

**Table 7.4.1G-2: Maximum input level for intra-band contiguous multi-carrier for V2X UE**

| Rx Parameter   | Units | V2X Bandwidth Class |   |   |   |   |   |
|--|-------|---------------------|---|---|---|---|---|
|  |       | A                   | B   | C/C <sub>1</sub>  | D | E | F |
| Power in largest Transmission Bandwidth Configuration CC | dBm   |                     | -22 <sup>2</sup>                                  | -22 <sup>2</sup>  |   |   |   |
|  |       |                     | -23 <sup>3</sup>                                  | -23 <sup>3</sup>  |   |   |   |
| Power in each other CC                                   | dBm   |                     | -22+<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$ | -22 <sup>2</sup> +<br>$10\log(N_{RB,c} / N_{RB,largest\ BW})^2$ |   |   |   |
|  |       |                     | -23+<br>$10\log(N_{RB,c})$                        | -23+<br>$10\log(N_{RB,c})$                                      |   |   |   |

|  |  |  |                        |                        |  |  |  |
|--|--|--|------------------------|------------------------|--|--|--|
|  |  |  | $/N_{RB,largest BW}^3$ | $/N_{RB,largest BW}^3$ |  |  |  |
| NOTE 1: Void<br>NOTE 2: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.<br>NOTE 3: This requirement is applicable for 64QAM. |  |  |                        |                        |  |  |  |

## 7.4A Void

### 7.4A.1 Void

## 7.5 Adjacent Channel Selectivity (ACS)

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

### 7.5.1 Minimum requirements

The UE shall fulfil the minimum requirement specified in Table 7.5.1-1 for all values of an adjacent channel interferer up to  $-25$  dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1-2 and Table 7.5.1-3 where the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1). For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.5.1-1: Adjacent channel selectivity**

| Rx Parameter | Units | Channel bandwidth |       |       |        |        |        |
|--------------|-------|-------------------|-------|-------|--------|--------|--------|
|              |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| ACS          | dB    | 33.0              | 33.0  | 33.0  | 33.0   | 30     | 27     |

**Table 7.5.1-2: Test parameters for Adjacent channel selectivity, Case 1**

| Rx Parameter                                  | Units | Channel bandwidth              |                            |                            |                                |                              |                                  |
|---|-------|--------------------------------|----------------------------|----------------------------|--------------------------------|------------------------------|----------------------------------|
|   |       | 1.4 MHz                        | 3 MHz                      | 5 MHz                      | 10 MHz                         | 15 MHz                       | 20 MHz                           |
| Power in Transmission Bandwidth Configuration | dBm   | REFSENS + 14 dB                |                            |                            |                                |                              |                                  |
| $P_{Interferer}$                              | dBm   | REFSENS +45.5dB                | REFSENS +45.5dB            | REFSENS +45.5dB            | REFSENS +45.5dB                | REFSENS +42.5dB              | REFSENS +39.5dB                  |
| $BW_{Interferer}$                             | MHz   | 1.4                            | 3                          | 5                          | 5                              | 5                            | 5                                |
| $F_{Interferer}$ (offset)                     | MHz   | 1.4+0.0025<br>/<br>-1.4-0.0025 | 3+0.0075<br>/<br>-3-0.0075 | 5+0.0025<br>/<br>-5-0.0025 | 7.5+0.0075<br>/<br>-7.5-0.0075 | 10+0.0125<br>/<br>-10-0.0125 | 12.5+0.0025<br>/<br>-12.5-0.0025 |

NOTE 1: The transmitter shall be set to 4dB below  $P_{CMAX\_L}$  at the minimum uplink configuration specified in Table 7.3.1-2 with  $P_{CMAX\_L}$  as defined in subclause 6.2.5.

NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1.

NOTE 3: The REFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.

NOTE 4: For DL category M1 and M2 UE, the reference sensitivity for category M1 in table 7.3.1E-3 and category M2 in Table 7.3.1E-8 should be used as REFSENS for the power in Transmission Bandwidth Configuration and  $P_{Interferer}$ .

NOTE5: For DL category M1 and M2 UE, the parameters for the applicable channel bandwidth apply.

**Table 7.5.1-3: Test parameters for Adjacent channel selectivity, Case 2**

| Rx Parameter  | Units | Channel bandwidth              |                            |                            |                                |                              |                                  |
|---|-------|--------------------------------|----------------------------|----------------------------|--------------------------------|------------------------------|----------------------------------|
|   |       | 1.4 MHz                        | 3 MHz                      | 5 MHz                      | 10 MHz                         | 15 MHz                       | 20 MHz                           |
| Power in Transmission Bandwidth Configuration   | dBm   | -56.5                          | -56.5                      | -56.5                      | -56.5                          | -53.5                        | -50.5                            |
| $P_{\text{Interferer}}$   | dBm   | -25                            |                            |                            |                                |                              |                                  |
| $BW_{\text{Interferer}}$  | MHz   | 1.4                            | 3                          | 5                          | 5                              | 5                            | 5                                |
| $F_{\text{Interferer}}$ (offset)  | MHz   | 1.4+0.0025<br>/<br>-1.4-0.0025 | 3+0.0075<br>/<br>-3-0.0075 | 5+0.0025<br>/<br>-5-0.0025 | 7.5+0.0075<br>/<br>-7.5-0.0075 | 10+0.0125<br>/<br>-10-0.0125 | 12.5+0.0025<br>/<br>-12.5-0.0025 |
| NOTE 1: The transmitter shall be set to 24dB below $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5.                         |       |                                |                            |                            |                                |                              |                                  |
| NOTE 2: The interferer consists of the Reference measurement channel specified in Annex 3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1. |       |                                |                            |                            |                                |                              |                                  |

### 7.5.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band, the adjacent channel requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.5.1 for each component carrier while all downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink operation or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For a component carrier configured in Band 46 or Band 49, the requirements specified in subclause 7.5.1 are replaced by the requirements in Table 7.5.1A-0a with test parameters in Table 7.5.1A-0b and Table 7.5.1A-0c.

**Table 7.5.1A-0a: Adjacent channel selectivity**

| E-UTRA band | Rx Parameter | Units | Channel bandwidth |       |       |        |        |        |
|-------------|--------------|-------|-------------------|-------|-------|--------|--------|--------|
|             |              |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 46          | ACS          | dB    |                   |       |       | 33     |        | 27     |
| 49          | ACS          | dB    |                   |       |       | 33     |        | 33     |

**Table 7.5.1A-0b: Test parameters for Adjacent channel selectivity, Case 1**

| E-UTRA Band | Rx Parameter                                  | Units | Channel bandwidth |       |       |                      |        |                              |
|-------------|---|-------|-------------------|-------|-------|----------------------|--------|------------------------------|
|             |   |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz               | 15 MHz | 20 MHz                       |
| 46          | Power in Transmission Bandwidth Configuration | dBm   | REFSENS + 14 dB   |       |       |                      |        |                              |
|             | $P_{\text{Interferer}}$                       | dBm   |                   |       |       | REFSENS+45.5dB       |        | REFSENS +39.5dB              |
|             | $BW_{\text{Interferer}}$                      | MHz   |                   |       |       | 20                   |        | 20                           |
|             | $F_{\text{Interferer}}$ (offset)              | MHz   |                   |       |       | 15+0.0075/-15-0.0075 |        | 20+0.0025<br>/<br>-20-0.0025 |
| 49          | Power in Transmission Bandwidth Configuration | dBm   | REFSENS + 14 dB   |       |       |                      |        |                              |
|             | $P_{\text{Interferer}}$                       | dBm   |                   |       |       | REFSENS+45.5dB       |        | REFSENS+45.5dB               |
|             | $BW_{\text{Interferer}}$                      | MHz   |                   |       |       | 10                   |        | 20                           |

|   |                                     |     |  |  |  |                              |  |                              |
|---|-------------------------------------|-----|--|--|--|------------------------------|--|------------------------------|
|   | $F_{\text{Interferer}}$<br>(offset) | MHz |  |  |  | 10+0.0125<br>/<br>-10-0.0125 |  | 20+0.0025<br>/<br>-20-0.0025 |
| NOTE 1: In a band capable of uplink operation, the transmitter shall be set to 4dB below $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5. |                                     |     |  |  |  |                              |  |                              |
| NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1. |                                     |     |  |  |  |                              |  |                              |

**Table 7.5.1A-0c: Test parameters for Adjacent channel selectivity, Case 2**

| E-UTRA band  | Rx Parameter                                  | Units | Channel bandwidth |       |       |                                      |        |                              |
|--|---|-------|-------------------|-------|-------|--------------------------------------|--------|------------------------------|
|  |   |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz                               | 15 MHz | 20 MHz                       |
| 46   | Power in Transmission Bandwidth Configuration | dBm   |                   |       |       | -56.5                                |        | -50.5                        |
|  | $P_{\text{Interferer}}$                       | dBm   | -25               |       |       |                                      |        |                              |
|  | $BW_{\text{Interferer}}$                      | MHz   |                   |       |       | 20                                   |        | 20                           |
|  | $F_{\text{Interferer}}$<br>(offset)           | MHz   |                   |       |       | 15+0.00<br>75/-15-<br>0.0075         |        | 20+0.0025<br>/<br>-20-0.0025 |
| 49   | Power in Transmission Bandwidth Configuration |       |                   |       |       | -56.5                                |        | -56.5                        |
|  | $P_{\text{Interferer}}$                       |       | -25               |       |       |                                      |        |                              |
|  | $BW_{\text{Interferer}}$                      |       |                   |       |       | 10                                   |        | 20                           |
|  | $F_{\text{Interferer}}$<br>(offset)           |       |                   |       |       | 10+0.01<br>25<br>/<br>-10-<br>0.0125 |        | 20+0.0025<br>/<br>-20-0.0025 |
| NOTE 1: In a band capable of unlink operation, the transmitter shall be set to 24dB below $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5. |   |       |                   |       |       |                                      |        |                              |
| NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1.  |   |       |                   |       |       |                                      |        |                              |

For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the adjacent channel requirements of subclause 7.5.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.5.1A-2 and Table 7.5.1A-3 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement specified in Table 7.5.1A-1 for an adjacent channel interferer on either side of the aggregated downlink signal at a specified frequency offset and for an interferer power up to -25 dBm. The throughput of each carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5.1A-2 and 7.5.1A-3. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.5.1A-2 and 7.5.1A-3.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, each larger than or equal to 5 MHz, the adjacent channel selectivity requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.5.1 and 7.5.1A for one component carrier and two component carriers per sub-block, respectively. The UE shall fulfil the minimum requirements all values of a single adjacent channel interferer in-gap and out-of-gap up to a -25 dBm interferer power while all downlink carriers are active. For the lower range of test parameters (Case 1), the interferer power  $P_{\text{interferer}}$  shall be set to the maximum of the levels given by the carriers of the respective sub-blocks as specified in Table 7.5.1-2 and Table 7.5.1A-2 for one component carrier and two component

carriers per sub-block, respectively. The wanted signal power levels for the carriers of each sub-block shall then be adjusted relative to  $P_{interferer}$  in accordance with the ACS requirement for each sub-block (Table 7.5.1-1 and Table 7.5.1A-1). For the upper range of test parameters (Case 2) for which the interferer power  $P_{interferer}$  is -25 dBm (Table 7.5.1-3 and Table 7.5.1A-3) the wanted signal power levels for the carriers of each sub-block shall be adjusted relative to  $P_{interferer}$  like for Case 1.

**Table 7.5.1A-1: Adjacent channel selectivity**

| Rx Parameter | Units | CA Bandwidth Class |    |      |    |    |
|--------------|-------|--------------------|----|------|----|----|
|              |       | B                  | C  | D    | E  | F  |
| ACS          | dB    | 27                 | 24 | 22.2 | 21 | 20 |

**Table 7.5.1A-2: Test parameters for Adjacent channel selectivity, Case 1**

| Rx Parameter   | Units | CA Bandwidth Class                             |  |  |  |  |
|--|-------|--|--|--|--|--|
|  |       | B  | C  | D  | E  | F  |
| Pw in Transmission Bandwidth Configuration, per CC   |       | REFSENS + 14 dB                                | REFSENS + 14 dB                                | REFSENS + 14 dB                                | REFSENS + 14 dB                                | REFSENS + 14 dB                                |
| $P_{interferer}$   | dBm   | Aggregated power + 25.5 dB                     | Aggregated power + 22.5 dB                     | Aggregated power + 20.7 dB                     | Aggregated power + 19.5 dB                     | Aggregated power + 18.5 dB                     |
| $BW_{interferer}$  | MHz   | 5  | 5  | 5  | 5  | 5  |
| $F_{interferer}$ (offset)  | MHz   | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ |
| <p>NOTE 1: The transmitter shall be set to 4dB below <math>P_{CMAX\_L,c}</math> or <math>P_{CMAX\_L}</math> as defined in subclause 6.2.5A.</p> <p>NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1</p> <p>NOTE 3: The <math>F_{interferer}</math> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to <math>\lfloor \frac{F_{interferer}}{0.015 + 0.5} \rfloor 0.015 + 0.0075</math> MHz to be offset from the sub-carrier raster.</p> |       |  |  |  |  |  |

**Table 7.5.1A-3: Test parameters for Adjacent channel selectivity, Case 2**

| Rx Parameter  | Units | CA Bandwidth Class                             |  |  |  |  |
|---|-------|--|--|--|--|--|
|   |       | B  | C  | D  | E  | F  |
| Pw in Transmission Bandwidth Configuration, per CC  | dBm   | $-50.5 + 10 \log_{10}(N_{RB,c} / N_{RB,agg})$  | $-47.5 + 10 \log_{10}(N_{RB,c} / N_{RB,agg})$  | $45.7 + 10 \log_{10}(N_{RB,c} / N_{RB,agg})$   | $-44.5 + 10 \log_{10}(N_{RB,c} / N_{RB,agg})$  | $-43.5 + 10 \log_{10}(N_{RB,c} / N_{RB,agg})$  |
| $P_{interferer}$  | dBm   | -25  |  |  |  |  |
| $BW_{interferer}$   | MHz   | 5  | 5  | 5  | 5  | 5  |
| $F_{interferer}$ (offset)   | MHz   | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ | $2.5 + F_{offset}$<br>/<br>$-2.5 - F_{offset}$ |
| <p>NOTE 1: The transmitter shall be set to 24dB below <math>P_{CMAX\_L,c}</math> or <math>P_{CMAX\_L}</math> as defined in subclause 6.2.5A.</p> <p>NOTE 2: The interferer consists of the Reference measurement channel specified in Annex 3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1</p> <p>NOTE 3: The <math>F_{interferer}</math> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to <math>\lfloor \frac{F_{interferer}}{0.015 + 0.5} \rfloor 0.015 + 0.0075</math> MHz to be offset from the sub-carrier raster.</p> |       |  |  |  |  |  |

For combinations of intra-band and inter-band carrier aggregation and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in each band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous



component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For these uplink configurations, the UE shall meet the adjacent channel selectivity requirements for intra-band non-contiguous carrier aggregation with  $\Delta R_{IBNC} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) for the two or more non-contiguous downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.5.1. For contiguously aggregated component carriers configured in Band 46, the said requirements for intra-band contiguous carrier aggregation of downlink carriers are replaced by requirements in Table 7.5.1A-4 with test parameters in Table 7.5.1A-5 and Table 7.5.1A-6. For non-contiguously aggregated component carriers configured in Band 46, the said requirements are applied to each sub-block for in-gap and out-of-gap interferers. For the sub-block with a single component carrier, the requirement is replaced by Table 7.5.1A-0a with test parameters in Table 7.5.1A-0b and Table 7.5.1A-0c. For the sub-block with two or more contiguous component carriers, the requirement is replaced by Table 7.5.1A-4 with test parameters in Table 7.5.1A-5 and Table 7.5.1A-6. All downlink carriers shall be active throughout the tests and the requirements for downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

**Table 7.5.1A-4: Adjacent channel selectivity**

| E-UTRA band | Rx Parameter | Units | CA Bandwidth Class |    |      |    |   |
|-------------|--------------|-------|--------------------|----|------|----|---|
|             |              |       | B                  | C  | D    | E  | F |
| 46          | ACS          | dB    |                    | 24 | 22.2 | 21 |   |

**Table 7.5.1A-5: Test parameters for Adjacent channel selectivity, Case 1**

| E-UTRA Band  | Rx Parameter                                       | Units | CA Bandwidth Class |  |  |  |   |
|--|--|-------|--------------------|--|--|--|---|
|  |  |       | B                  | C  | D  | E  | F |
| 46   | Pw in Transmission Bandwidth Configuration, per CC |       |                    | REFSENS + 14 dB                                      | REFSENS + 14 dB                                      | REFSENS + 14 dB                                      |   |
|  | P <sub>Interferer</sub>                            | dBm   |                    | Aggregate d power + 22.5 dB                          | Aggregate d power + 20.7 dB                          | Aggregate d power + 19.5 dB                          |   |
|  | BW <sub>Interferer</sub>                           | MHz   |                    | 20   | 20   | 20   |   |
|  | F <sub>Interferer (offset)</sub>                   | MHz   |                    | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> |   |
| <p>NOTE 1*: In a band capable of uplink operation, the transmitter shall be set to 4dB below P<sub>CMAX_L,c</sub> or P<sub>CMAX_L</sub> as defined in subclause 6.2.5A.</p> <p>NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNB Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1.</p> <p>NOTE 3: The F<sub>interferer (offset)</sub> is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to <math>\lfloor \frac{F_{interferer}}{0.015 + 0.5} \rfloor 0.015 + 0.0075</math> MHz to be offset from the sub-carrier raster.</p> |  |       |                    |  |  |  |   |

**Table 7.5.1A-6: Test parameters for Adjacent channel selectivity, Case 2**

| E-UTRA band  | Rx Parameter                                       | Units | CA Bandwidth Class |  |  |  |   |
|--|--|-------|--------------------|--|--|--|---|
|  |  |       | B                  | C  | D  | E  | F |
| 46   | Pw in Transmission Bandwidth Configuration, per CC | dBm   |                    | -47.5 + 10log10( $\frac{N_{RB}}{N_{RB,agg}}$ )       | -45.7 + 10log10( $\frac{N_{RB,c}}{N_{RB,agg}}$ )     | -44.5 + 10log10( $\frac{N_{RB,c}}{N_{RB,agg}}$ )     |   |
|  | P <sub>Interferer</sub>                            | dBm   |                    | -25  |  |  |   |
|  | BW <sub>Interferer</sub>                           | MHz   |                    | 20   | 20   | 20   |   |
|  | F <sub>Interferer (offset)</sub>                   | MHz   |                    | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> | 10 + F <sub>offset</sub> / -10 - F <sub>offset</sub> |   |
| <p>NOTE 1: In a band capable of uplink operation, the transmitter shall be set to 24dB below P<sub>CMAX_L,c</sub> or P<sub>CMAX_L</sub> as defined in subclause 6.2.5A.</p> <p>NOTE 2: The interferer consists of the Reference measurement channel specified in Annex 3.2 with one sided dynamic OCNB Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1.</p> |  |       |                    |  |  |  |   |

NOTE 3: The  $F_{\text{interferer}}$  (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to  $\lfloor F_{\text{interferer}} / 0.015 + 0.5 \rfloor 0.015 + 0.0075$  MHz to be offset from the sub-carrier raster.

### 7.5.1B Minimum requirements for UL-MIMO

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.5.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter  $P_{\text{CMAX,L}}$  is defined as the total transmitter power over the two transmit antenna connectors.

### 7.5.1D Minimum requirements for ProSe

The UE shall fulfil the minimum requirement specified in Table 7.5.1D-1 for all values of an adjacent channel interferer up to  $-25$  dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1D-2 and Table 7.5.1D-3 where the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.6.2.

**Table 7.5.1D-1: Adjacent channel selectivity for ProSe**

| Rx Parameter | Units | Channel bandwidth |       |       |        |        |        |
|--------------|-------|-------------------|-------|-------|--------|--------|--------|
|              |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| ACS          | dB    |                   |       | 33.0  | 33.0   | 30     | 27     |

**Table 7.5.1D-2: Test parameters for Adjacent channel selectivity for ProSe, Case 1**

| Rx Parameter                                  | Units | Channel bandwidth                |       |                      |                          |                        |                            |
|---|-------|----------------------------------|-------|----------------------|--------------------------|------------------------|----------------------------|
|   |       | 1.4 MHz                          | 3 MHz | 5 MHz                | 10 MHz                   | 15 MHz                 | 20 MHz                     |
| Power in Transmission Bandwidth Configuration | dBm   | REFSENS <sub>ProSe</sub> + 14 dB |       |                      |                          |                        |                            |
| $P_{\text{Interferer}}$                       | dBm   |                                  |       | REFSENS +45.5dB      | REFSENS +45.5dB          | REFSENS +42.5dB        | REFSENS +39.5dB            |
| $BW_{\text{Interferer}}$                      | MHz   |                                  |       | 5                    | 5                        | 5                      | 5                          |
| $F_{\text{Interferer}}$ (offset)              | MHz   |                                  |       | 5+0.0025 / -5-0.0025 | 7.5+0.0075 / -7.5-0.0075 | 10+0.0125 / -10-0.0125 | 12.5+0.0025 / -12.5-0.0025 |

NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211.

**Table 7.5.1D-3: Test parameters for Adjacent channel selectivity for ProSe, Case 2**

| Rx Parameter                                  | Units | Channel bandwidth |       |                      |                          |                        |                            |
|---|-------|-------------------|-------|----------------------|--------------------------|------------------------|----------------------------|
|   |       | 1.4 MHz           | 3 MHz | 5 MHz                | 10 MHz                   | 15 MHz                 | 20 MHz                     |
| Power in Transmission Bandwidth Configuration | dBm   |                   |       | -56.5                | -56.5                    | -53.5                  | -50.5                      |
| $P_{\text{Interferer}}$                       | dBm   | -25               |       |                      |                          |                        |                            |
| $BW_{\text{Interferer}}$                      | MHz   |                   |       | 5                    | 5                        | 5                      | 5                          |
| $F_{\text{Interferer}}$ (offset)              | MHz   |                   |       | 5+0.0025 / -5-0.0025 | 7.5+0.0075 / -7.5-0.0075 | 10+0.0125 / -10-0.0125 | 12.5+0.0025 / -12.5-0.0025 |

NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211.

## 7.5.1F Minimum requirements for category NB1 and NB2

Category NB1 and NB2 UE shall fulfil the minimum requirement specified in Table 7.5.1F-1 for all values of an adjacent channel interferer up to  $-25$  dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1F-1 where the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2.

**Table 7.5.1F: Adjacent channel selectivity parameters for category NB1 and NB2**

| ACS1 test Parameters   |                 |                 |
|--|-----------------|-----------------|
| Interferer   | GSM (GMSK)      | E-UTRA          |
| Category NB1 or NB2 signal power ( $P_{\text{wanted}}$ ) / dBm | REFSENS + 14 dB |                 |
| Interferer signal power ( $P_{\text{Interferer}}$ ) / dBm      | REFSENS + 42 dB | REFSENS + 47 dB |
| Interferer bandwidth   | 200 kHz         | 5 MHz           |
| Interferer offset from category NB1 or NB2 channel edge        | $\pm 200$ kHz   | $\pm 2.5$ MHz   |
| ACS2 test Parameters   |                 |                 |
| Interferer   | GSM (GMSK)      | E-UTRA          |
| Category NB1 or NB2 signal power ( $P_{\text{wanted}}$ ) / dBm | -53 dBm         | -58 dBm         |
| Interferer signal power ( $P_{\text{Interferer}}$ ) / dBm      | -25 dBm         |                 |
| Interferer bandwidth   | 200 kHz         | 5 MHz           |
| Interferer offset from category NB1 or NB2 channel edge        | $\pm 200$ kHz   | $\pm 2.5$ MHz   |

## 7.5.1G Minimum requirements for V2X

The V2X UE shall fulfil the minimum requirement specified in Table 7.5.1G-1 for all values of an adjacent channel interferer up to  $-22$  dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1G-2 and Table 7.5.1G-3 where the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2.

**Table 7.5.1G-1: Adjacent channel selectivity for V2X**

| Rx Parameter | Units | Channel bandwidth |       |       |        |        |        |
|--------------|-------|-------------------|-------|-------|--------|--------|--------|
|              |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| ACS          | dB    |                   |       |       | 33.0   |        | 27     |

**Table 7.5.1G-2: Test parameters for Adjacent channel selectivity for V2X, Case 1**

| Rx Parameter   | Units | Channel bandwidth                 |       |       |                                      |        |                                      |
|--|-------|-----------------------------------|-------|-------|--------------------------------------|--------|--------------------------------------|
|  |       | 1.4 MHz                           | 3 MHz | 5 MHz | 10 MHz                               | 15 MHz | 20 MHz                               |
| Power in Transmission Bandwidth Configuration  | dBm   | $P_{\text{REFSENS\_V2X}} + 14$ dB |       |       |                                      |        |                                      |
| $P_{\text{Interferer}}$  | dBm   |                                   |       |       | $P_{\text{REFSENS\_V2X}} + 45.5$ dB  |        | $P_{\text{REFSENS\_V2X}} + 39.5$ dB  |
| $BW_{\text{Interferer}}$   | MHz   |                                   |       |       | 10                                   |        | 10                                   |
| $F_{\text{Interferer}}$ (offset)   | MHz   |                                   |       |       | $10 + 0.0125$<br>/<br>$-10 - 0.0125$ |        | $15 + 0.0075$<br>/<br>$-15 - 0.0075$ |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211. |       |                                   |       |       |                                      |        |                                      |

**Table 7.5.1G-3: Test parameters for Adjacent channel selectivity for V2X, Case 2**

| Rx Parameter   | Units | Channel bandwidth |       |       |                              |        |                              |
|--|-------|-------------------|-------|-------|------------------------------|--------|------------------------------|
|  |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz                       | 15 MHz | 20 MHz                       |
| Power in Transmission Bandwidth Configuration  | dBm   |                   |       |       | -53.5                        |        | -47.5                        |
| $P_{\text{Interferer}}$  | dBm   | -22               |       |       |                              |        |                              |
| $BW_{\text{Interferer}}$   | MHz   |                   |       |       | 10                           |        | 10                           |
| $F_{\text{Interferer}}$ (offset)   | MHz   |                   |       |       | 10+0.0125<br>/<br>-10-0.0125 |        | 15+0.0075<br>/<br>-15-0.0075 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211. |       |                   |       |       |                              |        |                              |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.5.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.5.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, the V2X UE shall fulfil the minimum requirement specified in Table 7.5.1G-4 to Table 7.5.1G-6 where the throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2.

**Table 7.5.1G-4: Adjacent channel selectivity for intra-band contiguous multi-carrier for V2X UE**

| Rx Parameter | Units | V2X Bandwidth Class |                   |   |   |   |
|--------------|-------|---------------------|-------------------|---|---|---|
|              |       | B                   | C/ C <sub>1</sub> | D | E | F |
| ACS          | dB    | 30                  | 24                |   |   |   |

**Table 7.5.1G-5: Test parameters for Adjacent channel selectivity, Case 1**

| Rx Parameter  | Units | V2X Bandwidth Class                                      |  |   |   |   |
|---|-------|--|--|---|---|---|
|   |       | B  | C/ C <sub>1</sub>  | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC  |       | REFSENS + 14 dB  | REFSENS + 14 dB  |   |   |   |
| $P_{\text{Interferer}}$   | dBm   | Aggregated power + 28.5 dB                               | Aggregated power + 22.5 dB                               |   |   |   |
| $BW_{\text{Interferer}}$  | MHz   | 10   | 10   |   |   |   |
| $F_{\text{Interferer}}$ (offset)  | MHz   | 5 + $F_{\text{offset}}$<br>/<br>-5 - $F_{\text{offset}}$ | 5 + $F_{\text{offset}}$<br>/<br>-5 - $F_{\text{offset}}$ |   |   |   |
| NOTE 1: The $F_{\text{interferer}}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to $\lfloor \frac{F_{\text{interferer}}}{0.015 + 0.5} \rfloor 0.015 + 0.0075$ MHz to be offset from the sub-carrier raster. |       |  |  |   |   |   |
| NOTE 2: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.   |       |  |  |   |   |   |

**Table 7.5.1G-6: Test parameters for Adjacent channel selectivity, Case 2**

| Rx Parameter                                       | Units | V2X Bandwidth Class  |  |   |   |   |
|--|-------|--|--|---|---|---|
|  |       | B  | C/ C <sub>1</sub>  | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm   | -50.5 + $10\log_{10}(N_{RB, \text{c}} / N_{RB, \text{agg}})$ | -47.5 + $10\log_{10}(N_{RB, \text{c}} / N_{RB, \text{agg}})$ |   |   |   |
| $P_{\text{Interferer}}$                            | dBm   | -22  |  |   |   |   |
| $BW_{\text{Interferer}}$                           | MHz   | 10   | 10   |   |   |   |

|   |     |  |  |  |  |  |
|---|-----|--|--|--|--|--|
| $F_{\text{Interferer}}$ (offset)  | MHz | $5+ F_{\text{offset}}$<br>/<br>$-5- F_{\text{offset}}$ | $5+ F_{\text{offset}}$<br>/<br>$-5- F_{\text{offset}}$ |  |  |  |
| <p>NOTE 1: The <math>F_{\text{interferer}}</math> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to <math>\lfloor F_{\text{interferer}} / 0.015 + 0.5 \rfloor 0.015 + 0.0075</math> MHz to be offset from the sub-carrier raster.</p> <p>NOTE 2: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.</p> |     |  |  |  |  |  |

## 7.6 Blocking characteristics

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

### 7.6.1 In-band blocking

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels.

For CA configurations including Band 46, in-band blocking in Band 46 is defined for a 20 MHz unwanted interfering signal falling into the UE receive band or into the first 60 MHz below or above the UE receive band (Table 7.6.1.1A-0a and Table 7.6.1.1A-0b).

For CA configurations including Band 49, in-band blocking in Band 49 is defined for an unwanted interfering signal falling into the UE receive band or into the first 60 MHz below or above the UE receive band (Table 7.6.1.1A-0a and Table 7.6.1.1A-0b).

#### 7.6.1.1 Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.1.1-1 and 7.6.1.1-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.6.1.1-1: In band blocking parameters**

| Rx parameter  | Units | Channel bandwidth                                |            |             |             |             |             |
|---|-------|--|------------|-------------|-------------|-------------|-------------|
|   |       | 1.4 MHz  | 3 MHz      | 5 MHz       | 10 MHz      | 15 MHz      | 20 MHz      |
| Power in Transmission Bandwidth Configuration   | dBm   | REFSENS + channel bandwidth specific value below |            |             |             |             |             |
|   |       | 6  | 6          | 6           | 6           | 7           | 9           |
| $BW_{\text{Interferer}}$  | MHz   | 1.4  | 3          | 5           | 5           | 5           | 5           |
| $F_{\text{offset, case 1}}$   | MHz   | 2.1+0.0125                                       | 4.5+0.0075 | 7.5+0.0125  | 7.5+0.0025  | 7.5+0.0075  | 7.5+0.0125  |
| $F_{\text{offset, case 2}}$   | MHz   | 3.5+0.0075                                       | 7.5+0.0075 | 12.5+0.0075 | 12.5+0.0125 | 12.5+0.0025 | 12.5+0.0075 |
|   |       |  |            |             | 5           | 5           | 5           |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX,L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX,L}}$ as defined in subclause 6.2.5.                              |       |  |            |             |             |             |             |
| NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1. |       |  |            |             |             |             |             |
| NOTE 3: The REFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.  |       |  |            |             |             |             |             |
| NOTE 4: For DL category M1 and M2 UE, the reference sensitivity for category M1 in table 7.3.1E-3 and category M2 in Table 7.3.1E-8 should be used as REFSENS for the power in Transmission Bandwidth Configuration.      |       |  |            |             |             |             |             |
| NOTE5: For DL category M1 and M2 UE, the parameters for the applicable channel bandwidth apply.   |       |  |            |             |             |             |             |

Table 7.6.1.1-2: In-band blocking

| E-UTRA band  | Parameter                        | Unit | Case 1  | Case 2  | Case 3 | Case 4 | Case 5                    | Case 6                    |
|--|----------------------------------|------|---|---|--------|--------|---------------------------|---------------------------|
|  | $P_{\text{Interferer}}$          | dBm  | -56   | -44   |        |        | -38                       | -15                       |
|  | $F_{\text{Interferer}}$ (offset) | MHz  | $= -BW/2 - F_{\text{offset, case 1}}$<br>&<br>$= +BW/2 + F_{\text{offset, case 1}}$ | $\leq -BW/2 - F_{\text{offset, case 2}}$<br>&<br>$\geq +BW/2 + F_{\text{offset, case 2}}$ |        |        | $-BW/2 - 11$              |                           |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 48, 50, 51, 52, 53, 65, 66, 68, 70, 72, 73, 74, 85, 87, 88  | $F_{\text{Interferer}}$          | MHz  | (NOTE 2)  | $F_{\text{DL, low}} - 15$<br>to<br>$F_{\text{DL, high}} + 15$                             | Void   | Void   |                           |                           |
| 30   | $F_{\text{Interferer}}$          | MHz  | (NOTE 2)  | $F_{\text{DL, low}} - 15$<br>to<br>$F_{\text{DL, high}} + 15$                             |        |        | $F_{\text{DL, low}} - 11$ |                           |
| 71   | $F_{\text{Interferer}}$          | MHz  | (NOTE 2)  | $F_{\text{DL, low}} - 12$ to<br>$F_{\text{DL, high}} + 15$                                |        |        |                           | $F_{\text{DL, low}} - 12$ |
| <p>NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band</p> <p>NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br/>                     a. the carrier frequency <math>-BW/2 - F_{\text{offset, case 1}}</math> and<br/>                     b. the carrier frequency <math>+BW/2 + F_{\text{offset, case 1}}</math></p> <p>NOTE 3: <math>F_{\text{Interferer}}</math> range values for unwanted modulated interfering signal are interferer center frequencies</p> |                                  |      |   |   |        |        |                           |                           |

For the UE which supports inter band CA configuration in Table 7.3.1-1A,  $P_{\text{Interferer}}$  power defined in Table 7.6.1.1-2 is increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

7.6.1.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the in-band blocking requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. For adjacent downlink bands separated by less than 30 MHz the frequency separation between the center frequencies of adjacent component carriers belonging to different bands shall be  $\geq BW_1/2 + BW_2/2 + 2F_{\text{offset, case } j}$  for Case  $j$  interferers,  $j = 1,2$ , where  $BW_k/2$  are the channel bandwidths of carrier  $k$ ,  $k = 1,2$ . The UE shall meet the requirements specified in subclause 7.6.1.1 for each component carrier while all downlink carriers are active. For the UE which supports inter band CA configuration in Table 7.3.1-1A,  $P_{\text{Interferer}}$  power defined in Table 7.6.1.1-2 is increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A. For E-UTRA CA configurations including an operating band without uplink operation or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. The requirements for the component carrier configured in the operating band without uplink operation are specified in Table 7.6.1.1A-0, Table 7.6.1.1A-0a and Table 7.6.1.1A-0b. The requirements for a component carrier configured in Band 49 are specified in Table 7.6.1.1A-0a and Table 7.6.1.1A-0b.

Table 7.6.1.1A-0: In-band blocking for additional operating bands for carrier aggregation

| E-UTRA band            | Parameter                        | Unit | Case 1  | Case 2  |
|------------------------|----------------------------------|------|---|---|
|                        | $P_{\text{Interferer}}$          | dBm  | -56   | -44   |
|                        | $F_{\text{Interferer}}$ (offset) | MHz  | $= -BW/2 - F_{\text{offset, case 1}}$<br>&<br>$= +BW/2 + F_{\text{offset, case 1}}$ | $\leq -BW/2 - F_{\text{offset, case 2}}$<br>&<br>$\geq +BW/2 + F_{\text{offset, case 2}}$ |
| 29, 32, 67, 69, 75, 76 | $F_{\text{Interferer}}$          | MHz  | (NOTE 2)  | $F_{\text{DL, low}} - 15$<br>to   |

|  |
|--|
| F <sub>DL_high</sub> + 15  |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band   |
| NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency -BW/2 - F <sub>offset, case 1</sub> and<br>b. the carrier frequency +BW/2 + F <sub>offset, case 1</sub> |
| NOTE 3: F <sub>Interferer</sub> range values for unwanted modulated interfering signal are interferer center frequencies   |

**Table 7.6.1.1A-0a: In band blocking parameters for additional operating bands for carrier aggregation**

| E-UTRA band    | Rx parameter                                  | Units | Channel bandwidth                                |       |           |        |           |        |
|----------------|---|-------|--|-------|-----------|--------|-----------|--------|
|                |   |       | 1.4 MHz  | 3 MHz | 5 MHz     | 10 MHz | 15 MHz    | 20 MHz |
| 46<br>(NOTE 3) | Power in Transmission Bandwidth Configuration | dBm   | REFSENS + channel bandwidth specific value below |       |           |        |           |        |
|                | BW <sub>Interferer</sub>                      |       |  |       | 20        |        | 20        |        |
|                | F <sub>offset, case 1</sub>                   |       |  |       | 30+0.0025 |        | 30+0.0125 |        |
|                | F <sub>offset, case 2</sub>                   |       |  |       | 50+0.0125 |        | 50+0.0075 |        |
| 49<br>(NOTE 3) | Power in Transmission Bandwidth Configuration | dBm   |  |       |           | 6      |           | 6      |
|                | BW <sub>Interferer</sub>                      |       |  |       | 10        |        | 20        |        |
|                | F <sub>offset, case 1</sub>                   |       |  |       | 15+0.025  |        | 30+0.125  |        |
|                | F <sub>offset, case 2</sub>                   |       |  |       | 25+0.075  |        | 50+0.075  |        |

NOTE 1: The transmitter shall be set to 4dB below P<sub>C<sub>MAX,L</sub></sub> at the minimum uplink configuration specified in Table 7.3.1-2 with P<sub>C<sub>MAX,L</sub></sub> as defined in subclause 6.2.5.

NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1

NOTE 3: The interferer consists of the Reference measurement channel specified in Annex A.3.2 (TBD)

**Table 7.6.1.1A-0b: In-band blocking for additional operating bands for carrier aggregation**

| E-UTRA band | Parameter                        | Unit                    | Case 1  | Case 2  |
|-------------|----------------------------------|-------------------------|---|---|
|             |                                  | P <sub>Interferer</sub> | dBm   | -50   |
|             | F <sub>Interferer (offset)</sub> | MHz                     | =-BW/2 - F <sub>offset, case 1</sub><br>&<br>=+BW/2 + F <sub>offset, case 1</sub> | ≤-BW/2 - F <sub>offset, case 2</sub><br>&<br>≥+BW/2 + F <sub>offset, case 2</sub> |
| 46, 49      | F <sub>Interferer</sub>          | MHz                     | (Note 2)  | F <sub>DL_low</sub> - 60<br>to<br>F <sub>DL_high</sub> + 60                       |

NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz or 60 MHz below or above the UE receive band

NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  
a. the carrier frequency -BW/2 - F<sub>offset, case 1</sub> and  
b. the carrier frequency +BW/2 + F<sub>offset, case 1</sub>

NOTE 3: F<sub>Interferer</sub> range values for unwanted modulated interfering signal are interferer center frequencies

For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the in-band blocking requirements of subclause 7.6.1.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.6.1.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.1.1A-1 and Tables 7.6.1.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG

Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.1.1A-1 and 7.6.1.1A-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.6.2.1A-1 and 7.6.2.1A-2.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, each larger than or equal to 5 MHz, the in-band blocking requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclause 7.6.1.1 and in this subclause for one component carrier and two component carriers per sub-block, respectively. The requirements apply for in-gap and out-of-gap interferers while all downlink carriers are active.

**Table 7.6.1.1A-1: In band blocking parameters**

| Rx Parameter   | Units | CA Bandwidth Class                                |      |      |      |      |
|--|-------|---|------|------|------|------|
|  |       | B   | C    | D    | E    | F    |
| Pw in Transmission Bandwidth Configuration, per CC   | dBm   | REFSENS + CA Bandwidth Class specific value below |      |      |      |      |
|  |       | 9   | 12   | 13.8 | 15   | 16   |
| BW <sub>Interferer</sub>   | MHz   | 5   | 5    | 5    | 5    | 5    |
| F <sub>offset, case 1</sub>  | MHz   | 7.5   | 7.5  | 7.5  | 7.5  | 7.5  |
| F <sub>offset, case 2</sub>  | MHz   | 12.5  | 12.5 | 12.5 | 12.5 | 12.5 |
| NOTE 1: The transmitter shall be set to 4dB below P <sub>C<sub>MAX</sub>,L,c</sub> or P <sub>C<sub>MAX</sub>,L</sub> as defined in subclause 6.2.5A  |       |   |      |      |      |      |
| NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNB Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 |       |   |      |      |      |      |

**Table 7.6.1.1A-2: In-band blocking**

| CA configuration  | Parameter                        | Unit                    | Case 1  | Case 2  |
|---|----------------------------------|-------------------------|---|---|
|   |                                  | P <sub>Interferer</sub> | dBm   | -56   |
|   | F <sub>Interferer (offset)</sub> | MHz                     | =-F <sub>offset</sub> - F <sub>offset, case 1</sub><br>&<br>=+F <sub>offset</sub> + F <sub>offset, case 1</sub> | ≤-F <sub>offset</sub> - F <sub>offset, case 2</sub><br>&<br>≥+F <sub>offset</sub> + F <sub>offset, case 2</sub> |
| CA_1C, CA_2C, CA_3B, CA_3C, CA_5B, CA_7B, CA_7C, CA_8B, CA_12B, CA_23B, CA_27B, CA_28C, CA_38C, CA_39C, CA_40C, CA_40D, CA_40E, CA_40F, CA_41C, CA_41D, CA_41E, CA_41F, CA_42C, CA_42D, CA_42E, CA_42F, CA_43C, CA_48B, CA_48C, CA_48D, CA_48E, CA_48F, CA_66B, CA_66C, CA_66D, CA_70C  | F <sub>Interferer (Range)</sub>  | MHz                     | (NOTE 2)  | F <sub>DL,low</sub> - 15<br>to<br>F <sub>DL,high</sub> + 15   |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band  |                                  |                         |   |   |
| NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency -F <sub>offset</sub> - F <sub>offset, case 1</sub> and<br>b. the carrier frequency +F <sub>offset</sub> + F <sub>offset, case 1</sub>  |                                  |                         |   |   |
| NOTE 3: F <sub>offset</sub> is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.   |                                  |                         |   |   |
| NOTE 4: The F <sub>interferer (offset)</sub> is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to $\lfloor \frac{F_{interferer}}{0.015 + 0.5} \rfloor 0.015 + 0.0075$ MHz to be offset from the sub-carrier raster. |                                  |                         |   |   |

For combinations of intra-band and inter-band carrier aggregation and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For these uplink configurations, the UE shall meet the in-band blocking requirements for intra-band non-contiguous carrier aggregation with ΔR<sub>IBNC</sub> = 0 dB for all sub-block



gaps (Table 7.3.1A-3) for the two or more non-contiguous downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.6.1. For contiguously aggregated component carriers configured in Band 46, the said requirements for intra-band contiguous carrier aggregation of downlink carriers are replaced by requirements in Table 7.6.1.1A-3 and 7.6.1.1A-4. For non-contiguously aggregated component carriers configured in Band 46, the said requirements are applied to each sub-block for in-gap and out-of-gap interferers. For the sub-block with a single component carrier, the requirement is replaced by Table 7.6.1.1A-0a and 7.6.1.1A-0b. For the sub-block with two or more contiguous component carriers, the requirement is replaced by Table 7.6.1.1A-3 and 7.6.1.1A-4. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of uplink operation.

**Table 7.6.1.1A-3: In band blocking parameters**

| E-UTRA Band | Rx Parameter                                       | Units | CA Bandwidth Class                                |      |    |    |   |
|-------------|--|-------|---|------|----|----|---|
|             |  |       | B   | C    | D  | E  | F |
| 46          | Pw in Transmission Bandwidth Configuration, per CC | dBm   | REFSENS + CA Bandwidth Class specific value below |      |    |    |   |
|             |  |       | 12  | 13.8 | 15 |    |   |
|             | BW <sub>Interferer</sub>                           | MHz   |   | 20   | 20 | 20 |   |
|             | F <sub>offset, case 1</sub>                        | MHz   |   | 30   | 30 | 30 |   |
|             | F <sub>offset, case 2</sub>                        | MHz   |   | 50   | 50 | 50 |   |

NOTE 1: In a band capable of uplink operation, the transmitter shall be set to 4dB below P<sub>C<sub>MAX</sub>L,c</sub> or P<sub>C<sub>MAX</sub>L</sub> as defined in subclause 6.2.5A

NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 and set-up according to Annex C.3.1

**Table 7.6.1.1A-4: In-band blocking**

| E-UTRA Band | Parameter                        | Unit                    | Case 1  | Case 2  |
|-------------|----------------------------------|-------------------------|---|---|
|             |                                  | P <sub>Interferer</sub> | dBm   | -50   |
|             | F <sub>Interferer</sub> (offset) | MHz                     | $= -F_{offset} - F_{offset, case 1}$<br>&<br>$= +F_{offset} + F_{offset, case 1}$ | $\leq -F_{offset} - F_{offset, case 2}$<br>&<br>$\geq +F_{offset} + F_{offset, case 2}$ |
| 46          | F <sub>Interferer</sub> (Range)  | MHz                     | (Note 2)  | F <sub>DL_low</sub> - 60<br>to<br>F <sub>DL_high</sub> + 60                             |

NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band

NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  
a. the carrier frequency  $-F_{offset} - F_{offset, case 1}$  and  
b. the carrier frequency  $+F_{offset} + F_{offset, case 1}$

NOTE 3: F<sub>offset</sub> is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.

NOTE 4: The F<sub>interferer</sub> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to  $\lfloor F_{interferer} / 0.015 + 0.5 \rfloor 0.015 + 0.0075$  MHz to be offset from the sub-carrier raster.

**7.6.1.1D Minimum requirements for ProSe**

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.6.2.

**Table 7.6.1.1D-1: In band blocking parameters for ProSe Direct Discovery**

| Rx parameter                                  | Units | Channel bandwidth   |       |            |            |            |            |
|---|-------|---|-------|------------|------------|------------|------------|
|   |       | 1.4 MHz   | 3 MHz | 5 MHz      | 10 MHz     | 15 MHz     | 20 MHz     |
| Power in Transmission Bandwidth Configuration | dBm   | P <sub>REFSENS_ProSe</sub> + channel bandwidth specific value below + P <sub>offset</sub> |       |            |            |            |            |
|   |       |   |       | 6          | 6          | 7          | 9          |
| BW <sub>interferer</sub>                      | MHz   |   |       | 5          | 5          | 5          | 5          |
| F <sub>offset, case 1</sub>                   | MHz   |   |       | 7.5+0.0125 | 7.5+0.0025 | 7.5+0.0075 | 7.5+0.0125 |

|   |     |  |  |             |             |             |             |
|---|-----|--|--|-------------|-------------|-------------|-------------|
| $F_{\text{offset, case 2}}$   | MHz |  |  | 12.5+0.0075 | 12.5+0.0125 | 12.5+0.0025 | 12.5+0.0075 |
| $P_{\text{offset}}$   | dB  |  |  | 10.9        | 13.9        | 15.7        | 16.9        |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 |     |  |  |             |             |             |             |

**Table 7.6.1.1D-2: In band blocking parameters for ProSe Direct Communication**

| Rx parameter  | Units | Channel bandwidth                                       |       |             |             |             |             |
|---|-------|---|-------|-------------|-------------|-------------|-------------|
|   |       | 1.4 MHz   | 3 MHz | 5 MHz       | 10 MHz      | 15 MHz      | 20 MHz      |
| Power in Transmission Bandwidth Configuration   | dBm   | PREFSENS_ProSe + channel bandwidth specific value below |       |             |             |             |             |
|   |       |   |       | 6           | 6           | 7           | 9           |
| $BW_{\text{interferer}}$  | MHz   |   |       | 5           | 5           | 5           | 5           |
| $F_{\text{offset, case 1}}$   | MHz   |   |       | 7.5+0.0125  | 7.5+0.0025  | 7.5+0.0075  | 7.5+0.0125  |
| $F_{\text{offset, case 2}}$   | MHz   |   |       | 12.5+0.0075 | 12.5+0.0125 | 12.5+0.0025 | 12.5+0.0075 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 |       |   |       |             |             |             |             |

**Table 7.6.1.1D-3: In-band blocking for ProSe**

| E-UTRA ProSe band  | Parameter                        | Unit                    | Case 1  | Case 2  |
|--|----------------------------------|-------------------------|---|---|
|  |                                  | $P_{\text{interferer}}$ | dBm   | -56   |
|  | $F_{\text{interferer}}$ (offset) | MHz                     | $\leq -BW/2 - F_{\text{offset, case 1}}$<br>&<br>$\geq +BW/2 + F_{\text{offset, case 1}}$ | $\leq -BW/2 - F_{\text{offset, case 2}}$<br>&<br>$\geq +BW/2 + F_{\text{offset, case 2}}$ |
| 2,3,4,7,14,20,26,28,31   | $F_{\text{interferer}}$          | MHz                     | (NOTE 2)  | $F_{\text{DL\_low}} - 15$<br>to<br>$F_{\text{DL\_high}} + 15$                             |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band   |                                  |                         |   |   |
| NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency $-BW/2 - F_{\text{offset, case 1}}$ and<br>b. the carrier frequency $+BW/2 + F_{\text{offset, case 1}}$ |                                  |                         |   |   |
| NOTE 3: $F_{\text{interferer}}$ range values for unwanted modulated interfering signal are interferer center frequencies   |                                  |                         |   |   |

For the UE which supports inter band CA configuration in Table 7.3.1-1A,  $P_{\text{interferer}}$  power defined in Table 7.6.1.1D-3 is increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

**7.6.1.1F Minimum requirements for category NB1 and NB2**

Category NB1 and NB2 UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with parameters specified in Table 7.6.1.1F-1.

**Table 7.6.1.1F-1: In-band blocking parameters for category NB1 and NB2**

| IBB1 test Parameters   |   |
|--|---|
| Category NB1 or NB2 signal power ( $P_{\text{wanted}}$ ) / dBm | REFSENS + 6 dB                                      |
| Interferer   | E-UTRA  |
| Interferer signal power ( $P_{\text{interferer}}$ ) / dBm      | - 56 dBm  |
| Interferer bandwidth   | 5 MHz   |
| Interferer offset from category NB1 or NB2 channel edge        | +7.5 MHz + 0.005 MHz<br>and<br>-7.5 MHz - 0.005 MHz |

| IBB2 test Parameters  |  |
|---|--|
| Category NB1 or NB2 signal power<br>( $P_{wanted}$ ) / dBm    | REFSENS + 6 dB   |
| Interferer  | E-UTRA   |
| Interferer signal power<br>( $P_{interferer}$ ) / dBm         | - 44 dBm   |
| Interferer bandwidth  | 5 MHz  |
| Interferer offset range from category NB1 or NB2 channel edge | From +12.5 MHz to $F_{DL\_high} + 15$ MHz<br>and<br>From -12.5 MHz to $F_{DL\_low} - 15$ MHz |

7.6.1.1G Minimum requirements for V2X

The V2X UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters defined in Table 7.6.1.1G-1 and Table 7.6.1.1G-2.

Table 7.6.1.1G-1: In band blocking parameters

| Rx parameter                                  | Units | Channel bandwidth   |       |       |             |        |             |
|---|-------|---|-------|-------|-------------|--------|-------------|
|   |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz      | 15 MHz | 20 MHz      |
| Power in Transmission Bandwidth Configuration | dBm   | $P_{REFSENS\_V2X}$ + channel bandwidth specific value below |       |       |             |        |             |
|   |       |   |       |       | 6           |        | 9           |
| $BW_{interferer}$                             | MHz   |   |       |       | 10          |        | 10          |
| $F_{offset, case 1}$                          | MHz   |   |       |       | $15+0.0025$ |        | $15+0.005$  |
| $F_{offset, case 2}$                          | MHz   |   |       |       | $25+0.0075$ |        | $25+0.0025$ |

NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211

Table 7.6.1.1G-2: In-band blocking

| E-UTRA V2X band | Parameter                 | Unit             | Case 1  | Case 2  |
|-----------------|---------------------------|------------------|---|---|
|                 |                           | $P_{interferer}$ | dBm   | -44   |
|                 | $F_{interferer}$ (offset) | MHz              | $=-BW/2 - F_{offset, case 1}$<br>&<br>$=+BW/2 + F_{offset, case 1}$ | $\leq -BW/2 - F_{offset, case 2}$<br>&<br>$\geq +BW/2 + F_{offset, case 2}$ |
| 47              | $F_{interferer}$          | MHz              | (NOTE 2)  | $F_{DL\_low} - 30$<br>to<br>$F_{DL\_high} + 30$                             |

NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band

NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  
a. the carrier frequency  $-BW/2 - F_{offset, case 1}$  and  
b. the carrier frequency  $+BW/2 + F_{offset, case 1}$

NOTE 3:  $F_{interferer}$  range values for unwanted modulated interfering signal are interferer center frequencies

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.6.1.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.6.1.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, the V2X UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters defined in Table 7.6.1.1G-3 and Table 7.6.1.1G-4.

Table 7.6.1.1G-3: In band blocking parameters for intra-band contiguous multi-carrier for V2X UE

| Rx Parameter | Units | V2X Bandwidth Class |
|--------------|-------|---------------------|
|--------------|-------|---------------------|

|  |     | B  | C/ C <sub>1</sub> | D | E | F |
|--|-----|--|-------------------|---|---|---|
| P <sub>w</sub> in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + V2X Bandwidth Class specific value below |                   |   |   |   |
|  |     | 9  | 12                |   |   |   |
| BW <sub>Interferer</sub>                                       | MHz | 10   | 10                |   |   |   |
| F <sub>offset, case 1</sub>                                    | MHz | 15   | 15                |   |   |   |
| F <sub>offset, case 2</sub>                                    | MHz | 25   | 25                |   |   |   |

**Table 7.6.1.1G-4: In-band blocking for intra-band contiguous multi-carrier for V2X UE**

| V2X multi-carrier configuration  | Parameter                        | Unit                    | Case 1  | Case 2  |
|--|----------------------------------|-------------------------|---|---|
|  |                                  | P <sub>Interferer</sub> | dBm   | -44   |
|  | F <sub>Interferer</sub> (offset) | MHz                     | $=-F_{\text{offset}} - F_{\text{offset, case 1}}$<br>&<br>$=+F_{\text{offset}} + F_{\text{offset, case 1}}$ | $\leq -F_{\text{offset}} - F_{\text{offset, case 2}}$<br>&<br>$\geq +F_{\text{offset}} + F_{\text{offset, case 2}}$ |
| V2X_47B, V2X_47C, V2X_47C <sub>1</sub>   | F <sub>Interferer</sub> (Range)  | MHz                     | (NOTE 2)  | F <sub>DL_low</sub> - 30<br>to<br>F <sub>DL_high</sub> + 30   |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 30 MHz below or above the UE receive band   |                                  |                         |   |   |
| NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency $-F_{\text{offset}} - F_{\text{offset, case 1}}$<br>b. the carrier frequency $+F_{\text{offset}} + F_{\text{offset, case 1}}$   |                                  |                         |   |   |
| NOTE 3: F <sub>offset</sub> is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.  |                                  |                         |   |   |
| NOTE 4: The F <sub>interferer</sub> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to $\lfloor F_{\text{interferer}} / (0.015 + 0.5) \rfloor \cdot 0.015 + 0.0075$ MHz to be offset from the sub-carrier raster. |                                  |                         |   |   |
| NOTE 5: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.  |                                  |                         |   |   |

## 7.6.2 Out-of-band blocking

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the UE receive band. For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.

For CA configurations including Band 46 or Band 49, out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 60 MHz below or above the UE receive band (see Table 7.6.2.1A-0a). For the first 60 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1A and subclause 7.6.1A shall be applied.

### 7.6.2.1 Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1-1 and 7.6.2.1-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to  $\max(24, 6 \cdot \lceil N_{RB} / 6 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  $N_{RB}$  is the number of resource blocks in the downlink transmission bandwidth configuration (see Figure 5.6-1). For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to  $\max(8, \lceil (N_{RB} + 2 \cdot L_{CRBs}) / 8 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  $N_{RB}$  is the number of resource blocks in the downlink transmission bandwidth configurations (see Figure 5.6-1) and  $L_{CRBs}$  is the

number of resource blocks allocated in the uplink. For these exceptions the requirements of clause 7.7 spurious response are applicable.

**Table 7.6.2.1-1: Out-of-band blocking parameters**

| Rx Parameter   | Units | Channel bandwidth                                |       |       |        |        |        |
|--|-------|--|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration  | dBm   | REFSENS + channel bandwidth specific value below |       |       |        |        |        |
|  |       | 6  | 6     | 6     | 6      | 7      | 9      |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX\_L}$ as defined in subclause 6.2.5.                                     |       |  |       |       |        |        |        |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.  |       |  |       |       |        |        |        |
| NOTE 3: The REFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.   |       |  |       |       |        |        |        |
| NOTE 4: For DL category M1 and M2 UE, the reference sensitivity for category M1 in table 7.3.1E-3 and category M2 in Table 7.3.1E-8 should be used as REFSENS for the power in Transmission Bandwidth Configuration. |       |  |       |       |        |        |        |
| NOTE5: For DL category M1 and M2 UE, the parameters for the applicable channel bandwidth apply.  |       |  |       |       |        |        |        |

**Table 7.6.2.1-2: Out of band blocking**

| E-UTRA band   | Parameter             | Units | Frequency   |  |  |                                       |
|---|-----------------------|-------|---|--|--|---------------------------------------|
|   |                       |       | Range 1   | Range 2  | Range 3  | Range 4                               |
|   | $P_{Interferer}$      | dBm   | -44   | -30  | -15  | -15                                   |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42 (NOTE 2), 43 (NOTE 2), 44, 45, 48 (NOTE 2), 50, 51, 52 (NOTE 6), 53 <sup>9</sup> , 65, 66, 68, 70, 71, 72, 73, 74, 85, 87, 88   | $F_{Interferer}$ (CW) | MHz   | $F_{DL\_low} -15$ to $F_{DL\_low} -60$<br><br>$F_{DL\_high} +15$ to $F_{DL\_high} + 60$ | $F_{DL\_low} -60$ to $F_{DL\_low} -85$<br><br>$F_{DL\_high} +60$ to $F_{DL\_high} +85$ | $F_{DL\_low} -85$ to 1 MHz<br><br>$F_{DL\_high} +85$ to +12750 MHz | -                                     |
| 2, 5, 12, 17, 85  | $F_{Interferer}$      | MHz   | -   | -  | -  | $F_{UL\_low} - F_{UL\_high}$ (NOTE 5) |
| NOTE 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS.  |                       |       |   |  |  |                                       |
| NOTE 2: The power level of the interferer ( $P_{Interferer}$ ) for Range 3 shall be modified to -20 dBm for $F_{Interferer} > 2800$ MHz and $F_{Interferer} < 4400$ MHz. The power level of the interferer ( $P_{Interferer}$ ) for Range 3 shall be modified to -20 dBm for $F_{Interferer} > 2800$ MHz and $F_{Interferer} < 4800$ MHz when UE supports both E-UTRA band B42 and NR bands n77, n78. |                       |       |   |  |  |                                       |
| NOTE 3: For the UE that supports both Band 4 and Band 66, the out-of-blocking frequency range for Band 4 is defined relative to $F_{DL\_low}$ and $F_{DL\_high}$ of Band 66.  |                       |       |   |  |  |                                       |
| NOTE 4: For a UE supporting CA_20A-28A, CA_1A-3A-7A-20A-28A, CA_1A-3A-20A-28A, CA_1A-3A-3A-20A-28A, CA_1A-7A-20A-28A, CA_1A-20A-28A, CA_3A-7A-20A-28A, CA_3A-20A-28A or CA_7A-20A-28A the requirements for Band 20 and Band 28 apply with $F_{DL\_low}$ given by the lower limit of the restricted operating frequency range in Band 28 and $F_{DL\_high}$ by Band 20 (Table 5.5A-2).                 |                       |       |   |  |  |                                       |
| NOTE 5: Range 4 requirement does not apply to category M1 and M2.   |                       |       |   |  |  |                                       |
| NOTE 6: The power level of the interferer ( $P_{Interferer}$ ) for Range 3 shall be modified to -20 dBm for $F_{Interferer} > 2700$ MHz and $F_{Interferer} < 4000$ MHz.  |                       |       |   |  |  |                                       |
| NOTE 7: For band 51 the $F_{DL\_high}$ of band 50 is applied as $F_{DL\_high}$ for band 51.   |                       |       |   |  |  |                                       |
| NOTE 8: For UEs supporting both bands 38 and 41, the $F_{DL\_high}$ and $F_{DL\_low}$ of band 41 is applied as $F_{DL\_high}$ and $F_{DL\_low}$ for band 38.  |                       |       |   |  |  |                                       |

NOTE 9: The power level of the interferer ( $P_{\text{Interferer}}$ ) for Range 3 shall be modified to [-20 dBm] for  $F_{\text{Interferer}} > [2580 \text{ MHz}]$  and  $F_{\text{Interferer}} < [2775 \text{ MHz}]$ .

### 7.6.2.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band, the out-of-band blocking requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The throughput in the downlink measured shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1-1 and 7.6.2.1A-0. For E-UTRA CA configurations including an operating band without uplink operation (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the uplink active in the band(s) capable of UL operation. For the E-UTRA CA configurations with band 46 or Band 49, the parameters specified in Table 7.6.2.1A-0 are replaced by those specified in Table 7.6.2.1A-0a. The UE shall meet these requirements for each component carrier while all downlink carriers are active.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the out-of-band blocking requirements specified above shall be met with the transmitter power for the uplink set to 7 dB below  $P_{\text{CMAX}_L,c}$  for each serving cell  $c$ .

For E-UTRA CA configurations including an operating band without uplink band or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the out-of-band blocking requirements of subclause 7.6.2.1A do not apply.

**Table 7.6.2.1A-0: out-of-band blocking for inter-band carrier aggregation**

| Parameter  | Unit | Range 1   | Range 2   | Range 3  |
|--|------|---|---|--|
| $P_w$  | dBm  | Table 7.6.2.1-1 for all component carriers  |   |  |
| $P_{\text{interferer}}$  | dBm  | $-44 + \Delta R_{\text{IB},c}$  | $-30 + \Delta R_{\text{IB},c}$  | $-15 + \Delta R_{\text{IB},c}$   |
| $F_{\text{interferer}}$ (CW)   | MHz  | $-60 < f - F_{\text{DL\_Low}(j)} < -15$<br>or<br>$15 < f - F_{\text{DL\_High}(j)} < 60$ | $-85 < f - F_{\text{DL\_Low}(j)} \leq -60$<br>or<br>$60 \leq f - F_{\text{DL\_High}(j)} < 85$ | $1 \leq f \leq F_{\text{DL\_Low}(1)} - 85$<br>or<br>$F_{\text{DL\_High}(j)} + 85 \leq f \leq F_{\text{DL\_Low}(j+1)} - 85$ with $j < X$<br>or<br>$F_{\text{DL\_High}(X)} + 85 \leq f \leq 12750$ |
| NOTE 1: $F_{\text{DL\_Low}(j)}$ and $F_{\text{DL\_High}(j)}$ denote the respective lower and upper frequency limits of the operating band containing carrier $j$ , $j = 1, \dots, X$ , with carriers numbered in increasing order of carrier frequency and $X$ the number of component carriers in the band combination.<br>NOTE 2: For $F_{\text{DL\_Low}(j+1)} - F_{\text{DL\_High}(j)} < 145 \text{ MHz}$ and $F_{\text{interferer}}$ in $F_{\text{DL\_High}(j)} < f < F_{\text{DL\_Low}(j+1)}$ with $j < X$ , $F_{\text{interferer}}$ can be in both Range 1 and Range 2. Then the lower of the $P_{\text{interferer}}$ applies.<br>NOTE 3: For $F_{\text{DL\_Low}(j)} - 15 \text{ MHz} \leq f \leq F_{\text{DL\_High}(j)} + 15 \text{ MHz}$ the appropriate adjacent channel selectivity and in-band blocking requirements in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied for carrier $j$ .<br>NOTE 4: $\Delta R_{\text{IB},c}$ according to Table 7.3.1-1A applies when serving cell $c$ is measured.<br>NOTE 5: For inter-band CA combinations containing Bands 42, 43, or 48, the interferer with respect to Band 42, Band 43, or Band 48 shall have power level ( $P_{\text{interferer}}$ ) for Range 3 modified to -20 + $\Delta R_{\text{IB},c}$ dBm for $F_{\text{interferer}} > 2800 \text{ MHz}$ and $F_{\text{interferer}} < 4400 \text{ MHz}$ .<br>NOTE 6: For inter-band CA combinations containing Bands 7 and 38 simultaneously, for $F_{\text{interferer}}$ Bands 7 and 38 are considered as one single band as follows: $F_{\text{DL\_Low}} = 2570 \text{ MHz}$ and $F_{\text{DL\_High}} = 2690 \text{ MHz}$ . For Range 2, the following applies for $F_{\text{DL\_Low}}$ : $-95 < f - F_{\text{DL\_Low}} \leq -60$ or $60 \leq f - F_{\text{DL\_High}} < 85$ . For Range 3 the following applies $1 \leq f \leq F_{\text{DL\_Low}} - 95$ or $F_{\text{DL\_High}} + 85 \leq f \leq 12750$ . For UEs supporting both bands 38 and 41, $F_{\text{DL\_Low}} = 2496 \text{ MHz}$ .<br>NOTE 7: For CA_20A-28A, CA_1A-3A-7A-20A-28A, CA_1A-3A-20A-28A, CA_1A-3A-3A-20A-28A, CA_1A-7A-20A-28A, CA_1A-20A-28A, CA_3A-7A-20A-28A, CA_3A-20A-28A and CA_7A-20A-28A the $F_{\text{DL\_Low}(1)}$ is given by the lower limit of the restricted operating frequency range in Band 28 and $F_{\text{DL\_high}(2)}$ by Band 20 (Table 5.5A-2).<br>NOTE 8: For inter-band CA combinations including DL in band 76, the $F_{\text{DL\_high}}$ of band 75 is applied as $F_{\text{DL\_high}}$ for band 76.<br>NOTE 9: For CA band combinations including DL in band 32, $F_{\text{DL\_high}}$ of band 75 is applied as $F_{\text{DL\_high}}$ for band 32, and $F_{\text{DL\_low}}$ of band 76 is applied as $F_{\text{DL\_low}}$ for band 32. |      |   |   |  |

**Table 7.6.2.1A-0a: out-of-band blocking for inter-band carrier aggregation with band 46 or Band 49 and with one active uplink**

| Parameter   | Unit | Range 1  | Range 2   | Range 3   |
|---|------|--|---|---|
| $P_{\text{wanted}}$   | dBm  | Table 7.6.2.1-1 for component carriers in bands with $j \leq K$ and Table 7.6.1.1A-0a for component carriers in bands with $j > K$ |   |   |
| $P_{\text{interferer}}$   | dBm  | $-44 + \Delta R_{\text{IB},c}$   | $-30 + \Delta R_{\text{IB},c}$  | $-15 + \Delta R_{\text{IB},c}$<br>(NOTE 5)  |
| $F_{\text{interferer}}$<br>(CW)   | MHz  | $-60 < f - F_{\text{DL\_Low}(j)} < -15$<br>with $j \leq K$<br>or<br>$15 < f - F_{\text{DL\_High}(j)} < 60$<br>with $j \leq K$      | $-85^6 < f - F_{\text{DL\_Low}(j)} \leq -60$<br>or<br>$60 \leq f - F_{\text{DL\_High}(j)} < 85^6$ | $1 \leq f \leq F_{\text{DL\_Low}(j)} - 85^6$<br>or<br>$F_{\text{DL\_High}(j)} + 85^6 \leq f \leq 12750$ |
| <p>NOTE 1: <math>F_{\text{DL\_Low}(j)}</math> and <math>F_{\text{DL\_High}(j)}</math>, <math>j = 1, \dots, K, \dots, N</math>, denote the respective lower and upper frequency limits of the (non-overlapping) operating bands of the CA configuration numbered in increasing order of frequency, with N the number of bands in the band combination and K the number of bands with <math>F_{\text{DL\_High}} \leq 3800</math> MHz for Band 46 and <math>F_{\text{DL\_High}} \leq 2700</math> MHz for Band 49.</p> <p>NOTE 2: For <math>F_{\text{DL\_Low}(j)} - 15 \text{ MHz} \leq f \leq F_{\text{DL\_High}(j)} + 15 \text{ MHz}</math> the appropriate adjacent channel selectivity and in-band blocking requirements in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied for carrier <math>j \leq K</math>.</p> <p>NOTE 3: For <math>F_{\text{DL\_Low}(j)} - 60 \text{ MHz} \leq f \leq F_{\text{DL\_High}(j)} + 60 \text{ MHz}</math> the appropriate adjacent channel selectivity and in-band blocking requirements in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied for carrier <math>K &lt; j \leq N</math>.</p> <p>NOTE 4: <math>\Delta R_{\text{IB},c}</math> according to Table 7.3.1-1A applies when serving cell <math>c</math> is measured.</p> <p>NOTE 5: The power level (<math>P_{\text{interferer}}</math>) for Range 3 is modified to -20 dBm for <math>F_{\text{interferer}} &gt; 4400</math> MHz except for band combinations with Band 42 or Band 43 for which <math>P_{\text{interferer}}</math> for Range 3 is modified to -20 dBm for <math>F_{\text{interferer}} &gt; 2800</math> MHz.</p> <p>NOTE 6: The -85 MHz and 85 MHz offset from <math>F_{\text{DL\_Low}(j)}</math> and <math>F_{\text{DL\_High}(j)}</math> is modified to -200 MHz and 200 MHz for carrier <math>j</math> in Band 46.</p> |      |  |   |   |

For Table 7.6.2.1A-0 and Table 7.6.2.1A-0b in frequency ranges 1, 2 and 3, up to  $\max(24,6 \cdot \lceil N_{\text{RB}} / 6 \rceil)$  exceptions per downlink are allowed for spurious response frequencies for one active uplink when measured using a step size of 1 MHz.

For Table 7.6.2.1A-0 in frequency ranges 1, 2 and 3, up to  $2 \cdot \max(24,6 \cdot \lceil N_{\text{RB}} / 6 \rceil)$  exceptions per downlink are allowed for spurious response frequencies for two active uplinks when measured using a step size of 1 MHz. For these exceptions the requirements in clause 7.7.1A apply.

For intra-band contiguous carrier aggregations the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.6.2.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2.

The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.2.1A-1 and Tables 7.6.2.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1A-1 and 7.6.2.1A-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.6.2.1A-1 and 7.6.2.1A-2.

For Table 7.6.2.1A-2 in frequency range 1, 2 and 3, up to  $\max(24,6 \cdot \lceil N_{\text{RB}} / 6 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

**Table 7.6.2.1A-1: Out-of-band blocking parameters**

| Rx Parameter | Units | CA Bandwidth Class |   |   |   |   |
|--------------|-------|--------------------|---|---|---|---|
|              |       | B                  | C | D | E | F |

|   |     |   |   |   |   |
|---|-----|---|---|---|---|
| Pw in Transmission Bandwidth Configuration, per CC  | dBm | REFSENS + CA Bandwidth Class specific value below |   |   |   |
|   |     | 9   | 9 | 9 | 9 |
| NOTE 1: The transmitter shall be set to 4dB below P <sub>C<sub>MAX</sub>L,c</sub> or P <sub>C<sub>MAX</sub>L</sub> as defined in subclause 6.2.5A.      |     |   |   |   |   |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2. |     |   |   |   |   |

**Table 7.6.2.1A-2: Out of band blocking**

| CA configuration  | Parameter                    | Units | Frequency  |  |  |
|---|------------------------------|-------|--|--|--|
|   |                              |       | Range 1  | Range 2  | Range 3  |
|   | P <sub>Interferer</sub>      | dBm   | -44  | -30  | -15  |
| CA_1C, CA_2C, CA_3B, CA_3C, CA_5B, CA_7B, CA_7C, CA_8B, CA_12B, CA_23B, CA_27B, CA_28C, CA_38C, CA_39C, CA_40C, CA_40D, CA_40E, CA_40F, CA_41C, CA_41D, CA_41E, CA_41F, CA_42C <sup>1</sup> , CA_42D <sup>1</sup> , CA_42E <sup>1</sup> , CA_42F <sup>1</sup> , CA_43C <sup>1</sup> , CA_48B <sup>1</sup> , CA_48C <sup>1</sup> , CA_48D <sup>1</sup> , CA_48E <sup>1</sup> , CA_48F <sup>1</sup> , CA_66B, CA_66C, CA_66D, CA_70C                                      | F <sub>Interferer</sub> (CW) | MHz   | F <sub>DL_low</sub> - 15 to F <sub>DL_low</sub> - 60<br>F <sub>DL_high</sub> + 15 to F <sub>DL_high</sub> + 60 | F <sub>DL_low</sub> - 60 to F <sub>DL_low</sub> - 85<br>F <sub>DL_high</sub> + 60 to F <sub>DL_high</sub> + 85 | F <sub>DL_low</sub> - 85 to 1 MHz<br>F <sub>DL_high</sub> + 85 to +12750 MHz |
| NOTE 1: The power level of the interferer (P <sub>Interferer</sub> ) for this CA configuration for Range 3 shall be modified to -20 dBm for F <sub>Interferer</sub> > 2800 MHz and F <sub>Interferer</sub> < 4400 MHz. The power level of the interferer (P <sub>Interferer</sub> ) for Range 3 shall be modified to -20 dBm for F <sub>Interferer</sub> > 2800 MHz and F <sub>Interferer</sub> < 4800 MHz when UE supports both E-UTRA band B42 and NR bands n77, n78. |                              |       |  |  |  |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, the out-of-band blocking requirements are defined with the uplink configuration in accordance with table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.6.2.1 and 7.6.2.1A for one component carrier and two or more component carriers per sub-block, respectively. The requirements apply with all downlink carriers active.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to  $\max(24,6 \cdot \lceil N_{RB} \cdot /6 \rceil)$  exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies for one active uplink when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to  $\max(8, \lceil (N_{RB} + 2 \cdot L_{CRBs}) / 8 \rceil)$  exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies for one active uplink when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7 spurious response are applicable.

For intra-band non-contiguous carrier aggregation with two uplink carriers and two or more downlink carriers, the out-of-band blocking requirements are defined with the uplink configuration of the PCC and SCC being in accordance with Table 7.3.1A-4 and powers of both carriers set to P<sub>C<sub>MAX</sub>L,c</sub> - 7 dBm. The UE shall meet the requirements specified in subclause 7.6.2.1 for each component carrier while both downlink carriers are active.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to  $2 \cdot \max(24,6 \cdot \lceil N_{RB} \cdot /6 \rceil)$  exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies for two active uplinks in the same operating band when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to  $2 \cdot \max(8, \lceil (N_{RB} + 2 \cdot L_{CRBs}) / 8 \rceil)$  exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies for two active uplinks in the same operating band when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7 spurious response are applicable.

For combinations of intra-band and inter-band carrier aggregation and the uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in a band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per



band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For the two or more non-contiguous component carriers within the same band,  $P_{wanted}$  in Table 7.6.2.1A-0 is set using  $\Delta R_{BNC} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) while a band supporting contiguously aggregated carriers the out-of-band blocking parameters in Table 7.6.2.1-1 are replaced by those specified in Table 7.6.2.1A-1. For each downlink the UE shall meet the out-of-band blocking requirements applicable for inter-band carrier aggregation with one component carrier per operating band with the following exception. For each component carrier of the E-UTRA CA Configurations with band 46 or band 49, the requirements specified in Table 7.6.2.1A-0 are replaced by those in Table 7.6.2.1A-0a. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

**7.6.2.1D Minimum requirements for ProSe**

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Tables 7.6.2.1D-1, 7.6.2.1D-2 and 7.6.2.1D-3.

For Table 7.6.2.1D-3 in frequency range 1, 2 and 3, up to  $\max(24, 6 \cdot \lceil N_{RB} / 6 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  $N_{RB}$  is the number of resource blocks in the downlink transmission bandwidth configuration (see Figure 5.6-1). For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

**Table 7.6.2.1D-1: Out-of-band blocking parameters for ProSe Direct Discovery**

| Rx Parameter   | Units | Channel bandwidth   |       |       |        |        |        |
|--|-------|---|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | $P_{REFSENS\_ProSe} + \text{channel bandwidth specific value below} + P_{offset}$ |       |       |        |        |        |
|  |       |   |       | 6     | 6      | 7      | 9      |
| $P_{offset}$   | dB    |   |       | 10.9  | 13.9   | 15.7   | 16.9   |
| NOTE 2: Reference measurement channel is specified in Annex A.6.2. |       |   |       |       |        |        |        |

**Table 7.6.2.1D-2: Out-of-band blocking parameters for ProSe Direct Communication**

| Rx Parameter   | Units | Channel bandwidth  |       |       |        |        |        |
|--|-------|--|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | $P_{REFSENS\_ProSe} + \text{channel bandwidth specific value below}$ |       |       |        |        |        |
|  |       |  |       | 6     | 6      | 7      | 9      |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. |       |  |       |       |        |        |        |

**Table 7.6.2.1D-3: Out of band blocking for ProSe**

| E-UTRA ProSe band  | Parameter             | Units | Frequency                                |  |                                  |
|--|-----------------------|-------|--|--|----------------------------------|
|  |                       |       | Range 1                                  | Range 2                                  | Range 3                          |
|  | $P_{Interferer}$      |       | dBm                                      | -44                                      | -30                              |
| 2,3,4,7,14, 20,26,28,31,72   | $F_{Interferer}$ (CW) | MHz   | $F_{DL\_low} -15$ to $F_{DL\_low} -60$   | $F_{DL\_low} -60$ to $F_{DL\_low} -85$   | $F_{DL\_low} -85$ to 1 MHz       |
|  |                       |       | $F_{DL\_high} +15$ to $F_{DL\_high} +60$ | $F_{DL\_high} +60$ to $F_{DL\_high} +85$ | $F_{DL\_high} +85$ to +12750 MHz |
| NOTE 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS. |                       |       |  |  |                                  |

**7.6.2.1F Minimum requirements for category NB1 and NB2**

The category NB1 and NB2 UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.3.2 with parameters specified in Table 7.6.2.1F-1.

For Table 7.6.2.1F-1 in frequency range 1, 2 and 3, up to 24 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7.1F spurious response are applicable.

**Table 7.6.2.1F-1: Out-of-band blocking parameters for category NB1 and NB2 UE**

| Parameter   | Units | Frequency                                  |  |                                  |
|---|-------|--|--|----------------------------------|
|   |       | Range 1                                    | Range 2                                    | Range 3                          |
| $P_{wanted}$  | dBm   | REFSENS + 6 dB                             |  |                                  |
| $P_{interferer}$ (CW)   | dBm   | -44  | -30  | -15                              |
| $F_{interferer}$ range  | MHz   | $F_{DL\_low} - 15$ to $F_{DL\_low} - 60$   | $F_{DL\_low} - 60$ to $F_{DL\_low} - 85$   | $F_{DL\_low} - 85$ to 1 MHz      |
|   | MHz   | $F_{DL\_high} + 15$ to $F_{DL\_high} + 60$ | $F_{DL\_high} + 60$ to $F_{DL\_high} + 85$ | $F_{DL\_high} + 85$ to 12750 MHz |
| NOTE 1: For operating bands which downlink band frequency range is between 617 MHz < f < 1 GHz the power level of the interferer ( $P_{interferer}$ ) for Range 3 shall be modified to: -18 dBm for the frequency range which is bounded by $F_{DL\_low} - 150$ MHz of the lowest band that UE supports in frequency range 617 MHz < f < 1 GHz and $F_{DL\_high} + 150$ MHz of the highest band that UE supports in frequency range 617 MHz < f < 1 GHz.                            |       |  |  |                                  |
| NOTE 2: For operating bands which downlink band frequency range is between 1475.9 MHz < f < 2690 MHz the power level of the interferer ( $P_{interferer}$ ) for Range 3 shall be modified to: -20 dBm for the frequency range which is bounded by $F_{DL\_low} - 200$ MHz of the lowest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz and $F_{DL\_high} + 200$ MHz of the highest band that UE supports supports in frequency range 1475.9 MHz < f < 2690 MHz. |       |  |  |                                  |
| NOTE 3: For operating bands which downlink band frequency range is between 460 MHz < f < 467.5 MHz the power level of the interferer ( $P_{interferer}$ ) for Range 3 shall be modified to: - 18 dBm for the frequency range which is bounded by $F_{DL\_low} - 150$ MHz of the lowest band that UE supports in frequency range 460 MHz < f < 467.5 0 MHz and $F_{DL\_high} + 150$ MHz of the highest band that UE supports supports in frequency range 460 MHz < f < 467.5.        |       |  |  |                                  |
| NOTE 4: The power level of the interferer ( $P_{interferer}$ ) for Range 3 shall be modified to -20 dBm for $F_{interferer} > 2800$ MHz and $F_{interferer} < 4400$ MHz.  |       |  |  |                                  |

**7.6.2.1G Minimum requirements for V2X**

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Tables 7.6.2.1G-1, 7.6.2.1G-2.

For Table 7.6.2.1G-2 in frequency range 1, 2 and 3, up to  $\max(24, 6 \cdot \lceil N_{RB} / 6 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  $N_{RB}$  is the number of resource blocks in the downlink transmission bandwidth configuration (see Figure 5.6-1). For these exceptions the requirements of subclause 7.7 spurious response are applicable.

**Table 7.6.2.1G-1: Out-of-band blocking parameters**

| Rx Parameter   | Units | Channel bandwidth                                     |       |       |        |        |        |
|--|-------|---|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | PREFSENS_V2X + channel bandwidth specific value below |       |       |        |        |        |
|  |       |   |       |       | 6      |        | 9      |
| NOTE 1: Reference measurement channel is specified in Annex A.8.2. |       |   |       |       |        |        |        |

**Table 7.6.2.1G-2: Out of band blocking**

| E-UTRA V2X band | Parameter             | Units | Frequency                                |  |                             |
|-----------------|-----------------------|-------|--|--|-----------------------------|
|                 |                       |       | Range 1                                  | Range 2                                  | Range 3                     |
|                 | $P_{interferer}$      | dBm   | -44                                      | -30                                      | -15                         |
| 47              | $F_{interferer}$ (CW) | MHz   | $F_{DL\_low} - 30$ to $F_{DL\_low} - 60$ | $F_{DL\_low} - 60$ to $F_{DL\_low} - 85$ | $F_{DL\_low} - 85$ to 1 MHz |
|                 |                       |       | $F_{DL\_high} + 30$ to                   | $F_{DL\_high} + 60$ to                   | $F_{DL\_high} + 85$ to      |

|   |  |  |                           |                          |            |
|---|--|--|---------------------------|--------------------------|------------|
|   |  |  | F <sub>DL_high</sub> + 60 | F <sub>DL_high</sub> +85 | +12750 MHz |
| NOTE: The power level of the interferer (P <sub>Interferer</sub> ) for Range 3 shall be modified to -20 dBm for F <sub>Interferer</sub> > 4400 MHz. |  |  |                           |                          |            |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.6.2.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.6.2.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, the V2X UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Tables 7.6.2.1G-3 and 7.6.2.1G-4.

For Table 7.6.2.1G-4 in frequency range 1, 2 and 3, up to  $\max(24,6 \cdot \lceil N_{RB} / 6 \rceil)$  exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 spurious response are applicable.

**Table 7.6.2.1G-3: Out-of-band blocking parameters for intra-band contiguous multi-carrier for V2X UE**

| Rx Parameter   | Units | V2X Bandwidth Class                                |                   |   |   |   |
|--|-------|--|-------------------|---|---|---|
|  |       | B  | C/ C <sub>1</sub> | D | E | F |
| P <sub>w</sub> in Transmission Bandwidth Configuration, per CC | dBm   | REFSENS + V2X Bandwidth Class specific value below |                   |   |   |   |
|  |       | 9  | 9                 |   |   |   |

**Table 7.6.2.1G-4: Out of band blocking for intra-band contiguous multi-carrier for V2X UE**

| V2X multi-carrier configuration   | Parameter                    | Units | Frequency   |  |  |
|---|------------------------------|-------|---|--|--|
|   |                              |       | Range 1   | Range 2  | Range 3                                |
|   | P <sub>Interferer</sub>      | dBm   | -44   | -30  | -15                                    |
| V2X_47B, V2X_47C, V2X_47C <sub>1</sub>  | F <sub>Interferer</sub> (CW) | MHz   | F <sub>DL_low</sub> -30 to F <sub>DL_low</sub> -60    | F <sub>DL_low</sub> -60 to F <sub>DL_low</sub> -85   | F <sub>DL_low</sub> -85 to 1 MHz       |
|   |                              |       | F <sub>DL_high</sub> +30 to F <sub>DL_high</sub> + 60 | F <sub>DL_high</sub> +60 to F <sub>DL_high</sub> +85 | F <sub>DL_high</sub> +85 to +12750 MHz |
| NOTE 1: The power level of the interferer (P <sub>Interferer</sub> ) for Range 3 shall be modified to -20 dBm for F <sub>Interferer</sub> > 4400 MHz. |                              |       |   |  |  |
| NOTE 2: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.   |                              |       |   |  |  |

### 7.6.3 Narrow band blocking

This requirement is measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing.

#### 7.6.3.1 Minimum requirements

The relative throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3.1-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.6.3.1-1: Narrow-band blocking**

| Parameter                                | Unit | Channel Bandwidth   |        |        |        |        |         |
|--|------|---|--------|--------|--------|--------|---------|
|  |      | 1.4 MHz   | 3 MHz  | 5 MHz  | 10 MHz | 15 MHz | 20 MHz  |
| P <sub>w</sub>                           | dBm  | P <sub>REFSENS</sub> + channel-bandwidth specific value below |        |        |        |        |         |
|  |      | 22  | 18     | 16     | 13     | 14     | 16      |
| P <sub>uw</sub> (CW)                     | dBm  | -55   | -55    | -55    | -55    | -55    | -55     |
| F <sub>uw</sub> (offset for Δf = 15 kHz) | MHz  | 0.9075  | 1.7025 | 2.7075 | 5.2125 | 7.7025 | 10.2075 |

|  |     |  |  |  |  |  |  |
|--|-----|--|--|--|--|--|--|
| $F_{uw}$ (offset for $\Delta f = 7.5$ kHz)   | MHz |  |  |  |  |  |  |
| <p>NOTE 1: The transmitter shall be set a 4 dB below <math>P_{C_{MAX,L}}</math> at the minimum uplink configuration specified in Table 7.3.1-2 with <math>P_{C_{MAX,L}}</math> as defined in subclause 6.2.5.</p> <p>NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.</p> <p>NOTE 3: The <math>P_{REFSENS}</math> power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.</p> <p>NOTE 4: For DL category M1 and M2 UE, the reference sensitivity for category M1 in table 7.3.1E-3 and category M2 in Table 7.3.1E-8 should be used as <math>P_{REFSENS}</math> for <math>P_w</math>.</p> <p>NOTE5: For DL category M1 and M2 UE, the parameters for the applicable channel bandwidth apply.</p> <p>NOTE6: For DL category M1 UE, the parameter, <math>P_w</math>, for all the channel bandwidth will be <math>P_{REFSENS} + 22</math> dBm.</p> <p>NOTE7: For DL category M2 UE, the parameter, <math>P_w</math>, for all channel bandwidths greater than 3 MHz will be <math>P_{REFSENS} + 16</math> dBm.</p> |     |  |  |  |  |  |  |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A,  $P_{UW}$  power defined in Table 7.6.3.1-1 is increased by the amount given by  $\Delta R_{IB,c}$  in Table 7.3.1-1A.

### 7.6.3.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the narrow-band blocking requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.3.1 for each component carrier while all downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the narrow-band blocking requirements of subclause 7.6.3.1A do not apply. For E-UTRA CA configurations with a component carrier assigned in Band 46, narrow-band blocking requirements do not apply in the presence of a narrow-band interferer in Band 46.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.6.3.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.6.3.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3.1A-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Table 7.6.3.1A-1.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, the narrow band blocking requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.6.3.1 and 7.6.3.1A for one component carrier and two component carriers per sub-block, respectively. The requirements apply for in-gap and out-of-gap interferers while all downlink carriers are active.

**Table 7.6.3.1A-1: Narrow-band blocking**

| Parameter   | Unit | CA Bandwidth Class                                |   |   |   |   |
|---|------|---|---|---|---|---|
|   |      | B   | C   | D   | E   | F   |
| $P_w$ in Transmission Bandwidth Configuration, per CC | dBm  | REFSENS + CA Bandwidth Class specific value below |   |   |   |   |
|   |      | 16  | 16 <sup>4</sup>                                   | 16  | 16  | 16  |
| $P_{uw}$ (CW)   | dBm  | -55   | -55   | -55   | -55   | -55   |
| $F_{uw}$ (offset for $\Delta f = 15$ kHz)             | MHz  | - $F_{offset} - 0.2$<br>/<br>+ $F_{offset} + 0.2$ | - $F_{offset} - 0.2$<br>/<br>+ $F_{offset} + 0.2$ | - $F_{offset} - 0.2$<br>/<br>+ $F_{offset} + 0.2$ | - $F_{offset} - 0.2$<br>/<br>+ $F_{offset} + 0.2$ | - $F_{offset} - 0.2$<br>/<br>+ $F_{offset} + 0.2$ |

|  |     |  |  |  |  |  |
|--|-----|--|--|--|--|--|
| $F_{uw}$ (offset for $\Delta f = 7.5$ kHz)   | MHz |  |  |  |  |  |
| <p>NOTE 1: The transmitter shall be set to 4dB below <math>P_{C_{MAX,L,c}}</math> or <math>P_{C_{MAX,L}}</math> as defined in subclause 6.2.5A.</p> <p>NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.</p> <p>NOTE 3: The <math>F_{uw}</math> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to <math>\lfloor F_{interferer} / (0.015 + 0.5) \rfloor \cdot 0.015 + 0.0075</math> MHz to be offset from the sub-carrier raster.</p> <p>NOTE 4: The requirement is applied for the band combinations whose component carriers' <math>BW \geq 5</math> MHz.</p> |     |  |  |  |  |  |

For combinations of intra-band and inter-band carrier aggregation and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in a band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For these uplink configurations, the UE shall meet the narrow-band blocking requirements for intra-band non-contiguous carrier aggregation with  $\Delta R_{IBNC} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) for the two or more non-contiguous downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.6.3. For E-UTRA CA configurations with component carriers assigned in Band 46, narrow-band blocking requirements do not apply in the presence of a narrow-band interferer in Band 46. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

### 7.6.3.1D Minimum requirements for ProSe

The relative throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Table 7.6.3.1D-1 and Table 7.6.3.1D-2.

**Table 7.6.3.1D-1: Narrow-band blocking for ProSe Direct Discovery**

| Parameter  | Unit | Channel Bandwidth   |       |        |        |        |         |
|--|------|---|-------|--------|--------|--------|---------|
|  |      | 1.4 MHz   | 3 MHz | 5 MHz  | 10 MHz | 15 MHz | 20 MHz  |
| $P_w$  | dBm  | $P_{REFSENS\_ProSe} + \text{channel-bandwidth specific value below} + P_{offset}$ |       |        |        |        |         |
|  |      |   |       | 16     | 13     | 14     | 16      |
| $P_{uw}$ (CW)  | dBm  |   |       | -55    | -55    | -55    | -55     |
| $P_{offset}$   |      | dB  |       |        | 10.9   | 13.9   | 15.7    |
| $F_{uw}$ (offset for $\Delta f = 15$ kHz)                          | MHz  |   |       | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| $F_{uw}$ (offset for $\Delta f = 7.5$ kHz)                         |      |   |       |        |        |        |         |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. |      |   |       |        |        |        |         |

**Table 7.6.3.1D-2: Narrow-band blocking for ProSe Direct Communication**

| Parameter  | Unit | Channel Bandwidth  |       |       |        |        |        |
|--|------|--|-------|-------|--------|--------|--------|
|  |      | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| $P_w$  | dBm  | $P_{REFSENS\_ProSe} + \text{channel-bandwidth specific value below}$ |       |       |        |        |        |
|  |      |  |       | 16    | 13     | 14     | 16     |
| $P_{uw}$ (CW)  | dBm  |  |       | -55   | -55    | -55    | -55    |
| $F_{uw}$ (offset for $\Delta f = 15$ kHz)                          |      | MHz  |       |       | 2.7075 | 5.2125 | 7.7025 |
| $F_{uw}$ (offset for $\Delta f = 7.5$ kHz)                         |      |  |       |       |        |        |        |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. |      |  |       |       |        |        |        |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A,  $P_{uw}$  power defined in Table 7.6.3.1D-1 and Table 7.6.3.1D-2 is increased by the amount given by  $\Delta R_{IB,c}$  in Table 7.3.1-1A.

## 7.6A Void

<Reserved for future use>

## 7.6B Blocking characteristics for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.6 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter  $P_{\text{CMAX}_L}$  is defined as the total transmitter power over the two transmit antenna connectors.

## 7.7 Spurious response

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in subclause 7.6.2 is not met.

### 7.7.1 Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNB Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7.1-1 and 7.7.1-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.7.1-1: Spurious response parameters**

| Rx parameter  | Units | Channel bandwidth                                |       |       |        |        |        |
|---|-------|--|-------|-------|--------|--------|--------|
|   |       | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration   | dBm   | REFSENS + channel bandwidth specific value below |       |       |        |        |        |
|   |       | 6  | 6     | 6     | 6      | 7      | 9      |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX}_L}$ at the minimum uplink configuration specified in Table 7.3.1-2.                     |       |  |       |       |        |        |        |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNB Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. |       |  |       |       |        |        |        |
| NOTE 3: The REFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.                            |       |  |       |       |        |        |        |

**Table 7.7.1-2: Spurious response**

| Parameter                          | Unit | Level                         |
|------------------------------------|------|-------------------------------|
| $P_{\text{Interferer}}(\text{CW})$ | dBm  | -44                           |
| $F_{\text{Interferer}}$            | MHz  | Spurious response frequencies |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A,  $P_{\text{interferer}}$  power defined in Table 7.7.1-2 is increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

### 7.7.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the spurious response requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The throughput measured in each downlink with  $F_{\text{interferer}}$  in Table 7.6.2.1A-0 and Table 7.6.2.1A-0a at spurious response frequencies shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNB Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7.1-1 and 7.7.1-2. The UE shall meet these requirements for each component carrier while all downlink carriers are active.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the spurious response requirements applicable specified above shall be met with the transmitter power for the uplink set to 7 dB below  $P_{\text{CMAX}_L,c}$  for each serving cell  $c$ .

For E-UTRA CA configurations including an operating band without uplink band or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the spurious response requirements of subclause 7.7.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.7.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The throughput of each carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7.1A-1 and 7.7.1A-2. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.7.1A-1 and 7.7.1A-2.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, the spurious response requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.7.1 and 7.7.1A for one component carrier and two component carriers per sub-block, respectively. The requirements apply with all downlink carriers active.

For intra-band non-contiguous carrier aggregation with two uplink carriers and two or more downlink carriers, the spurious response requirements applicable specified above shall be met with the transmitter powers for the uplinks set to  $P_{\text{CMAX}_L,c} - 7$  dBm.

**Table 7.7.1A-1: Spurious response parameters**

| Rx Parameter  | Units | CA Bandwidth Class                                |   |   |   |   |
|---|-------|---|---|---|---|---|
|   |       | B   | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC  | dBm   | REFSENS + CA Bandwidth Class specific value below |   |   |   |   |
|   |       | 9   | 9 | 9 | 9 | 9 |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX}_L,c}$ or $P_{\text{CMAX}_L}$ as defined in subclause 6.2.5A.                            |       |   |   |   |   |   |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. |       |   |   |   |   |   |

**Table 7.7.1A-2: Spurious response**

| Parameter                    | Unit | Level                         |
|------------------------------|------|-------------------------------|
| $P_{\text{Interferer}}$ (CW) | dBm  | -44                           |
| $F_{\text{Interferer}}$      | MHz  | Spurious response frequencies |

For combinations of intra-band and inter-band carrier aggregation and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in a band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. The downlink PCC shall be configured closer to the uplink operating band than the downlink SCC(s) when the uplink is active in band(s) supporting contiguous aggregation. For the two or more non-contiguous component carriers within the same band,  $P_{\text{wanted}}$  in Table 7.6.2.1A-0 is set using  $\Delta R_{\text{BNC}} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) while a band supporting contiguously aggregated carriers the out-of-band blocking parameters in Table 7.7.1-1 are replaced by those specified in Table 7.7.1A-1. For each downlink the UE shall meet the spurious-response requirements applicable for inter-band carrier aggregation with one component carrier per operating band. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

## 7.7.1B Minimum requirements for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.7.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter  $P_{\text{CMAX}_L}$  is defined as the total transmitter power over the two transmit antenna connectors.

## 7.7.1D Minimum requirements for ProSe

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Tables 7.7.1D-1, 7.7.1D-2, and 7.7.1D-3.

**Table 7.7.1D-1: Spurious response parameters for ProSe Direct Discovery**

| Rx parameter   | Units | Channel bandwidth   |       |       |        |        |        |
|--|-------|---|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | $P_{\text{REFSENS\_ProSe}} + \text{channel bandwidth specific value below} + P_{\text{offset}}$ |       |       |        |        |        |
|  |       |   |       | 6     | 6      | 7      | 9      |
| $P_{\text{offset}}$  | dB    |   |       | 10.9  | 13.9   | 15.7   | 16.9   |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. |       |   |       |       |        |        |        |

**Table 7.7.1D-2: Spurious response parameters for ProSe Direct Communication**

| Rx parameter   | Units | Channel bandwidth   |       |       |        |        |        |
|--|-------|---|-------|-------|--------|--------|--------|
|  |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | $P_{\text{REFSENS\_ProSe}} + \text{channel bandwidth specific value below}$ |       |       |        |        |        |
|  |       |   |       | 6     | 6      | 7      | 9      |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. |       |   |       |       |        |        |        |

**Table 7.7.1D-3: Spurious response for ProSe**

| Parameter                    | Unit | Level                         |
|------------------------------|------|-------------------------------|
| $P_{\text{Interferer (CW)}}$ | dBm  | -44                           |
| $F_{\text{Interferer}}$      | MHz  | Spurious response frequencies |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A,  $P_{\text{interferer}}$  power defined in Table 7.7.1D-3 is increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

## 7.7.1F Minimum requirements for UE category NB1 and NB2

The category NB1 and NB2 UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with parameters specified in Tables 7.7.1F-1.

**Table 7.7.1F-1: Spurious response parameters for UE category NB1 and NB2**

| Parameter  | Unit | Level                         |
|--|------|-------------------------------|
| $P_{\text{signal}}$  | dBm  | REFSENS+6                     |
| $P_{\text{Interferer (CW)}}$                                       | dBm  | -44                           |
| $F_{\text{Interferer}}$  | MHz  | Spurious response frequencies |
| Number of spurious response frequencies                            |      | 24 (in OOB range 1, 2, 3)     |
| NOTE 1: Reference measurement channel is specified in Annex A.3.2. |      |                               |
| NOTE 2: The REFSENS power level is specified in 7.3.1F.1-1.        |      |                               |
| NOTE 3: OOB range 1, 2, 3 refers to Table 7.6.2.1F-1.              |      |                               |



## 7.7.1G Minimum requirements for V2X

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Tables 7.7.1G-1.

**Table 7.7.1G-1: Spurious response parameters**

| Rx parameter   | Units | Channel bandwidth   |       |       |        |        |
|--|-------|---|-------|-------|--------|--------|
|  |       | 1.4 MHz   | 3 MHz | 5 MHz | 10 MHz | 15 MHz |
| Power in Transmission Bandwidth Configuration                      | dBm   | P <sub>REFSENS_V2X</sub> + channel bandwidth specific value below |       |       |        |        |
|  |       |   |       |       | 6      |        |
| NOTE 1: Reference measurement channel is specified in Annex A.8.2. |       |   |       |       |        |        |

**Table 7.7.1G-2: Spurious response**

| Parameter                    | Unit | Level                         |
|------------------------------|------|-------------------------------|
| P <sub>Interferer</sub> (CW) | dBm  | -44                           |
| F <sub>Interferer</sub>      | MHz  | Spurious response frequencies |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.7.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.7.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, the V2X UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Table 7.7.1G-3 and Table 7.7.1G-4.

**Table 7.7.1G-3: Spurious response parameters for intra-band contiguous multi-carrier for V2X UE**

| Rx Parameter  | Units | V2X Bandwidth Class                                |                   |   |   |   |
|---|-------|--|-------------------|---|---|---|
|   |       | B  | C/ C <sub>1</sub> | D | E | F |
| P <sub>w</sub> in Transmission Bandwidth Configuration, per CC  | dBm   | REFSENS + V2X Bandwidth Class specific value below |                   |   |   |   |
|   |       | 9  | 9                 |   |   |   |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. |       |  |                   |   |   |   |

**Tables 7.7.1G-4: Spurious response for intra-band contiguous multi-carrier for V2X UE**

| Parameter   | Unit | Level                         |
|---|------|-------------------------------|
| P <sub>Interferer</sub> (CW)  | dBm  | -44                           |
| F <sub>Interferer</sub>   | MHz  | Spurious response frequencies |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. |      |                               |

## 7.8 Intermodulation characteristics

Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

## 7.8.1 Wide band intermodulation

The wide band intermodulation requirement is defined following the same principles using modulated E-UTRA carrier and CW signal as interferer.

### 7.8.1.1 Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.8.1.1 for the specified wanted signal mean power in the presence of two interfering signals. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

**Table 7.8.1.1-1: Wide band intermodulation**

| Rx Parameter   | Units | Channel bandwidth                                |                                |                                 |        |        |        |
|--|-------|--|--------------------------------|---------------------------------|--------|--------|--------|
|  |       | 1.4 MHz  | 3 MHz                          | 5 MHz                           | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration  | dBm   | REFSENS + channel bandwidth specific value below |                                |                                 |        |        |        |
|  |       | 12   | 8                              | 6                               | 6      | 7      | 9      |
| $P_{\text{Interferer 1}}$ (CW)   | dBm   | -46  |                                |                                 |        |        |        |
| $P_{\text{Interferer 2}}$ (Modulated)  | dBm   | -46  |                                |                                 |        |        |        |
| $BW_{\text{Interferer 2}}$   |       | 1.4  | 3                              | 5                               |        |        |        |
| $F_{\text{Interferer 1}}$ (Offset)   | MHz   | -BW/2 -2.1<br>/<br>+BW/2+ 2.1                    | -BW/2 -4.5<br>/<br>+BW/2 + 4.5 | -BW/2 - 7.5<br>/<br>+BW/2 + 7.5 |        |        |        |
| $F_{\text{Interferer 2}}$ (Offset)   | MHz   | $2 * F_{\text{Interferer 1}}$                    |                                |                                 |        |        |        |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5.   |       |  |                                |                                 |        |        |        |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.  |       |  |                                |                                 |        |        |        |
| NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 with set-up according to Annex C.3.1The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth $\geq 5\text{MHz}$ . |       |  |                                |                                 |        |        |        |
| NOTE 4: The REFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively.   |       |  |                                |                                 |        |        |        |
| NOTE 5: For DL category M1 and M2 UE, the reference sensitivity for category M1 in table 7.3.1E-3 and category M2 in Table 7.3.1E-8 should be used as REFSENS for the power in Transmission Bandwidth Configuration.   |       |  |                                |                                 |        |        |        |
| NOTE6: For DL category M1 and M2 UE, the parameters for the applicable channel bandwidth apply, and BW refers to the corresponding channel bandwidth.  |       |  |                                |                                 |        |        |        |

For the UE which supports inter band CA configuration in Table 7.3.1-1A,  $P_{\text{interferer1}}$  and  $P_{\text{interferer2}}$  powers defined in Table 7.8.1.1-1 are increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

### 7.8.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the wide band intermodulation requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.8.1.1 for each component carrier while all downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band or an operating band with an unpaired DL part (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For a component carrier configured in Band 46 or Band 49, the requirements specified in subclause 7.8.1.1 are replaced by the requirements in Table 7.8.1-1A-0.

**Table 7.8.1.1A-0: Wide band intermodulation**

| E-UTRA band  | Rx Parameter                                  | Units                         | Channel bandwidth                                |       |       |                     |        |                         |
|--|---|-------------------------------|--|-------|-------|---------------------|--------|-------------------------|
|  |   |                               | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz              | 15 MHz | 20 MHz                  |
| 46   | Power in Transmission Bandwidth Configuration | dBm                           | REFSENS + channel bandwidth specific value below |       |       |                     |        |                         |
|  |   |                               |  |       | 6     |                     | 9      |                         |
|  | $P_{\text{Interferer 1 (CW)}}$                | dBm                           | -46  |       |       |                     |        |                         |
|  | $P_{\text{Interferer 2 (Modulated)}}$         | dBm                           | -46  |       |       |                     |        |                         |
|  | $BW_{\text{Interferer 2}}$                    |                               |  |       | 20    |                     | 20     |                         |
|  | $F_{\text{Interferer 1 (Offset)}}$            | MHz                           |  |       |       | -BW/2-30 / +BW/2+30 |        |                         |
| $F_{\text{Interferer 2 (Offset)}}$   | MHz   | $2 * F_{\text{Interferer 1}}$ |  |       |       |                     |        |                         |
| 49   | Power in Transmission Bandwidth Configuration | dBm                           |  |       |       | 6                   |        | 6                       |
|  |   |                               |  |       |       |                     |        |                         |
|  | $P_{\text{Interferer 1 (CW)}}$                | dBm                           | -46  |       |       |                     |        |                         |
|  | $P_{\text{Interferer 2 (Modulated)}}$         | dBm                           | -46  |       |       |                     |        |                         |
|  | $BW_{\text{Interferer 2}}$                    | MHz                           |  |       |       | 10                  |        | 20                      |
|  | $F_{\text{Interferer 1 (Offset)}}$            | MHz                           |  |       |       | -BW/2-15 / +BW/2+15 |        | -BW/2 - 30 / +BW/2 + 30 |
| $F_{\text{Interferer 2 (Offset)}}$   | MHz   | $2 * F_{\text{Interferer 1}}$ |  |       |       |                     |        |                         |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5.   |   |                               |  |       |       |                     |        |                         |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1.                           |   |                               |  |       |       |                     |        |                         |
| NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. |   |                               |  |       |       |                     |        |                         |

For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the wideband intermodulation requirements of subclause 7.8.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC, For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.8.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.8.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.8.1A-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.8.1A-1.

**Table 7.8.1A-1: Wide band intermodulation**

| Rx parameter                    | Units | CA Bandwidth Class                                |    |      |    |    |
|---------------------------------|-------|---|----|------|----|----|
|                                 |       | B   | C  | D    | E  | F  |
| $P_w$ in Transmission Bandwidth | dBm   | REFSENS + CA Bandwidth Class specific value below |    |      |    |    |
|                                 |       | 9   | 12 | 13.8 | 15 | 16 |

|   |     |  |  |  |  |  |
|---|-----|--|--|--|--|--|
| Configuration, per CC   |     |  |  |  |  |  |
| $P_{\text{Interferer 1 (CW)}}$  | dBm | -46  |  |  |  |  |
| $P_{\text{Interferer 2 (Modulated)}}$   | dBm | -46  |  |  |  |  |
| $BW_{\text{Interferer 2}}$  | MHz | 5  | 5  | 5  | 5  | 5  |
| $F_{\text{Interferer 1 (Offset)}}$  | MHz | $-F_{\text{offset}}-7.5$<br>/<br>$+ F_{\text{offset}}+7.5$ | $-F_{\text{offset}}-7.5$<br>/<br>$+ F_{\text{offset}}+7.5$ | $-F_{\text{offset}}-7.5$<br>/<br>$+ F_{\text{offset}}+7.5$ | $-F_{\text{offset}}-7.5$<br>/<br>$+ F_{\text{offset}}+7.5$ | $-F_{\text{offset}}-7.5$<br>/<br>$+ F_{\text{offset}}+7.5$ |
| $F_{\text{Interferer 2 (Offset)}}$  | MHz | $2 * F_{\text{Interferer 1}}$                              |  |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below $P_{\text{CMAX\_L,c}}$ or $P_{\text{CMAX\_L}}$ as defined in subclause 6.2.5A.  |     |  |  |  |  |  |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.   |     |  |  |  |  |  |
| NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 with set-up according to Annex C.3.1.  |     |  |  |  |  |  |
| NOTE 4: The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth $\geq 5\text{MHz}$ ;   |     |  |  |  |  |  |
| NOTE 5: The $F_{\text{Interferer 1}}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the CW interferer and $F_{\text{Interferer 2}}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the modulated interferer. |     |  |  |  |  |  |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two or more downlink sub-blocks, the wide band intermodulation requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.8.1.1 and in this subclause for one component carrier and two or more component carriers per sub-block, respectively. The requirements apply for out-of-gap interferers while all downlink carriers are active.

For combinations of intra-band and inter-band carrier aggregation and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in a band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two or more non-contiguous component carriers, Table 7.3.1A-1 when the uplink is active in a band supporting two contiguous component carriers and in accordance with Table 7.3.1-2 when the uplink is active in a band supporting one carrier per band. For these uplink configurations, the UE shall meet the wide-band intermodulation requirements for intra-band non-contiguous carrier aggregation with  $\Delta R_{\text{IBNC}} = 0$  dB for all sub-block gaps (Table 7.3.1A-3) for the two or more non-contiguous downlink sub-blocks, the requirements for intra-band contiguous carrier aggregation for the contiguously aggregated downlink carriers and for any remaining component carrier(s) the requirements specified in subclause 7.8.1. For contiguously aggregated component carriers configured in Band 46, the said requirements for intra-band contiguous carrier aggregation of two or more downlink carriers are replaced by requirements in Table 7.8.1A-2. For non-contiguously aggregated component carriers configured in Band 46, the said requirements are applied to each sub-block for out-of-gap interferers. For the sub-block with a single component carrier, the requirement is replaced by Table 7.8.1.1A-0. For the sub-block with two or more contiguous component carriers, the requirement is replaced by Table 7.8.1.1A-2. All downlink carriers shall be active throughout the tests and the requirements for the downlinks shall be met with the single uplink carrier active in each band capable of UL operation.

**Table 7.8.1A-2: Wide band intermodulation**

| E-UTRA Band                        | Rx parameter  | Units | CA Bandwidth Class                                |                                  |                                  |    |   |
|------------------------------------|---|-------|---|----------------------------------|----------------------------------|----|---|
|                                    |   |       | B   | C                                | D                                | E  | F |
| 46                                 | Power per CC in Aggregated Transmission Bandwidth Configuration | dBm   | REFSENS + CA Bandwidth Class specific value below |                                  |                                  |    |   |
|                                    |   |       |   | 12                               | 13.8                             | 15 |   |
|                                    | $P_{\text{Interferer 1 (CW)}}$                                  | dBm   | -46   |                                  |                                  |    |   |
|                                    | $P_{\text{Interferer 2 (Modulated)}}$                           | dBm   | -46   |                                  |                                  |    |   |
|                                    | $BW_{\text{Interferer 2}}$                                      | MHz   |   | 20                               | 20                               | 20 |   |
| $F_{\text{Interferer 1 (Offset)}}$ | MHz   |       | $-F_{\text{offset}}-30$<br>/<br>                  | $-F_{\text{offset}}-30$<br>/<br> | $-F_{\text{offset}}-30$<br>/<br> |    |   |

|   |                                       |     |                             |                           |                           |  |
|---|---------------------------------------|-----|-----------------------------|---------------------------|---------------------------|--|
|   |                                       |     | + F <sub>offset</sub> +30   | + F <sub>offset</sub> +30 | + F <sub>offset</sub> +30 |  |
|   | F <sub>Interferer 2</sub><br>(Offset) | MHz | 2*F <sub>Interferer 1</sub> |                           |                           |  |
| NOTE 1: The transmitter shall be set to 4dB below P <sub>C<sub>MAX</sub>L,c</sub> or P <sub>C<sub>MAX</sub>L</sub> as defined in subclause 6.2.5A.  |                                       |     |                             |                           |                           |  |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1.   |                                       |     |                             |                           |                           |  |
| NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD/FS3 as described in Annex A.5.1.1/A.5.2.1/A.5.4.1 with set-up according to Annex C.3.1.  |                                       |     |                             |                           |                           |  |
| NOTE 4: The interfering modulated signal is 20 MHz E-UTRA signal as described in Annex D interference setting 2;  |                                       |     |                             |                           |                           |  |
| NOTE 5: The F <sub>interferer 1</sub> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the CW interferer and F <sub>interferer 2</sub> (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the modulated interferer. |                                       |     |                             |                           |                           |  |

### 7.8.1B Minimum requirements for UL-MIMO

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.8.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter P<sub>C<sub>MAX</sub>L</sub> is defined as the total transmitter power over the two transmit antenna connectors.

### 7.8.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Table 7.8.1D-1, Table 7.8.1D-2, and Table 7.8.1D-3 for the specified wanted signal mean power in the presence of two interfering signals

**Table 7.8.1D-1: Wide band intermodulation parameters for ProSe Direct Discovery**

| Rx parameter        | Units | Channel bandwidth |       |       |        |        |        |
|---------------------|-------|-------------------|-------|-------|--------|--------|--------|
|                     |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| P <sub>offset</sub> | dB    |                   |       | 10.9  | 13.9   | 15.7   | 16.9   |

**Table 7.8.1D-2: Wide band intermodulation for ProSe Direct Communication**

| Rx parameter        | Units | Channel bandwidth |       |       |        |        |        |
|---------------------|-------|-------------------|-------|-------|--------|--------|--------|
|                     |       | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| P <sub>offset</sub> | dB    |                   |       | 0     | 0      | 0      | 0      |

**Table 7.8.1D-3: Wide band intermodulation for ProSe**

| Rx Parameter  | Units | Channel bandwidth  |                                |                                 |        |        |        |
|---|-------|--|--------------------------------|---------------------------------|--------|--------|--------|
|   |       | 1.4 MHz  | 3 MHz                          | 5 MHz                           | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration   | dBm   | P <sub>REFSENS_ProSe</sub> + channel bandwidth specific value below+ P <sub>offset</sub> |                                |                                 |        |        |        |
|   |       | 12   | 8                              | 6                               | 6      | 7      | 9      |
| P <sub>Interferer 1</sub> (CW)  | dBm   | -46  |                                |                                 |        |        |        |
| P <sub>Interferer 2</sub> (Modulated)   | dBm   | -46  |                                |                                 |        |        |        |
| BW <sub>Interferer 2</sub>  |       | 1.4  | 3                              | 5                               |        |        |        |
| F <sub>Interferer 1</sub> (Offset)  | MHz   | -BW/2 -2.1<br>/<br>+BW/2+ 2.1  | -BW/2 -4.5<br>/<br>+BW/2 + 4.5 | -BW/2 - 7.5<br>/<br>+BW/2 + 7.5 |        |        |        |
| F <sub>Interferer 2</sub> (Offset)  | MHz   | 2*F <sub>Interferer 1</sub>  |                                |                                 |        |        |        |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2   |       |  |                                |                                 |        |        |        |
| NOTE 2: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 |       |  |                                |                                 |        |        |        |

For the UE which supports inter band CA configuration in Table 7.3.1-1A,  $P_{\text{interferer1}}$  and  $P_{\text{interferer2}}$  powers defined in Table 7.8.1D-3 are increased by the amount given by  $\Delta R_{\text{IB,c}}$  in Table 7.3.1-1A.

## 7.8.1F Minimum requirements for category NB1 and NB2

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with parameters specified in Table 7.8.1F-1 for the specified wanted signal mean power in the presence of two interfering signals.

**Table 7.8.1F-1: Wide band intermodulation for category NB1 and NB2**

| Parameters for wideband intermodulation |                 |
|---|-----------------|
| Category NB1 or NB2 signal power        | REFSENS + 12 dB |
| CW interferer signal power              | - 46 dBm        |
| 1.4 MHz E-UTRA interferer signal power  | - 46 dBm        |
| CW interferer offset                    | $\pm 2.2$ MHz   |
| 1.4 MHz E-UTRA interferer offset        | $\pm 4.4$ MHz   |

## 7.8.1G Minimum requirements

The throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Table 7.8.1G-1 for the specified wanted signal mean power in the presence of two interfering signals

**Table 7.8.1G-1: Wide band intermodulation**

| Rx Parameter  | Units | Channel bandwidth  |       |       |                                     |        |                                     |
|---|-------|--|-------|-------|-------------------------------------|--------|-------------------------------------|
|   |       | 1.4 MHz  | 3 MHz | 5 MHz | 10 MHz                              | 15 MHz | 20 MHz                              |
| Power in Transmission Bandwidth Configuration   | dBm   | $P_{\text{REFSENS\_V2X}}$ + channel bandwidth specific value below |       |       |                                     |        |                                     |
|   |       |  |       |       | 6                                   |        | 9                                   |
| $P_{\text{Interferer 1}}$ (CW)  | dBm   | -46  |       |       |                                     |        |                                     |
| $P_{\text{Interferer 2}}$ (Modulated)   | dBm   | -46  |       |       |                                     |        |                                     |
| $BW_{\text{Interferer 2}}$  |       |  |       |       | 10                                  |        | 10                                  |
| $F_{\text{Interferer 1}}$ (Offset)  | MHz   |  |       |       | -BW/2 –<br>15<br>/<br>+BW/2 +<br>15 |        | -BW/2 –<br>15<br>/<br>+BW/2 +<br>15 |
| $F_{\text{Interferer 2}}$ (Offset)  | MHz   | $2 * F_{\text{Interferer 1}}$                                      |       |       |                                     |        |                                     |
| NOTE 1: Reference measurement channel is specified in Annex A.8.2   |       |  |       |       |                                     |        |                                     |
| NOTE 2: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 |       |  |       |       |                                     |        |                                     |

When UE is configured for simultaneous E-UTRA V2X sidelink and E-UTRA downlink reception for inter-band E-UTRA V2X / E-UTRA bands specified in Table 5.5G-2, the requirements in subclause 7.8.1G apply for the E-UTRA V2X sidelink reception and the requirements in subclause 7.8.1 apply for the E-UTRA downlink reception while all downlink carriers are active.

For intra-band contiguous multi-carrier operation, the V2X UE throughput shall be  $\geq 95\%$  of the maximum throughput of the reference measurement channels as specified in Annex A.8.2 with parameters specified in Table 7.8.1G-2 for the specified wanted signal mean power in the presence of two interfering signals.

**Table 7.8.1G-2: Wide band intermodulation for intra-band contiguous multi-carrier for V2X UE**

| Rx parameter  | Units | V2X Bandwidth Class  |  |   |   |   |
|---|-------|--|--|---|---|---|
|   |       | B  | C/ C <sub>1</sub>  | D | E | F |
| P <sub>w</sub> in<br>Transmission<br>Bandwidth<br>Configuration, per<br>CC  | dBm   | REFSENS + V2X Bandwidth Class specific value below         |  |   |   |   |
|   |       | 9  | 12   |   |   |   |
| P <sub>Interferer 1</sub><br>(CW)   | dBm   | -46  |  |   |   |   |
| P <sub>Interferer 2</sub><br>(Modulated)  | dBm   | -46  |  |   |   |   |
| BW <sub>Interferer 2</sub>  | MHz   | 10   | 10   |   |   |   |
| F <sub>Interferer 1</sub><br>(Offset)   | MHz   | -F <sub>offset</sub> -15<br>/<br>+ F <sub>offset</sub> +15 | -F <sub>offset</sub> -15<br>/<br>+ F <sub>offset</sub> +15 |   |   |   |
| F <sub>Interferer 2</sub><br>(Offset)   | MHz   | 2*F <sub>Interferer 1</sub>                                |  |   |   |   |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. |       |  |  |   |   |   |

## 7.8.2 Void

## 7.9 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

### 7.9.1 Minimum requirements

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.1-1

**Table 7.9.1-1: General receiver spurious emission requirements**

| Frequency band  | Measurement bandwidth | Maximum level | NOTE |
|---|-----------------------|---------------|------|
| 30MHz ≤ f < 1GHz  | 100 kHz               | -57 dBm       |      |
| 1GHz ≤ f ≤ 12.75 GHz  | 1 MHz                 | -47 dBm       |      |
| 12.75 GHz ≤ f ≤ 5 <sup>th</sup> harmonic of the upper frequency edge of the DL operating band in GHz                                    | 1 MHz                 | -47 dBm       | 1    |
| 12.75 GHz – 26GHz   | 1 MHz                 | -47dBm        | 3    |
| NOTE 1: Applies only for Band 22, Band 42, Band 43, Band 48 and Band 49   |                       |               |      |
| NOTE 2: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1. |                       |               |      |
| NOTE 3: Applies for Band 46 and Band 47   |                       |               |      |

In addition, for a V2X UE operating in Region 1, the power of any spurious emission shall not exceed the levels specified in Table 7.9.1-2.

**Table 7.9.1-2: Additional RX spurious emissions limits in Region 1**

| Frequency Range  | Maximum Level  | Measurement bandwidth | NOTE |
|--|----------------|-----------------------|------|
| 5795 MHz ≤ f < 5815MHz   | -65 dBm (EIRP) | 1 MHz                 |      |
| NOTE: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain G <sub>post connector</sub> declared by the UE following the principle described in annex I. The additional Rx spurious emission limits, only apply when the network signaling value NS_33 or NS_34 is indicated. |                |                       |      |

## 7.9.1A Minimum requirements

For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.1A-1.

**Table 7.9.1A-1: General receiver spurious emission requirements**

| Frequency band  | Measurement bandwidth | Maximum level | NOTE |
|---|-----------------------|---------------|------|
| $30\text{MHz} \leq f < 1\text{GHz}$   | 100 kHz               | -57 dBm       |      |
| $1\text{GHz} \leq f \leq 12.75\text{GHz}$   | 1 MHz                 | -47 dBm       |      |
| $12.75\text{GHz} \leq f \leq 26\text{GHz}$  | 1 MHz                 | -47 dBm       | 3    |
| NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1. |                       |               |      |
| NOTE 2: The requirements apply when the UE is configured for carrier aggregation but is not transmitting.                               |                       |               |      |
| NOTE 3: Applies only for Band 46  |                       |               |      |

## 7.10 Receiver image

### 7.10.1 Void

#### 7.10.1A Minimum requirements for CA

Receiver image rejection is a measure of a receiver's ability to receive the E-UTRA signal on one component carrier while it is also configured to receive an adjacent aggregated carrier. Receiver image rejection ratio is the ratio of the wanted received power on a sub-carrier being measured to the unwanted image power received on the same sub-carrier when both sub-carriers are received with equal power at the UE antenna connector.

For intra-band contiguous carrier aggregation the UE shall fulfil the minimum requirement specified in Table 7.10.1A-1 for all values of aggregated input signal up to  $-22$  dBm.

**Table 7.10.1A-1: Receiver image rejection**

| Rx parameter             | Units | CA bandwidth class |    |    |    |    |    |
|--------------------------|-------|--------------------|----|----|----|----|----|
|                          |       | A                  | B  | C  | D  | E  | F  |
| Receiver image rejection | dB    |                    | 25 | 25 | 25 | 25 | 25 |

#### 7.10.1G Minimum requirements for V2X Communication

Receiver image rejection is a measure of a receiver's ability to receive the E-UTRA V2X signal on one component carrier while it is also configured to receive another aggregated carrier. Receiver image rejection ratio is the ratio of the wanted received power on a sub-carrier being measured to the unwanted image power received on the same sub-carrier when both sub-carriers are received with equal power at the UE antenna connector.

For intra-band contiguous multi-carrier operation, the UE shall fulfil the minimum requirement specified in Table 7.10.1G-1 for all values of aggregated input signal.

**Table 7.10.1G-1: Receiver image rejection**

| Rx parameter | Units | V2X Bandwidth Class |   |                   |   |   |   |
|--------------|-------|---------------------|---|-------------------|---|---|---|
|              |       | A                   | B | C/ C <sub>1</sub> | D | E | F |



|   |    |  |    |    |  |  |  |
|---|----|--|----|----|--|--|--|
| Receiver image rejection  | dB |  | 30 | 30 |  |  |  |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. |    |  |    |    |  |  |  |

## 8 Performance requirement

This clause contains performance requirements for the physical channels specified in TS 36.211 [4]. The performance requirements for the UE in this clause are specified for the measurement channels specified in Annex A.3, the propagation conditions in Annex B and the downlink channels in Annex C.3.2.

NOTE: For the requirements in the following sections, similar Release 8 and 9 requirements apply for time domain measurements restriction under colliding CRS.

### 8.1 General

#### 8.1.1 Receiver antenna capability

The performance requirements are based on UE(s) that utilize one or more antenna receivers.

For all test cases, the SNR is defined as

$$SNR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

where  $N_{RX}$  denotes the number of receiver antenna connectors and the superscript receiver antenna connector  $j$ . The above SNR definition assumes that the REs are not precoded. The SNR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in Table C.3.2-1. The SNR requirement applies for the UE categories and CA capabilities given for each test.

For enhanced performance requirements type A, the SINR is defined as

$$SINR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)'}}$$

where  $N_{RX}$  denotes the number of receiver antenna connectors and the superscript receiver antenna connector  $j$ . The above SINR definition assumes that the REs are not precoded. The SINR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in Table C.3.2-1. The SINR requirement applies for the UE categories given for each test.

For the performance requirements specified in this clause, it is assumed that  $N_{RX}=2$  unless otherwise stated.

**Table 8.1.1-1: Void**

8.1.1.1 Simultaneous unicast and MBMS operations

8.1.1.2 Dual-antenna receiver capability in idle mode

8.1.2 Applicability of requirements

8.1.2.1 Applicability of requirements for different channel bandwidths

In Clause 8 the test cases may be defined with different channel bandwidth to verify the same target FRC conditions with the same propagation conditions, correlation matrix and antenna configuration.

Test cases defined for 5MHz channel bandwidth that reference this clause are applicable to UEs that support only Band 31, 72, 73, 87 and/or 88.

8.1.2.2 Definition of CA capability

The definition with respect to CA capabilities for 2CCs is given as in Table 8.1.2.2-1. The definition with respect to CA capabilities for 3CCs is given in Table 8.1.2.2-3.

**Table 8.1.2.2-1: Definition of CA capability with 2DL CCs**

| CA Capability  | CA Capability Description                          |
|--|--|
| CA2_C  | Intra-band contiguous CA                           |
| CA2_A2   | Inter-band CA (two bands)                          |
| CA2_N2   | Intra-band non-contiguous CA (with two sub-blocks) |
| NOTE 1: CA2_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 2 DL CCs.<br>CA2_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 2 DL CCs.<br>CA2_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 2 DL CCs. |  |

The supported testable aggregated CA bandwidth combinations for 2CCs for each CA capability are listed in Table 8.1.2.2-2.

**Table 8.1.2.2-2: Supported testable aggregated CA bandwidth combinations for different CA capability with 2DL CCs**

| CA Capability  | Bandwidth combination for FDD CA                          | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA                       | Bandwidth combination for CA with LAA SCell(s)                                 |
|--|---|----------------------------------|--|--|
| CA2_C  | 5+5MHz, 5+10MHz, 5+15MHz, 10+10MHz, 20+20MHz              | 20+20MHz, 15+20MHz               | NA   | NA   |
| CA2_A2   | 10+10MHz, 20+5MHz, 10+15MHz, 10+20MHz, 15+20MHz, 20+20MHz | 20+20MHz                         | 10(FDD)+20(TDD)MHz, 15(FDD)+20(TDD)MHz, 20(FDD)+20(TDD)MHz | 20(FDD)+20(LAA)MHz, 10(FDD)+20(LAA)MHz, 15(FDD)+20(LAA)MHz, 20(TDD)+20(LAA)MHz |
| CA2_N2   | 5+10MHz, 10+10MHz, 10+20MHz, 20+20MHz                     | 20+20MHz                         | NA   | NA   |
| NOTE 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2. |   |                                  |  |  |

**Table 8.1.2.2-3: Definition of CA capability with 3 DL CCs**

| CA Capability | CA Capability Description  |
|---------------|--|
| CA3_C         | Intra-band contiguous CA   |
| CA3_A2        | Inter-band CA (two bands)  |
| CA3_A3        | Inter-band CA (three bands)  |
| CA3_N2        | Intra-band non-contiguous CA (with two sub-blocks)   |
| NOTE 1:       | CA3_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 3 DL CCs.<br>CA3_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 3 DL CCs.<br>CA3_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 3 DL CCs.<br>CA3_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 3 DL CCs. |

The supported testable largest aggregated CA bandwidth combinations for 3CCs for each CA capability are listed in Table 8.1.2.2-4.

**Table 8.1.2.2-4: Supported largest aggregated CA bandwidth combinations for different CA capability with 3 CCs**

| CA capability | Bandwidth combination for FDD CA   | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA  | Bandwidth combination for CA with LAA SCell(s)  |
|---------------|--|----------------------------------|---|---|
| CA3_C         | NA   | 20+20+20MHz                      | NA  | NA  |
| CA3_A2        | 5+5+10MHz,<br>5+10+10MHz,<br>5+5+20MHz,<br>10+10+10MHz,<br>5+10+20MHz,<br>5+15+20MHz,<br>10+10+20MHz,<br>10+20+20MHz,<br>15+20+20MHz,<br>20+20+20MHz | 15+20+20MHz,<br>20+20+20MHz      | 10(FDD)+20(TDD)+20(TDD)MHz<br>15(FDD)+20(TDD)+20(TDD)MHz,<br>20(FDD)+20(TDD)+20(TDD)MHz   | 10(FDD)+ 2x20(LAA)MHz,<br>15(FDD)+ 2x20(LAA)MHz,<br>20(FDD)+ 2x20(LAA)MHz,<br>20(TDD)+ 2x20(LAA)MHz |
| CA3_A3        | 10+10+20MHz,<br>10+15+15MHz,<br>10+15+20MHz,<br>10+20+20MHz,<br>15+15+20MHz,<br>15+20+20MHz,<br>20+20+20MHz  | NA                               | 2x20(FDD)+20(TDD)MHz,<br>20(FDD)+ 2x20(TDD)MHz,<br>20(FDD)+15(FDD)+20(TDD)MHz,<br>20(FDD)+10(FDD)+20(TDD)MHz,<br>2x15(FDD)+20(TDD)MHz | NA  |
| CA3_N2        | NA   | 20+20+20MHz                      | NA  | NA  |
| NOTE 1:       | This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2.             |                                  |   |   |

**Table 8.1.2.2-5: Definition of CA capability with 4 DL CCs**

| CA Capability | CA Capability Description  |
|---------------|--|
| CA4_C         | Intra-band contiguous CA   |
| CA4_A2        | Inter-band CA (two bands)  |
| CA4_A3        | Inter-band CA (three bands)  |
| CA4_A4        | Inter-band CA (four bands)   |
| CA4_N2        | Intra-band non-contiguous CA (with two sub-blocks)   |
| NOTE 1:       | CA4_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 3 DL CCs.<br>CA4_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 3 DL CCs.<br>CA4_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 3 DL CCs.<br>CA4_A4 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2b for 4 DL CCs |

CA4\_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 3 DL CCs.

The supported testable largest aggregated CA bandwidth combinations for 4CCs for each CA capability are listed in Table 8.1.2.2-6.

**Table 8.1.2.2-6: Supported largest aggregated CA bandwidth combinations for different CA capability with 4 CCs**

| CA capability | Bandwidth combination for FDD CA  | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA   | Bandwidth combination for CA with LAA SCell(s)  |
|---------------|---|----------------------------------|--|---|
| CA4_C         | NA  | 20+20+20+20MHz                   | NA   | NA  |
| CA4_A2        | 24x20MHz<br>10+3x20MHz<br>2x10+2x20MHz<br>210+5+2x20MHz<br>2x5+2x20MHz<br>3x10+20MHz<br>4x10MHz                                     | 20+20+20+20MHz<br>15+20+20+20MHz | 20(FDD)+3x20(TDD)MHz<br>2x20(FDD)+2x20(TDD)MHz<br>10(FDD)+3x20(TDD)MHz<br>2x10(FDD)+2x20(TDD)MHz<br>2x10(FDD)+20+15(TDD)MHz  | 10(FDD)+ 3x20(LAA)MHz,<br>15(FDD)+ 3x20(LAA)MHz,<br>20(FDD)+ 3x20(LAA)MHz,<br>20(TDD)+ 3x20(LAA)MHz |
| CA4_A3        | 24x20MHz<br>15+3x20MHz<br>210+3x20MHz<br>2x10+2x20MHz<br>5+10+2x20MHz<br>2x5+2x20MHz<br>3x10+20MHz<br>25+2x10+20MHz<br>2x5+10+20MHz | NA                               | 20(FDD)+3x20(TDD)MHz<br>2x20(FDD)+2x20(TDD)MHz,<br>3x20(FDD)+20(TDD)MHz<br>20(FDD)+15(FDD)+2x20(TDD)MHz,<br>2x15(FDD)+2x20(TDD)MHz<br>10(FDD)+20(FDD)+2x20(TDD)MHz<br>10(FDD)+3x20(TDD)MHz<br>10(FDD)+15(FDD)+2x20(TDD)MHz<br>2x10(FDD)+2x20(TDD)MHz | NA  |
| CA4_A4        | 24x20MHz<br>15+3x20MHz<br>210+3x20MHz<br>2x15+2x20MHz<br>10+15+2x20MHz<br>22x10+2x20MHz   | NA                               | 3x20(FDD)+20(TDD)MHz<br>2x20(FDD)+15(FDD)+20(TDD)MHz,<br>2x15(FDD)+20(FDD)+20(TDD)MHz<br>2x20(FDD)+10(FDD)+20(TDD)MHz<br>10(FDD)+20(FDD)+2x20(TDD)MHz<br>10(FDD)+15(FDD)+20(FDD)+20(TDD)MHz  | NA  |
| CA4_N2        | NA  | 20+20+20+20MHz                   | NA   | NA  |

NOTE 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2.

**Table 8.1.2.2-7: Definition of CA capability with 5 DL CCs**

| CA Capability | CA Capability Description                          |
|---------------|--|
| CA5_C         | Intra-band contiguous CA                           |
| CA5_A2        | Inter-band CA (two bands)                          |
| CA5_A3        | Inter-band CA (three bands)                        |
| CA5_A4        | Inter-band CA (four bands)                         |
| CA5_A5        | Inter-band CA (five bands)                         |
| CA5_N2        | Intra-band non-contiguous CA (with two sub-blocks) |

NOTE 1: CA5\_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 5 DL CCs.  
 CA5\_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 5 DL CCs.  
 CA5\_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 5 DL CCs.  
 CA5\_A4 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2b for 5 DL CCs  
 CA5\_A5 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2c for 5 DL CCs  
 CA5\_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 5 DL CCs.

The supported testable largest aggregated CA bandwidth combinations for 5CCs for each CA capability are listed in Table 8.1.2.2-8.

**Table 8.1.2.2-8: Supported largest aggregated CA bandwidth combinations for different CA capability with 5 CCs**

| CA capability | Bandwidth combination for FDD CA  | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA   | Bandwidth combination for CA with LAA SCell(s)  |
|---------------|---|----------------------------------|--|---|
| CA5_C         | NA  | 5x20MHz                          | NA   | NA  |
| CA5_A2        | 5x20MHz<br>3x20+2x10MHz<br>20+4x10MHz   | 5x20MHz<br>15+4x20MHz            | 2x20(FDD)+3x20(TDD)<br>20(FDD)+4x20(TDD)MHz<br>2x10(FDD)+3x20(TDD)MH   | 10(FDD)+<br>4x20(LAA)MHz,<br>15(FDD)+<br>4x20(LAA)MHz,<br>20(FDD)+<br>4x20(LAA)MHz,<br>20(TDD)+<br>4x20(LAA)MHz |
| CA5_A3        | 5x20MHz<br>10+4x20MHz<br>2x10+3x20MHz<br>5+10+3x20MHz<br>3x10+2x20MHz<br>4x10+20MHz | NA                               | 3x20(FDD)+2x20(TDD)MHz<br>20(FDD)+4x20(TDD)MHz<br>2x20(FDD)+3x20(TDD)MHz<br>10(FDD)+4x20(TDD)MHz   | NA  |
| CA5_A4        | 5x20MHz<br>15+4x20MHz<br>10+4x20MHz<br>2x10+3x20MHz<br>3x10+2x20MHz                 | NA                               | 3x20(FDD)+2x20(TDD)MHz<br>15+2x20(FDD)+2x20(TDD)MHz<br>0+2x20(FDD)+2x20(TDD)MHz<br>2x15+20(FDD)+2x20(TDD)MHz<br>10+15+20(FDD)+2x20(TDD)MHz<br>10+20(FDD)+3x20MHz | NA  |
| CA5_A5        | 5x20MHz   | NA                               | 4x20(FDD)+20(TDD)MHz   | NA  |
| CA5_N2        | NA  | 5x20MHz                          | NA   | NA  |

NOTE 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2.

**Table 8.1.2.2-9: Definition of CA capability with 6 DL CCs**

| CA Capability | CA Capability Description                          |
|---------------|--|
| CA6_C         | Intra-band contiguous CA                           |
| CA6_A2        | Inter-band CA (two bands)                          |
| CA6_A3        | Inter-band CA (three bands)                        |
| CA6_A4        | Inter-band CA (four bands)                         |
| CA6_A5        | Inter-band CA (five bands)                         |
| CA6_N2        | Intra-band non-contiguous CA (with two sub-blocks) |

NOTE 1: CA6\_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 6 DL CCs.  
 CA5\_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 6 DL CCs.  
 CA5\_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 6 DL CCs.  
 CA5\_A4 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2b for 6 DL CCs  
 CA5\_A5 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2c for 6 DL CCs  
 CA5\_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 6 DL CCs.

The supported testable largest aggregated CA bandwidth combinations for 6CCs for each CA capability are listed in Table 8.1.2.2-10.

**Table 8.1.2.2-10: Supported largest aggregated CA bandwidth combinations for different CA capability with 6 CCs**

| CA capability | Bandwidth combination for FDD CA | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA           | Bandwidth combination for CA with LAA SCell(s)  |
|---------------|----------------------------------|----------------------------------|--|---|
| CA6_C         | NA                               | NA                               | NA   | NA  |
| CA6_A2        | NA                               | 6x20MHz                          | 20(FDD)+5x20(TDD)MHz<br>2x20(FDD)+4x20(TDD)MHz | 10(FDD)+ 5x20(LAA)MHz,<br>15(FDD)+ 5x20(LAA)MHz,<br>20(FDD)+ 5x20(LAA)MHz,<br>20(TDD)+ 5x20(LAA)MHz |
| CA6_A3        | NA                               | NA                               | 20(FDD)+5x20(TDD)MHz<br>2x20(FDD)+4x20(TDD)MHz | NA  |
| CA6_A4        | 6x20MHz                          | NA                               | 20(FDD)+5x20(TDD)MHz<br>2x20(FDD)+4x20(TDD)MHz | NA  |
| CA6_A5        | NA                               | NA                               | NA   | NA  |
| CA6_N2        | NA                               | NA                               | NA   | NA  |

NOTE 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2.

**Table 8.1.2.2-11: Definition of CA capability with 7 DL CCs**

| CA Capability | CA Capability Description                          |
|---------------|--|
| CA7_C         | Intra-band contiguous CA                           |
| CA7_A2        | Inter-band CA (two bands)                          |
| CA7_A3        | Inter-band CA (three bands)                        |
| CA7_A4        | Inter-band CA (four bands)                         |
| CA7_A5        | Inter-band CA (five bands)                         |
| CA7_N2        | Intra-band non-contiguous CA (with two sub-blocks) |

NOTE 1: CA6\_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 7 DL CCs.  
CA5\_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 7 DL CCs.  
CA5\_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 7 DL CCs.  
CA5\_A4 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2b for 7 DL CCs  
CA5\_A5 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2c for 7 DL CCs  
CA5\_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 7 DL CCs.

The supported testable largest aggregated CA bandwidth combinations for 7CCs for each CA capability are listed in Table 8.1.2.2-12.

**Table 8.1.2.2-12: Supported largest aggregated CA bandwidth combinations for different CA capability with 7 CCs**

| CA capability | Bandwidth combination for FDD CA | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA           | Bandwidth combination for CA with LAA SCell(s)  |
|---------------|----------------------------------|----------------------------------|--|---|
| CA7_C         | NA                               | NA                               | NA   | NA  |
| CA7_A2        | NA                               | 7x20MHz                          | 20(FDD)+6x20(TDD)MHz<br>2x20(FDD)+5x20(TDD)MHz | 10(FDD)+ 6x20(LAA)MHz,<br>15(FDD)+ 6x20(LAA)MHz,<br>20(FDD)+ 6x20(LAA)MHz,<br>20(TDD)+ 6x20(LAA)MHz |
| CA7_A3        | NA                               | NA                               | 20(FDD)+6x20(TDD)MHz<br>2x20(FDD)+5x20(TDD)MHz | NA  |
| CA7_A4        | 7x20MHz                          | NA                               | 20(FDD)+6x20(TDD)MHz<br>2x20(FDD)+5x20(TDD)MHz | NA  |
| CA7_A5        | NA                               | NA                               | NA   | NA  |

|  |    |    |    |    |
|--|----|----|----|----|
| CA7_N2   | NA | NA | NA | NA |
| NOTE 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2. |    |    |    |    |

For test cases with more than one component carrier, "Fraction of Maximum Throughput" in the performance requirement refers to the ratio of the sum of throughput values of all component carriers to the sum of the nominal maximum throughput values of all component carriers, unless otherwise stated.

### 8.1.2.2A Definition of dual connectivity capability

The definition with respect to dual connectivity capabilities for configurations with 2CCs is given as in Table 8.1.2.2A-1. The definition with respect to dual connectivity capabilities for configurations with 3CCs is given as in Table 8.1.2.2A-3.

**Table 8.1.2.2A-1: Definition of dual connectivity capability with 2DL CCs**

| Dual connectivity Capability   | Dual connectivity capability Description |
|--|--|
| DC_A_2   | Inter-band dual connectivity (two bands) |
| NOTE 1: DC_A_2 corresponds to E-UTRA dual connectivity configurations and bandwidth combination sets defined for inter-band dual connectivity (two bands) as specified in 5.6C . |  |

The supported testable dual connectivity bandwidth combinations for 2CCs for each dual connectivity capability are listed in Table 8.1.2.2A-2.

**Table 8.1.2.2A-2: Supported testable dual connectivity bandwidth combinations for different dual connectivities capability with 2DL CCs**

| Dual connectivity capability  | Bandwidth combination for FDD dual connectivity           | Bandwidth combination for TDD dual connectivity | Bandwidth combination for TDD-FDD dual connectivity |
|---|---|---|---|
| DC_A_2  | 10+10MHz, 10+20MHz, 15+15MHz, 15+20MHz, 20+20MHz, 15+5MHz | 20+20MHz  | 20(FDD)+20(TDD)MHz                                  |
| NOTE 1: This table is only for information and applicability and test rules of dual connectivity performance requirements are specified in 8.1.2.3A |   |   |   |

**Table 8.1.2.2A-3: Definition of dual connectivity capability with 3DL CCs**

| Dual connectivity Capability  | Dual connectivity capability Description   |
|---|--|
| DC_A_3  | Inter-band dual connectivity (three bands) |
| NOTE 1: DC_A_3 corresponds to E-UTRA dual connectivity configurations and bandwidth combination sets defined for inter-band dual connectivity (three bands) as specified in 5.6C. |  |

The supported testable dual connectivity bandwidth combinations for 3CCs for each dual connectivity capability are listed in Table 8.1.2.2A-4.

**Table 8.1.2.2A-4: Supported testable dual connectivity bandwidth combinations for different dual connectivities capability with 3DL CCs**

| Dual connectivity capability  | Bandwidth combination for FDD dual connectivity | Bandwidth combination for TDD dual connectivity |
|---|---|---|
| DC_A_3  | 20+20+15MHz, 20+15+15MHz                        | NA  |
| NOTE 1: This table is only for information and applicability and test rules of dual connectivity performance requirements are specified in 8.1.2.3A |   |   |



### 8.1.2.3 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CCs in Table 8.1.2.3-1 and 3 or more DL CCs in Table 8.2.2.3-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 8.1.2.3-1: Applicability and test rules for CA UE demodulation tests with 2 DL CCs**

| Tests  | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply  | CA Bandwidth combination to be tested in priority order       |
|--|---|---|---|
| CA tests with 2CCs in Clause 8.2.1.1.1, 8.2.1.4.3            | Any one of the supported CA capabilities  | Any one of the supported FDD CA configurations  | 10+10 MHz, 20+20 MHz, 5+5 MHz, 10MHz+5MHz, 15MHz+5MHz         |
| CA tests with 2CCs in Clause 8.2.1.3.1                       | Each supported CA capability  | Any one of the supported FDD CA configurations in each CA capability  | 10+10 MHz, 20+20 MHz, 5+5 MHz, 10MHz+5MHz, other combinations |
| CA tests with 2CCs in Clause 8.2.1.3.1A, 8.7.1, 8.2.1.9.2    | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination                   |
| CA tests with 2CCs in Clause 8.2.1.7.1                       | CA_C  | Supported FDD intra-band contiguous CA configurations covering the lowest and highest operating bands                 | Largest aggregated CA bandwidth combinations                  |
| CA tests with 2CCs in Clause 8.2.2.1.1, 8.2.2.4.3, 8.2.2.9.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination                   |
| CA tests with 2CCs in Clause 8.2.2.3.1                       | Each supported CA capability  | Any one of the supported TDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination                   |
| CA tests with 2CCs in Clause 8.2.2.3.1A, 8.7.2               | Any one of the supported CA capabilities with largest aggregated CA bandwidth             | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination                   |
| CA tests with 2CCs in 8.2.2.7.1                              | CA_C  | Supported TDD intra-band contiguous CA configurations covering the lowest and highest operating bands                 | Largest aggregated CA bandwidth combinations                  |
| CA tests with 2CCs in Clause 8.2.1.8.1                       | CA_N  | CA_3A-3A defined in Table 5.6A.1-3  | 10+10 MHz   |
| CA tests with 2CCs in Clause 8.2.2.8.1                       | CA2_C   | CA_41C defined in Table 5.6A.1-1  | 20+20 MHz   |

|  |       |   |  |
|--|-------|---|--|
| CA tests in Clause 8.2.1.10.1 (NOTE 4)   | CA2_C | CA_1C and CA_3C defined in Table 5.6A.1-1 | Largest aggregated CA bandwidth combinations |
| NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>NOTE 3: A single Uplink CC is configured for all tests.<br>NOTE 4: For FDD carriers with minimum channel spacing, UE only supports the carriers in the following scenarios: <ul style="list-style-type: none"> <li>- Inter-band CA with <math>\geq 3</math> CCs, where Band 1 is with 1 CC and normal spacing (PCell) and Band 2 is with 2 intra-band contiguous CCs and minimum channel spacing (SCell), or</li> <li>- Band 1 is configured with 1CC and normal spacing, and UE accesses the CC on Band 1, and then handed over to Band 2 with 2 intra-band contiguous CCs and minimum channel spacing.</li> </ul> |       |   |  |

**Table 8.1.2.3-2: Applicability and test rules for CA UE demodulation tests with 3 or more DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply  | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 3 or more CCs in Clause 8.2.1.1.1, 8.2.1.4.3, 8.7.1, 8.2.1.9.1  | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination             |
| CA tests with 3 or more CCs in Clause 8.2.1.3.1   | Each supported CA capability  | Any one of the supported FDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 3 or more CCs in Clause 8.2.2.1.1, 8.2.2.4.3, 8.7.2, 8.2.2.9.2  | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination             |
| CA tests with 3 or more CCs in Clause 8.2.2.3.1   | Each supported CA capability  | Any one of the supported TDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 3CCs in Clause 8.2.2.8.1  | CA3_C   | CA_41D defined in Table 5.6A.1-1  | 20+20+20 MHz  |
| NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>NOTE 3: A single Uplink CC is configured for all tests |   |   |   |

**8.1.2.3A Applicability and test rules for different dual connectivity configuration and bandwidth combination set**

The performance requirement for dual connectivity UE demodulation tests in Clause 8 are defined independent of dual connectivity configurations and bandwidth combination sets specified in Clause 5.6C.1. For UEs supporting different dual connectivity configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for the configurations with 2CCs in Table 8.1.2.3A-1 and 3 DL CCs in Table 8.1.2.3A-2. For simplicity, dual connectivity configuration below refers to combination of dual connectivity configuration and bandwidth set.

Both CA performance requirements and dual connectivity performance requirements are applied for dual connectivity capable UE.

**Table 8.1.2.3A-1: Applicability and test rules for dual connectivity UE demodulation tests with 2DL CCs**

| Tests   | Dual connectivity capability where the tests apply  | Dual connectivity configuration from the selected CA capability where the tests apply   | Dual connectivity Bandwidth combination to be tested in priority order |
|---|---|---|--|
| Dual connectivity test with 2CCs in Clause 8.2.1.4.3A, 8.7.6      | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported FDD dual connectivity configurations with the largest aggregated dual connectivity bandwidth combination     | Largest dual connectivity aggregated bandwidth combination             |
| Dual connectivity test with 2CCs in Clause 8.2.2.4.3A, 8.7.7      | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported TDD dual connectivity configurations with the largest aggregated dual connectivity bandwidth combination     | Largest dual connectivity aggregated bandwidth combination             |
| Dual connectivity test with TDD FDD 2CCs in Clause 8.2.3.4, 8.7.8 | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported TDD FDD dual connectivity configurations with the largest aggregated dual connectivity bandwidth combination | Largest dual connectivity aggregated bandwidth combination             |

NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.  
NOTE 2: Number of the supported bandwidth combinations to be tested from each selected DC or CA configuration is 1.

**Table 8.1.2.3A-2: Applicability and test rules for dual connectivity UE demodulation tests with 3DL CCs**

| Tests  | Dual connectivity capability where the tests apply  | Dual connectivity configuration from the selected CA capability where the tests apply   | Dual connectivity Bandwidth combination to be tested in priority order |
|--|---|---|--|
| Dual connectivity test with 3CCs in Clause 8.2.1.4.3A, 8.7.6 | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported FDD dual connectivity configurations with the largest aggregated dual connectivity bandwidth combination | Largest dual connectivity aggregated bandwidth combination             |

NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.  
NOTE 2: Number of the supported bandwidth combinations to be tested from each selected DC or CA configuration is 1.

### 8.1.2.3B Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets

The performance requirement for TDD-FDD CA UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL TDD-FDD CA in Table 8.1.2.3B-1 and in Table 8.1.2.3B-2 for 3 or more DL TDD-FDD CA. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 8.1.2.3B-1: Applicability and test rules for CA UE demodulation tests for TDD-FDD CA with 2 DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|---|---|--|---|
| CA tests with 2CCs in Clause 8.2.3.1.1, 8.2.3.2.1A, 8.2.3.3.1, 8.7.5.1, 8.2.3.5.1 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |

|   |   |  |   |
|---|---|--|---|
| CA tests with 2CCs in Clause 8.2.3.2.1  | Each supported CA capability  | Any one of the supported TDD-FDD CA configurations with FDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.3.1.2, 8.2.3.2.2A, 8.2.3.3.2, 8.7.5.2, 8.2.3.5.2   | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.3.2.2  | Each supported CA capability  | Any one of the supported TDD-FDD CA configurations with TDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| <p>NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.</p> <p>NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.</p> <p>NOTE 3: A single Uplink CC is configured for all tests.</p> |   |  |   |

**Table 8.1.2.3B-2: Applicability and test rules for CA UE demodulation tests for TDD-FDD CA with 3 or more DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|---|---|--|---|
| CA tests with 3CCs, 4CCs, 5CCs in Clause 8.2.3.1.1, 8.2.3.2.1A, 8.2.3.3.1, 8.7.5.1  | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination             |
| CA tests with 3CCs, 4CCs, 5CCs in Clause 8.2.3.2.1  | Each supported CA capability  | Any one of the supported TDD-FDD CA configurations with FDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 3CCs, 4CCs, 5CCs in Clause 8.2.3.1.2, 8.2.3.2.2A, 8.2.3.3.2, 8.7.5.2  | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination                       | Largest aggregated CA bandwidth combination             |
| CA tests with 3CCs, 4CCs, 5CCs in Clause 8.2.3.2.2  | Each supported CA capability  | Any one of the supported TDD-FDD CA configurations with TDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| <p>NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.</p> <p>NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.</p> <p>NOTE 3: A single Uplink CC is configured for all tests.</p> |   |  |   |

**8.1.2.3C Applicability and test rules for SDR tests for 4Rx capable UEs**

For FDD single carrier or CA, UE is required to fulfill SDR tests specified in section 8.7.9. For TDD single carrier or CA, UE is required to fulfill SDR tests specified in section 8.7.10. For TDD-FDD CA, UE is required to fulfill SDR test in section 8.7.11.

For FDD DC, UE is required to fulfill SDR tests specified in section 8.7.13. For TDD DC, UE is required to fulfill SDR tests specified in section 8.7.14. For TDD-FDD DC, UE is required to fulfill SDR test in section 8.7.15.

For single carrier or CA SDR tests, CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.
- The procedure applies also for single carrier using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

For DC SDR tests, DC configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one DC bandwidth combination among all supported DC configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all DC bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {DC configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

For UEs with no supported 4Rx RF bands the applicability rule in 8.1.2.3C is not applied for SDR tests.

### 8.1.2.3D Applicability and test rules for different CA with LAA SCell(s) configurations and bandwidth combination sets

The performance requirement for CA with LAA SCell(s) UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA with LAA SCell(s) configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CA with LAA SCell(s) in Table 8.1.2.3D-1 and in Table 8.1.2.3D-2 for 3 or more DL CA with LAA SCell(s). For simplicity, CA configuration below refers to combination of CA with LAA SCell(s) configuration and bandwidth combination set.

**Table 8.1.2.3D-1: Applicability and test rules for CA UE demodulation tests for CA with LAA SCell(s) with 2 DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|---|---|--|---|
| CA tests with 2CCs in Clause 8.2.4.1.1, 8.3.3.1.1 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported CA with LAA SCell(s) configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 2CCs in Clause 8.2.4.1.2, 8.3.3.1.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported CA with LAA SCell(s) configurations with TDD PCell with largest                                     | Largest aggregated CA bandwidth combination             |

|   |  |                                     |  |
|---|--|-------------------------------------|--|
|   |  | aggregated CA bandwidth combination |  |
| NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.                |  |                                     |  |
| NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |  |                                     |  |
| NOTE 3: A single Uplink CC is configured for all tests.   |  |                                     |  |

**Table 8.1.2.3D-2: Applicability and test rules for CA UE demodulation tests for CA with LAA SCell(s) with 3 or more DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|---|---|--|---|
| CA tests with 2CCs in Clause 8.2.4.1.1, 8.3.3.1.1   | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported CA with LAA SCell(s) configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 2CCs in Clause 8.2.4.1.2, 8.3.3.1.2   | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported CA with LAA SCell(s) configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.                |   |  |   |
| NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |   |  |   |
| NOTE 3: A single Uplink CC is configured for all tests.   |   |  |   |

### 8.1.2.3E Applicability and test rules for SDR tests for 8Rx capable UEs

UE with support of 8Rx RF bands is required to fulfill the specified SDR tests for 8Rx test in section 8.7.17.

For single carrier or CA SDR tests, CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select the set(s) of {CA configuration, bandwidth combination, MIMO layer} among all the supported CA configurations that leads to the largest equivalent aggregated bandwidth which does not cause the transport block bits within a TTI to exceed the capability of the category of UE under test when the defined reference channel applies on each CC. The equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} a(R_i) R_i B_i$$

where  $N$  is the number of CCs,  $R_i \in \{2, 4, 8\}$  and  $B_i \in \{5, 10, 15, 20\}$  are MIMO layer and bandwidth of CC  $i$ , and  $a(R_i) = 1$  for  $R_i = 2, 4$  and  $a(R_i) = 0.75$  for  $R_i = 8$

- The procedure applies also for single carrier using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

### 8.1.2.4 Test coverage for different number of component carriers

For FDD tests specified in 8.2.1.1.1, 8.2.1.3.1, 8.2.1.4.3, and 8.7.1, if corresponding CA tests are tested, the test coverage can be considered fulfilled without executing single carrier tests.

For TDD tests specified in 8.2.2.1.1, 8.2.2.3.1, 8.2.2.4.3, and 8.7.2, if corresponding CA tests are tested, the test coverage can be considered fulfilled without executing single carrier tests.

For TDD FDD tests specified in 8.2.3.1, 8.2.3.2, 8.2.3.3, 8.2.3.5, and 8.7.5, if corresponding TDD FDD CA tests are tested, the test coverage can be considered fulfilled without executing both FDD and TDD single carrier tests.

For FDD CA tests specified in 8.2.1.1.1, 8.2.1.4.3, 8.7.1, 8.13.1.1.1 and 8.13.1.2.1, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For FDD CA tests specified in 8.2.1.3.1, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 8.2.2.1.1, 8.2.2.4.3, 8.7.2, 8.13.2.1.1 and 8.13.2.2.1, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 8.2.2.3.1, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 8.2.3.1, 8.2.3.3, 8.7.5, 8.13.3.1 and 8.13.3.2, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 8.2.3.2 and 8.2.3.5, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

For FDD CA power imbalance tests specified in 8.2.1.7.1, if they are tested with FDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE.

For TDD CA power imbalance tests specified in 8.2.2.7.1, if they are tested with TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with TDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE.

For FDD DC tests specified in 8.2.1.4.3A, 8.7.6 and 8.13.1.1.2, among all supported DC capabilities, if corresponding DC tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the DC tests with less than the largest number of CCs supported by the UE.

For TDD DC tests specified in 8.2.2.4.3A, 8.7.7 and 8.13.2.1.2, among all supported DC capabilities, if corresponding DC tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the DC tests with less than the largest number of CCs supported by the UE.

For TDD FDD DC tests specified in 8.2.3.4, 8.7.8 and 8.13.3.5, among all supported DC capabilities, if corresponding DC tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the DC tests with less than the largest number of CCs supported by the UE.

For LAA SCell(s) with FDD PCell tests specified in 8.2.4.1.1 and 8.3.3.1.1, for each supported CA capability, if corresponding CA with LAA SCell(s) tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA with LAA SCell(s) tests with less than the largest number of CCs supported by the UE.

For LAA SCell(s) with TDD PCell tests specified in 8.2.4.1.2 and 8.3.3.1.2, for each supported CA capability, if corresponding CA with LAA SCell(s) tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA with LAA SCell(s) tests with less than the largest number of CCs supported by the UE.

### 8.1.2.5 Applicability of performance requirements for Type B receiver

For TM10 capable UE, if corresponding tests specified in 8.3.1.1F, 8.3.2.1G, 9.3.8.3 are tested, the test coverage can be considered fulfilled without executing the tests specified in 8.3.1.1C, 8.3.2.1D, 9.3.8.2. For a UE which does not have TM10 capability, the tests specified in sections 8.3.1.1C, 8.3.2.1D, 9.3.8.2 should be used.

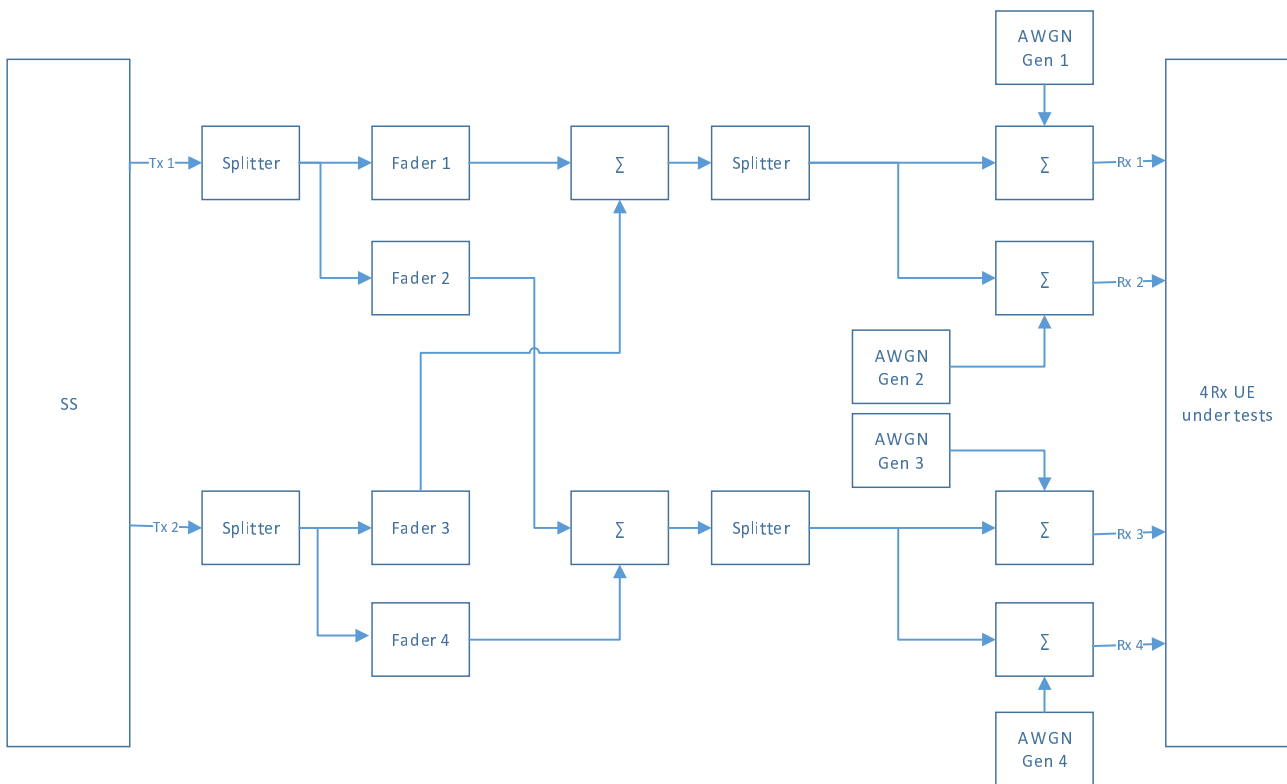
### 8.1.2.6 Applicability of performance requirements for 4Rx capable UEs

For 4Rx capable UEs, the 2Rx supported RF bands and 4Rx supported RF bands are up to UE's declaration.

#### 8.1.2.6.1 Applicability rule and antenna connection for single carrier tests with 2Rx

For 4Rx capable UEs all single carrier tests specified in 8.2 to 8.8 with 2Rx are tested on any of the 2 Rx supported RF bands by connecting 2 out of the 4Rx with data source from system simulator, and the other 2 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 2Rx should be applied.

For 4Rx capable UEs without any 2Rx RF bands, all single carrier tests specified in 8.2 to 8.8 with 2Rx are tested on any of the 4Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. Figure 8.1.2.6.1-1 shows an example of antenna connection for 4Rx UE in any one 4Rx supported RF band to perform a 2Rx performance test with antenna configuration as 2x2 without interference for information. The SNR requirements should be applied with 1.5 dB less than the number specified with 2Rx for test configuration with CRS-based TM and with 1.5 dB less than the number specified with 2Rx for test configuration with DMRS-based TM.



**Figure 8.1.2.6.1-1 Antenna connection example for 2Rx tests with antenna configuration as 2x2 without interference (informative)**

For 4Rx capable UEs without any 2Rx supported RF bands, for all single carrier tests listed in Table 8.1.2.6.1-0 specified from 8.2 to 8.8 with 2Rx can be skipped.

**Table 8.1.2.6.1-0: Requirement lists for 4Rx capable UEs**

| Requirement lists  |
|--|
| Enhanced downlink control channel performance requirements type A  |
| Enhanced downlink control channel performance requirements type B  |
| Enhanced performance requirements type B   |
| Enhanced performance requirements type C   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured |
| Requirements with CRS assistance information configured  |



For 4Rx capable UEs, if corresponding tests listed from the 4Rx test lists from Table 8.1.2.6.1-1 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed from the 2Rx test lists from Table 8.1.2.6.1-1.

**Table 8.1.2.6.1-1: Applicability rules for single carrier tests with 2Rx**

| 4Rx test lists     | 2Rx test lists    |
|--------------------|-------------------|
| 8.10.1.1.1 Test 1  | 8.2.1.2.1 Test 1  |
| 8.10.1.1.2 Test 1  | 8.2.1.3.1 Test 1  |
| 8.10.1.1.3 Test 1  | 8.2.1.4.1B Test 1 |
| 8.10.1.1.4 Test 1  | 8.2.1.4.2 Test 1  |
| 8.10.1.1.4 Test 2  | 8.2.1.4.2 Test 3  |
| 8.10.1.1.5 Test 1  | 8.3.1.1A Test 1   |
| 8.10.1.1.5A Test 1 | 8.3.1.1 Test 2    |
| 8.10.1.1.5B Test 1 | 8.3.1.1H Test 1   |
| 8.10.1.1.6 Test 1  | 8.3.1.2 Test 1    |
| 8.10.1.1.14 Test 1 | 8.2.1.9.2 Test 1  |
| 8.10.1.2.1 Test 1  | 8.2.2.2.1 Test 1  |
| 8.10.1.2.2 Test 1  | 8.2.2.3.1 Test 1  |
| 8.10.1.2.3 Test 1  | 8.2.2.4.1B Test 1 |
| 8.10.1.2.4 Test 1  | 8.2.2.4.2 Test 1  |
| 8.10.1.2.4 Test 2  | 8.2.2.4.2 Test 3  |
| 8.10.1.2.5 Test 1  | 8.3.2.1B Test 1   |
| 8.10.1.2.5A Test 1 | 8.3.2.1A Test 2   |
| 8.10.1.2.5B Test 1 | 8.3.1.1I Test 1   |
| 8.10.1.2.6 Test 1  | 8.3.2.2 Test 2    |
| 8.10.1.2.14 Test 1 | 8.2.2.9.2 Test 1  |
| 8.10.2.1.1 Test 1  | 8.4.1.1 Test 1    |
| 8.10.2.1.2 Test 1  | 8.4.1.2.1 Test 1  |
| 8.10.2.1.3 Test 1  | 8.4.1.2.2 Test 1  |
| 8.10.2.2.1 Test 1  | 8.4.2.1 Test 1    |
| 8.10.2.2.2 Test 1  | 8.4.2.2.1 Test 1  |
| 8.10.2.2.3 Test 1  | 8.4.2.2.2 Test 1  |
| 8.10.3.1.1 Test 1  | 8.5.1.1 Test 1    |
| 8.10.3.1.2 Test 1  | 8.5.1.2.1 Test 1  |
| 8.10.3.1.3 Test 1  | 8.5.1.2.2 Test 1  |
| 8.10.3.2.1 Test 1  | 8.5.2.1 Test 1    |
| 8.10.3.2.2 Test 1  | 8.5.2.2.1 Test 1  |
| 8.10.3.2.3 Test 1  | 8.5.2.2.2 Test 1  |
| 8.10.4.1.1 Test 1  | 8.8.1.1 Test 1    |
| 8.10.4.1.1 Test 2  | 8.8.1.1 Test 2    |
| 8.10.4.1.2 Test 1  | 8.8.1.2 Test 1    |
| 8.10.4.1.2 Test 2  | 8.8.1.2 Test 2    |
| 8.10.4.2.1 Test 1  | 8.8.2.1 Test 1    |
| 8.10.4.2.1 Test 2  | 8.8.2.1 Test 2    |
| 8.10.4.2.2 Test 1  | 8.8.2.2 Test 1    |
| 8.10.4.2.2 Test 2  | 8.8.2.2 Test 2    |

### 8.1.2.6.2 Applicability rule and antenna connection for CA and DC tests with 2Rx

All tests specified in 8.2 to 8.8 with 2Rx with CA, TDD-FDD CA and DC are tested with 4 Rx capable UEs.

Within the CA/DC configuration if any of the PCell and/or the SCells and/or PSCells is a 2Rx supported RF band, the antenna connection should follow the same method as defined in 8.1.2.6.1 for single carrier tests on any of the 2Rx supported RF bands, with same requirements specified with 2Rx applied. Within the CA configuration if any of the PCell and/or the SCells and/or PSCells is a 4Rx supported RF band, the antenna connection should follow the same as defined in 8.1.2.6.1 for single carrier tests on any of the 4 Rx supported RF bands, with the SNR requirements applied with 1.5 dB less than the number specified with 2Rx.

Same applicability rules defined in 8.1.2.3, 8.1.2.3A, and 8.1.2.3B for CA, TDD-FDD CA and DC applied for different CA and DC configurations and bandwidth combination sets should be applied for 4 Rx capable UEs.

### 8.1.2.6.3 Applicability rule and antenna connection for single carrier tests with 4Rx

For 4Rx capable UEs all single carrier tests specified in 8.10 with 4Rx are tested on any of the 4Rx supported RF bands by connecting all 4Rx with data source from system simulator.

### 8.1.2.6.4 Applicability rule for 256QAM tests

For 256QAM capable UE, if corresponding tests specified in 8.10.1.1.4 Test 2 and 8.10.1.2.4 Test 2 are tested, the test coverage can be considered fulfilled without executing the tests specified in 8.10.1.1.4 Test 1 and 8.10.1.2.4 Test 1. For a UE which does not have 256QAM capability, the test specified in 8.10.1.1.4 Test 1 and 8.10.1.2.4 Test 1 should be used.

### 8.1.2.6.5 Applicability rule and antenna connection for CA and DC tests with 4Rx

All tests specified in 8.13 with FDD CA/DC, TDD CA/DC and TDD-FDD CA/DC are tested with 4 Rx capable UEs.

Within the CA/DC configuration if any of the PCell and/or the SCells/PSCell is a 2Rx supported RF band, 2 out of the 4Rx should be connected with data source from system simulator, and the other 2Rx are connected with zero input, depending on UE's declaration and AP configuration. Within the CA/DC configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, all 4Rx should be connected with data source from system simulator.

For 4Rx capable UEs supporting different CA/DC configurations and bandwidth combination sets, the applicability and test rules are defined in Table 8.1.2.6.5-1 for FDD CA/DC, TDD CA/DC and TDD-FDD CA/DC. For simplicity, CA/DC configuration below refers to combination of CA/DC configuration and bandwidth combination set.

**Table 8.1.2.6.5-1: Applicability and test rules for CA/DC/TDD-FDD CA UE demodulation tests**

| Tests                                     | Step 1   | Step 2   | Step 3   | Step 4 |
|---|--|--|--|--------|
| CA tests in Clause 8.13.1.1.1, 8.13.1.2.1 | Select FDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported FDD CA configurations with any CA capability | Select FDD CA configurations with maximum number of 4Rx CCs among all the selected FDD CA configurations from Step 1 | Select any one of the FDD CA configuration with the largest aggregated CA bandwidth combination among all the selected FDD CA configurations from Step 2 | NA     |
| DC tests in Clause 8.13.1.1.2             | Select FDD DC configurations with the maximum number of CCs excluding the 2Rx only DC configuration among all supported FDD DC configurations with any DC capability | Select FDD DC configurations with maximum number of 4Rx CCs among all the selected FDD DC configurations from Step 1 | Select any one of the FDD DC configuration with the largest aggregated DC bandwidth combination among all the selected FDD DC configurations from Step 2 | NA     |
| CA tests in Clause 8.13.2.1.1, 8.13.2.2.1 | Select TDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported TDD CA configurations with any CA capability | Select TDD CA configurations with maximum number of 4Rx CCs among all the selected TDD CA configurations from Step 1 | Select any one of the TDD CA configuration with the largest aggregated CA bandwidth combination among all the selected TDD CA configurations from Step 2 | NA     |

|   |  |  |  |   |
|---|--|--|--|---|
| DC tests in Clause 8.13.2.1.2   | Select TDD DC configurations with the maximum number of CCs excluding the 2Rx only DC configuration among all supported TDD DC configurations with any DC capability         | Select TDD DC configurations with maximum number of 4Rx CCs among all the selected TDD DC configurations from Step 1         | Select any one of the TDD DC configuration with the largest aggregated DC bandwidth combination among all the selected TDD DC configurations from Step 2         | NA  |
| CA tests in Clause 8.13.3.1.1, 8.13.3.1.2, 8.13.3.2.1, 8.13.3.2.2                         | Select TDD-FDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported TDD-FDD CA configurations with any CA capability | Select TDD-FDD CA configurations with maximum number of 4Rx CCs among all the selected TDD-FDD CA configurations from Step 1 | Select any one of the TDD-FDD CA configuration with the largest aggregated CA bandwidth combination among all the selected TDD-FDD CA configurations from Step 2 | NA  |
| DC tests in Clause 8.13.3.5.1, 8.13.3.5.2   | Select TDD-FDD DC configurations with the maximum number of CCs excluding the 2Rx only DC configuration among all supported TDD-FDD DC configurations with any DC capability | Select TDD-FDD DC configurations with maximum number of 4Rx CCs among all the selected TDD-FDD DC configurations from Step 1 | Select any one of the TDD-FDD DC configuration with the largest aggregated DC bandwidth combination among all the selected TDD-FDD DC configurations from Step 2 | NA  |
| CA tests in Clause 8.13.1.3.1, 8.13.1.4.1, 8.13.1.1.3                                     | Select FDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported FDD CA configurations with any CA capability         | Select FDD CA configurations with maximum number of 4Rx CCs among all the selected FDD CA configurations from Step 1         | Select any one of the FDD CA configuration with the largest aggregated CA bandwidth combination among all the selected FDD CA configurations from Step 2         | Select 2CCs with maximum number of 4Rx CCs with the largest aggregated CA bandwidth combination among the selected FDD CA configuration from Step 3     |
| CA tests in Clause 8.13.2.3.1, 8.13.2.4.1, 8.13.2.1.3                                     | Select TDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported TDD CA configurations with any CA capability         | Select TDD CA configurations with maximum number of 4Rx CCs among all the selected TDD CA configurations from Step 1         | Select any one of the TDD CA configuration with the largest aggregated CA bandwidth combination among all the selected TDD CA configurations from Step 2         | Select 2CCs with maximum number of 4Rx CCs with the largest aggregated CA bandwidth combination among the selected TDD CA configuration from Step 3     |
| CA tests in Clause 8.13.3.3.1, 8.13.3.3.2, 8.13.3.4.1, 8.13.3.4.2, 8.13.3.6.1, 8.13.3.6.2 | Select TDD-FDD CA configurations with the maximum number of CCs excluding the 2Rx only CA configuration among all supported TDD-FDD CA configurations with any CA capability | Select TDD-FDD CA configurations with maximum number of 4Rx CCs among all the selected TDD-FDD CA configurations from Step 1 | Select any one of the TDD-FDD CA configuration with the largest aggregated CA bandwidth combination among all the selected TDD CA configurations from Step 2     | Select 2CCs with maximum number of 4Rx CCs with the largest aggregated CA bandwidth combination among the selected TDD-FDD CA configuration from Step 3 |

|   |   |  |    |    |
|---|---|--|----|----|
| CA tests in Clause 8.13.1.1.4             | Select FDD CA configurations with the maximum number of CCs supporting 4 layers MIMO among all supported FDD CA configurations with any CA capability         | Select any one of the FDD CA configuration with the largest aggregated CA bandwidth combinations on any 2CCs among all the CCs among all the selected FDD CA configuration from Step 1         | NA | NA |
| CA tests in Clause 8.13.2.1.4             | Select TDD CA configurations with the maximum number of CCs supporting 4 layers MIMO among all supported TDD CA configurations with any CA capability         | Select any one of the TDD CA configuration with the largest aggregated CA bandwidth combinations on any 2CCs among all the CCs among all the selected TDD CA configuration from Step 1         | NA | NA |
| CA tests in Clause 8.13.3.7.1, 8.13.3.7.2 | Select TDD-FDD CA configurations with the maximum number of CCs supporting 4 layers MIMO among all supported TDD-FDD CA configurations with any CA capability | Select any one of the TDD-FDD CA configuration with the largest aggregated CA bandwidth combinations on any 2CCs among all the CCs among all the selected TDD-FDD CA configuration from Step 1 | NA | NA |

NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.

NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.

NOTE 3: A single Uplink CC is configured for all CA tests and 2 Uplink CCs are configured for all DC tests.

For 4Rx capable UEs, if corresponding tests listed from the 4Rx CA/DC test lists from Table 8.1.2.6.5-2 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed from the 2Rx CA/DC test lists from Table 8.1.2.6.5-2.

**Table 8.1.2.6.5-2: Test lists for applicability rules for CA/DC/TDD-FDD CA tests with 4Rx**

| 4Rx test lists      | 2Rx test lists                          |
|---------------------|---|
| 8.13.1.1.1 CA tests | 8.2.1.4.3 CA tests                      |
| 8.13.1.1.2 DC tests | 8.2.1.4.3A DC tests                     |
| 8.13.1.2.1 CA tests | 8.2.1.1.1 CA tests                      |
| 8.13.2.1.1 CA tests | 8.2.2.4.3 CA tests                      |
| 8.13.2.1.2 DC tests | 8.2.2.4.3A DC tests                     |
| 8.13.2.2.1 CA tests | 8.2.2.1.1 CA tests                      |
| 8.13.3.1.1 CA tests | 8.2.3.3.1 CA tests                      |
| 8.13.3.1.2 CA tests | 8.2.3.3.2 CA tests                      |
| 8.13.3.2.1 CA tests | 8.2.3.1.1 CA tests                      |
| 8.13.3.2.2 CA tests | 8.2.3.1.2 CA tests                      |
| 8.13.1.1.3 CA tests | 8.2.1.4.2 test 3 and 8.10.1.1.4 test 2  |
| 8.13.1.1.4 CA tests | 8.10.1.1.8 test 1                       |
| 8.13.1.3.1 CA tests | 8.2.1.4.1B test 1 and 8.10.1.1.3 test 1 |
| 8.13.1.4.1 CA tests | 8.3.1.1A test 1 and 8.10.1.1.5 test 1   |
| 8.13.2.1.3 CA tests | 8.2.2.4.2 test 3 and 8.10.1.2.4 test 2  |
| 8.13.2.1.4 CA tests | 8.10.1.2.8 test 1                       |
| 8.13.2.3.1 CA tests | 8.2.2.4.1B test 1 and 8.10.1.2.3 test 1 |
| 8.13.2.4.1 CA tests | 8.3.2.1B test 1 and 8.10.1.2.5 test 1   |

#### 8.1.2.6.6 Applicability rule for Type C with 4Rx

For Type C with 4Rx capable UEs, if the tests from the 4Rx test lists are tested from Table 8.1.2.6.6-1, the test coverage can be considered fulfilled without executing the corresponding test from 2Rx test lists from Table 8.1.2.6.6-1.

**Table 8.1.2.6.6-1: Applicability rules for Type C with 4Rx**

| Test category | Type C with 2Rx test lists | Type C with 4Rx test lists |
|---------------|----------------------------|----------------------------|
| FDD Tests     | 8.2.1.3.1B                 | 8.2.1.3.1B                 |
|               | 8.2.1.3.1C                 | 8.2.1.3.1C                 |
|               | 8.2.1.4.2A                 | 8.10.1.1.4A                |
|               | 8.3.1.2A                   | 8.10.1.1.6A                |
| TDD Tests     | 8.2.2.3.1B                 | 8.2.2.3.1B                 |
|               | 8.2.2.3.1C                 | 8.2.2.3.1C                 |
|               | 8.2.2.4.2A                 | 8.10.1.2.4A                |
|               | 8.3.2.2A                   | 8.10.1.2.6A                |

### 8.1.2.6.7 Applicability rule for 1024QAM tests

For 1024QAM capable UE, if corresponding tests specified in 8.10.1.1.4 Test 3, 8.10.1.2.4 Test 3, 8.10.1.1.6B Test 1, and 8.10.1.2.6B Test 1 are tested, the test coverage can be considered fulfilled without executing the tests specified in 8.10.1.1.4 Test 1-2, 8.10.1.2.4 Test 1-2, 8.2.1.4.1A Test2, 8.2.2.4.1A Test 2, 8.3.1.1 Test 5, and 8.3.2.1A Test 5.

### 8.1.2.7 Applicability of Enhanced Downlink Control Channel Performance Requirements

For UE which supports downlink control channel Type A or Type B interference mitigation capabilities the tests from Table 8.1.2.7-1 rows corresponding should be applied in accordance to the supported UE-EUTRA-Capability [7].

**Table 8.1.2.7-1: Applicability rules for enhanced downlink control channel performance requirements**

| Test set | UE-EUTRA-Capability [7]  | Test category | Test list    | Applicability notes                                      |  |
|----------|--|---------------|--------------|--|--|
| 1        | cch-InterfMitigation-RefRecTypeA-r13 (Enhanced downlink control channel interference mitigation Type A receiver for 2 CRS antenna ports for UEs with 2 receiver antenna ports) | FDD           | PDCCH/PCFICH | 8.4.1.2.5 Test 1<br>8.4.1.2.6 Test 1                     |  |
|          |  |               | PHICH        | 8.5.1.2.5 Test 1<br>8.5.1.2.6 Test 1                     |  |
|          |  |               | EPDCCH       | 8.8.4.1 Test 1<br>8.8.6.1 Test 1                         |  |
|          |  | TDD           | PDCCH/PCFICH | 8.4.2.2.5 Test 1<br>8.4.2.2.6 Test 1                     |  |
|          |  |               | PHICH        | 8.5.2.2.5 Test 1<br>8.5.2.2.6 Test 1                     |  |
|          |  |               | EPDCCH       | 8.8.4.2 Test 1<br>8.8.5.1 Test 1                         |  |
| 2        | cch-InterfMitigation-RefRecTypeA-r13 (Enhanced downlink control channel interference mitigation Type A receiver for 4 CRS antenna ports for UEs with 2 receiver antenna ports) | FDD           | PDCCH/PCFICH | 8.4.1.2.9 Test 1   | UE may skip the tests 8.4.1.2.6 and 8.4.2.2.6 defined for test set 1 |
|          |  | TDD           | PDCCH/PCFICH | 8.4.2.2.9 Test 1   |  |
| 3        | cch-InterfMitigation-RefRecTypeB-r13   | FDD           | PDCCH/PCFICH | 8.4.1.2.5 Test 1<br>8.4.1.2.7 Test 1<br>8.4.1.2.8 Test 1 | UE may skip the tests defined for test set 1                         |
|          |  |               | PHICH        | 8.5.1.2.5 Test 1<br>8.5.1.2.7 Test 1<br>8.5.1.2.8 Test 1 |  |
|          |  |               | EPDCCH       | 8.8.4.1 Test 1<br>8.8.6.1 Test 1                         |  |
|          |  | TDD           | PDCCH/PCFICH | 8.4.2.2.7 Test 1<br>8.4.2.2.8 Test 1                     |  |
|          |  |               | PHICH        | 8.5.2.2.7 Test 1<br>8.5.2.2.8 Test 1                     |  |
|          |  |               | EPDCCH       | 8.8.4.2 Test 1<br>8.8.5.1 Test 1                         |  |
| 4        | MMSE-IRC DL Control Channel interference mitigation receiver for UEs   | FDD           | PDCCH/PCFICH | 8.10.2.1.4 Test 1  |  |
|          |  | TDD           | PDCCH/PCFICH | 8.10.2.2.4 Test 1  |  |

|   |   |     |              |  |  |
|---|---|-----|--------------|--|--|
|   | with 4 receiver antenna ports [TS 36.306 Section 6.6.5]   |     |              |  |  |
| 5 | [Enhanced downlink control channel interference mitigation Type A receiver for 2 CRS antenna ports for UEs with 1 receiver antenna ports and Category 1bis] | FDD | PDCCH/PCFICH | 8.9.4.1.1 Test 1                       |  |
|   |   | TDD | PDCCH/PCFICH | [8.9.4.2.1 Test 1]                     |  |
| 6 | [Enhanced downlink control channel interference mitigation Type A receiver for 4 CRS antenna ports for UEs with 1 receiver antenna ports and Category 1bis] | FDD | PDCCH/PCFICH | 8.9.4.1.2 Test 1                       | UE may skip the tests defined for test set 5 |
|   |   | TDD | PDCCH/PCFICH | [8.9.4.2.2 Test 1]                     |  |
| 7 | [Enhanced downlink control channel interference mitigation Type A receiver for 2 CRS antenna ports for UEs with 1 receiver antenna ports and Category M2]   | FDD | MPDCCH       | 8.11.2.1.3 Test 1<br>8.11.2.1.4 Test 1 |  |
|   |   | TDD | MPDCCH       | 8.11.2.2.3 Test 1<br>8.11.2.2.4 Test 1 |  |

**8.1.2.8 Applicability of performance requirements for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

For a UE which supports DMRS enhancement (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]), if corresponding tests specified in 8.3.1.1H Test 1 and 8.3.2.1I Test 1 are tested, the test coverage can be considered fulfilled without executing the tests specified in 8.3.1.1 Test 2 and 8.3.2.1A Test 2. For a UE which does not have DMRS enhancement capability, the test specified in 8.3.1.1 Test 2 and 8.3.2.1A Test 2 should be used.

**8.1.2.8A Applicability of performance requirements for UE supporting coverage enhancement**

The applicability and test rules are defined for the tests for UE supporting coverage enhancement with narrowband transmission in Table 8.1.2.8A-1 and 8.1.2.8A-2.

**Table 8.1.2.8A-1: Applicability rules for PDSCH requirements (FDD)**

| UE-EUTRA-Capability   | ue-Category or UE-CategoryDL                                      |  |
|---|---|--|
|   | M1, Cat-0, 1bis   | >=1 (Note 1)   |
| ce-ModeA-r13  | 8.11.1.1.1.1 Test 1<br>8.11.1.1.2.1 Test 1<br>8.11.1.1.3.1 Test 2 | 8.11.1.1.2.1 Test 2<br>8.11.1.1.2.1 Test 3   |
| ce-ModeB-r13  | 8.11.1.1.1.1 Test 1<br>8.11.1.1.2.1 Test 1<br>8.11.1.1.3.1 Test 1 | 8.11.1.1.2.1 Test 2<br>8.11.1.1.2.1 Test 3<br>8.11.1.1.3.1 Test 3<br>8.11.1.1.3.1 Test 4 |
| Note 1: Which test case applies to the UE depends on the supported receiver antenna number. |   |  |

**Table 8.1.2.8A-2: Applicability rules for PDSCH requirements (TDD)**

| UE-EUTRA-Capability | ue-Category or UE-CategoryDL                                      |  |
|---------------------|---|--|
|                     | M1, Cat-0, 1bis   | >=1 (Note 1)                               |
| ce-ModeA-r13        | 8.11.1.2.1.1 Test 1<br>8.11.1.2.2.1 Test 1<br>8.11.1.2.3.1 Test 2 | 8.11.1.2.2.1 Test 2<br>8.11.1.2.2.1 Test 3 |

|   |                     |                     |
|---|---------------------|---------------------|
| ce-ModeB-r13  | 8.11.1.2.1.1 Test 1 | 8.11.1.2.2.1 Test 2 |
|   | 8.11.1.2.2.1 Test 1 | 8.11.1.2.2.1 Test 3 |
|   | 8.11.1.2.3.1 Test 1 | 8.11.1.2.3.1 Test 3 |
|   |                     | 8.11.1.2.3.1 Test 4 |
| Note 1: Which test case applies to the UE depends on the supported receiver antenna number. |                     |                     |

The applicability and test rules are defined for the tests for UE supporting coverage enhancement with wideband transmission in Table 8.1.2.8A-3 and 8.1.2.8A-4.

**Table 8.1.2.8A-3: Applicability rules for PDSCH requirements (FDD)**

| UE-EUTRA-Capability   | ue-Category or UE-CategoryDL |                     |                     |
|---|------------------------------|---------------------|---------------------|
|   | M2, Cat-0, 1bis              | ≥1 (Note 1)         |                     |
| ce-PDSCH-PUSCH-MaxBandwidth-r14   | 5MHz                         | 5MHz                | 20MHz               |
| ce-ModeA-r13  | 8.11.1.1.1.1 Test 1          | 8.11.1.1.2.1 Test 2 | 8.11.1.1.2.1 Test 2 |
|   | 8.11.1.1.2.1 Test 1          | 8.11.1.1.2.1 Test 3 | 8.11.1.1.2.1 Test 3 |
|   | 8.11.1.1.3.2 Test 1          |                     | 8.11.1.1.3.2 Test 3 |
|   |                              |                     | 8.11.1.1.3.2 Test 4 |
| ce-ModeB-r13  | 8.11.1.1.1.1 Test 1          | 8.11.1.1.2.1 Test 2 | 8.11.1.1.2.1 Test 2 |
|   | 8.11.1.1.2.1 Test 1          | 8.11.1.1.2.1 Test 3 | 8.11.1.1.2.1 Test 3 |
|   | 8.11.1.1.3.2 Test 2          | 8.11.1.1.3.1 Test 3 | 8.11.1.1.3.1 Test 3 |
|   |                              | 8.11.1.1.3.1 Test 4 | 8.11.1.1.3.1 Test 4 |
| Note 1: Which test case applies to the UE depends on the supported receiver antenna number. |                              |                     |                     |

**Table 8.1.2.8A-4: Applicability rules for PDSCH requirements (TDD)**

| UE-EUTRA-Capability   | ue-Category or UE-CategoryDL |                     |                     |
|---|------------------------------|---------------------|---------------------|
|   | M2, Cat-0, 1bis              | ≥1 (Note 1)         |                     |
| ce-PDSCH-PUSCH-MaxBandwidth-r14   | 5MHz                         | 5MHz                | 20MHz               |
| ce-ModeA-r13  | 8.11.1.2.1.1 Test 1          | 8.11.1.2.2.1 Test 2 | 8.11.1.2.2.1 Test 2 |
|   | 8.11.1.2.2.1 Test 1          | 8.11.1.2.2.1 Test 3 | 8.11.1.2.2.1 Test 3 |
|   | 8.11.1.2.3.2 Test 1          |                     | 8.11.1.2.3.2 Test 3 |
|   |                              |                     |                     |
| ce-ModeB-r13  | 8.11.1.2.1.1 Test 1          | 8.11.1.2.2.1 Test 2 | 8.11.1.2.2.1 Test 2 |
|   | 8.11.1.2.2.1 Test 1          | 8.11.1.2.2.1 Test 3 | 8.11.1.2.2.1 Test 3 |
|   | 8.11.1.2.3.2 Test 2          | 8.11.1.2.3.1 Test 3 | 8.11.1.2.3.1 Test 3 |
|   |                              | 8.11.1.2.3.1 Test 4 | 8.11.1.2.3.1 Test 4 |
| Note 1: Which test case applies to the UE depends on the supported receiver antenna number. |                              |                     |                     |

The applicability and test rules are defined for the tests for UE supporting coverage enhancement in Tables 8.1.2.8A-5 and 8.1.2.8A-6.

**Table 8.1.2.8A-5: Applicability rules for PDSCH requirements (FDD)**

| UE-EUTRA-Capability | ue-Category or UE-CategoryDL |                      |
|---------------------|------------------------------|----------------------|
|                     | M1                           | M2                   |
| ce-ModeA-r13        | 8.11.1.1.3.1 Test 2a         | 8.11.1.1.3.1 Test 5  |
|                     | 8.11.1.1.3.1 Test 5          | 8.11.1.1.3.1 Test 6  |
|                     | 8.11.1.1.3.1 Test 6          |                      |
| ce-ModeB-r13        |                              | 8.11.1.1.3.2 Test 2a |

**Table 8.1.2.8A-6: Applicability rules for PDSCH requirements (TDD)**

| UE-EUTRA-Capability | ue-Category or UE-CategoryDL |                      |
|---------------------|------------------------------|----------------------|
|                     | M1                           | M2                   |
| ce-ModeA-r13        | 8.11.1.2.3.1 Test 2a         | 8.11.1.2.3.1 Test 5  |
|                     | 8.11.1.2.3.1 Test 5          | 8.11.1.2.3.1 Test 6  |
|                     | 8.11.1.2.3.1 Test 6          |                      |
| ce-ModeB-r13        |                              | 8.11.1.2.3.2 Test 2a |

### 8.1.2.9 Applicability of SDR requirements for CA and LAA

For UE supporting both CA and LAA, UE selects the corresponding SDR tests between CA and LAA as per the following applicability rules:

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC following the equation that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are LAA and non-LAA CA configurations with the same largest aggregated bandwidth, select non-LAA CA configuration.

### 8.1.2.10 Applicability of performance requirements for Multi-user Superposed Transmission

For a UE which does not supports DMRS enhancement table (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]), if corresponding tests specified in 8.3.1.1I Test 1, 8.3.2.1J Test 1 are tested, the test coverage can be considered fulfilled without executing other tests specified in 8.3.1.1I and 8.3.2.1J.

For a UE which supports DMRS enhancement table (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]) and enhanced performance Type D in TM8/9 or TM10 with assistance information for up to 1 interfering layer, if corresponding tests specified in 8.3.1.1I Test 2, 8.3.2.1J Test 2 are tested, the test coverage can be considered fulfilled without executing other tests specified in 8.3.1.1I and 8.3.2.1J.

For a UE which supports DMRS enhancement table (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]) and enhanced performance Type D in TM8/9 or TM10 with assistance information for up to 3 interfering layer, if corresponding tests specified in 8.3.1.1I Test 3, 8.3.2.1J Test 3 are tested, the test coverage can be considered fulfilled without executing other tests specified in 8.3.1.1I and 8.3.2.1J.

### 8.1.2.11 Applicability CRS interference mitigation receivers performance requirements

For UE which supports CRS interference mitigation capabilities the tests from Table 8.1.2.11-1 should be applied in accordance to the support UE capabilities (UE-EUTRA-Capability [7]).

**Table 8.1.2.11-1: Applicability rules for CRS interference mitigation performance requirements**

| Test set | UE-EUTRA-Capability [7]  | Test list                                |  | Notes   |
|----------|--|--|--|---|
|          |  | FDD                                      | TDD                                      |   |
| 1        | crs-InterfMitigationTM1toTM9-r13 (CRS-IM with 2 CRS antenna ports for PDSCH for UEs with 2 receiver antenna ports) | 8.2.1.4.1E Test 1<br>8.3.1.1G Test 1     | 8.2.2.4.1E Test 1<br>8.3.2.1H Test 1     |   |
| 2        | crs-InterfMitigationTM10-r13   | 8.3.1.3.4 Test 1<br>8.3.1.3.5 Test 1     | 8.3.2.3.4 Test 1<br>8.3.2.3.5 Test 1     |   |
| 3        | crs-InterfMitigationTM1toTM9-r13 (CRS-IM with 4 CRS antenna ports for PDSCH for UEs with 2 receiver antenna ports) | 8.2.1.4.1F Test 1<br>8.3.1.1G Test 1     | 8.2.2.4.1F Test 1<br>8.3.2.1H Test 1     | UE may skip the tests defined for test set 1          |
| 4        | crs-InterfMitigationTM1toTM9-r13 (CRS-IM with 2 CRS antenna ports for PDSCH for UEs with 4 receiver antenna ports) | 8.10.1.1.10 Test 1<br>8.10.1.1.12 Test 1 | 8.10.1.2.10 Test 1<br>8.10.1.2.12 Test 1 | UE may skip the tests defined for test set 1          |
| 5        | crs-InterfMitigationTM1toTM9-r13 (CRS-IM with 4 CRS antenna ports for PDSCH for UEs with 4 receiver antenna ports) | 8.10.1.1.11 Test 1<br>8.10.1.1.12 Test 1 | 8.10.1.2.11 Test 1<br>8.10.1.2.12 Test 1 | UE may skip the tests defined for test sets 1,3 and 4 |



|   |  |                     |                     |  |
|---|--|---------------------|---------------------|--|
| 6 | [CRS-IM with 2 CRS antenna ports for PDSCH for UEs with 1 receiver antenna port and Category 1bis] | 8.9.1.1.3.2 Test 1  | 8.9.1.2.3.2 Test 1  |  |
| 7 | [CRS-IM with 4 CRS antenna ports for PDSCH for UEs with 1 receiver antenna port and Category 1bis] | 8.9.1.1.2.3 Test 1  | 8.9.1.2.2.3 Test 1  | UE may skip the tests defined for test set 6 |
| 8 | [CRS-IM with 2 CRS antenna ports for PDSCH for UEs with 1 receiver antenna port and Category M2]   | 8.11.1.1.1.2 Test 1 | 8.11.1.1.2.2 Test 1 |  |
| 9 | [CRS-IM with 4 CRS antenna ports for PDSCH for UEs with 1 receiver antenna port and Category M2]   | 8.11.1.1.1.3 Test 1 | 8.11.1.1.2.3 Test 1 | UE may skip the tests defined for test set 8 |

### 8.1.2.12 Applicability of performance requirements for 8Rx capable UEs

For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE's declaration.

For any demodulation tests and CSI tests conducted in the 8Rx supported RF band, four receive antenna ports that UE may use for control channel demodulation are clarified via UE declaration. When testing an N-Rx ( $N = 2,4$ ) demodulation or CSI test on the 8Rx supported band, the fading duplication and antenna mapping should guarantee that the four receive antennas UE declares for the control channel demodulation collectively receives at least  $4/N$  duplicated version of the fading channel seen at each receive antenna of the N-Rx test, i.e., the connection diagrams in Figure 8.1.2.12.1-1 to Figure 8.1.2.12.1-4 are valid under the condition that Rx1, Rx3, Rx5 and Rx7 are the four receive antennas declared by UE for the control channel demodulation.

#### 8.1.2.12.1 Applicability rule and antenna connection for single carrier PDSCH tests

##### 8.1.2.12.1.1 Applicability rule and antenna connection for single carrier PDSCH tests with 2Rx and 4Rx

For 8Rx capable UEs, all single carrier tests specified in 8.2 to 8.8 with 2Rx are tested on any of the 2Rx supported RF bands by connecting 2 out of the 8Rx with data source from system simulator, and the other 6 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 2Rx should be applied.

For 8Rx capable UEs, all single carrier test cases specified in 8.10 with 4Rx are tested on any of the 4Rx supported RF bands by connecting 4 out of 8 Rx with data source from system simulator, and the other 4 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 4Rx should be applied.

For 8Rx capable UEs without support of any 4Rx RF bands, all single carrier tests specified in 8.10 with 4Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 1.5 dB less than the number specified for 4Rx tests.

For 8Rx capable UEs without support of any 2Rx and 4Rx RF bands, all single carrier tests specified in 8.2 to 8.8 with 2Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 3 dB less than the number specified for 2Rx tests.

For 8Rx capable UEs without support of any 2Rx RF bands but with support of 4Rx RF bands, all single carrier tests specified in 8.2 to 8.8 with 2Rx are tested on any of the 4Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. 4 out of 8 Rx are connected with data source from system simulator, and the other 4 Rx are connected with zero input, depending on UE's declaration and AP configuration. SNR requirements should be applied with 1.5 dB less than the number specified for 2Rx tests.

Figure 8.1.2.12.1-1 ~ Figure 8.1.2.12.1-4 show examples of antenna connection for 8Rx capable UE in any one 8Rx supported RF band to perform a 2Rx or 4Rx performance test with antenna configuration as 2x2 or 4x2 for 2Rx tests and 2x4 or 4x4 for 4Rx tests without interference for information.

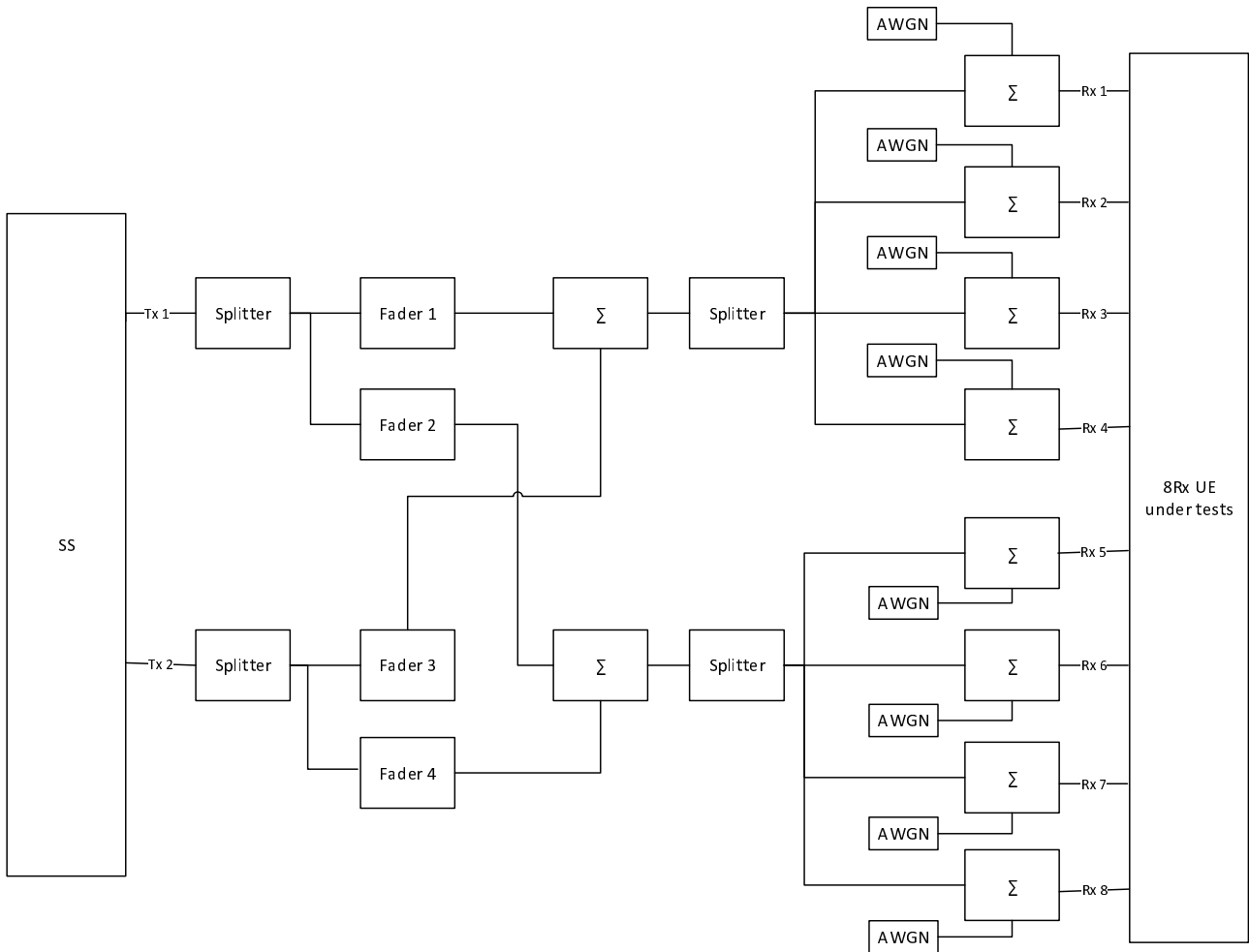


Figure 8.1.2.12.1-1: Antenna connection example for 2Rx tests with antenna configuration as 2x2 without interference (informative)

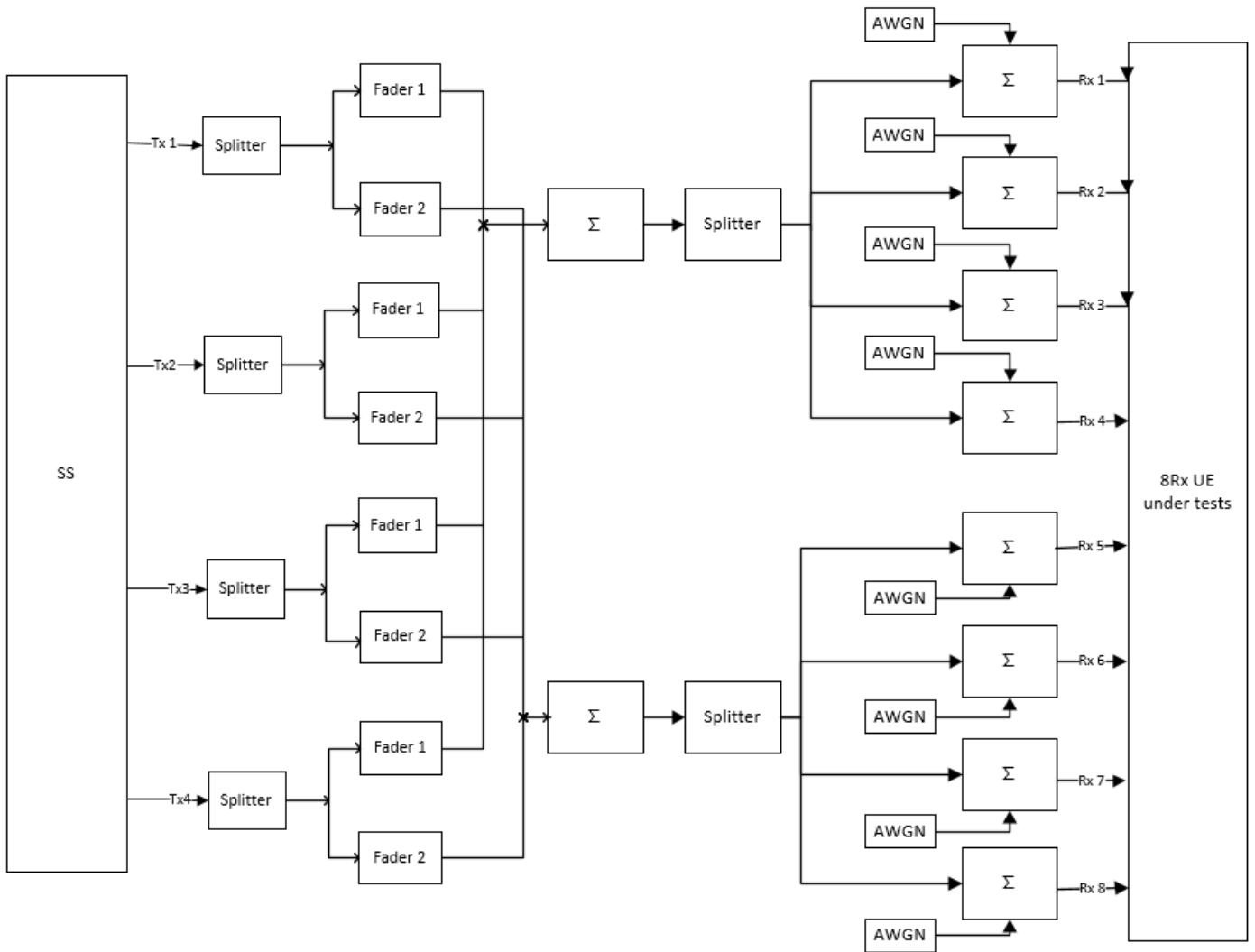


Figure 8.1.2.12.1-2: Antenna connection example for 2Rx tests with antenna configuration as 4x2 without interference (informative)

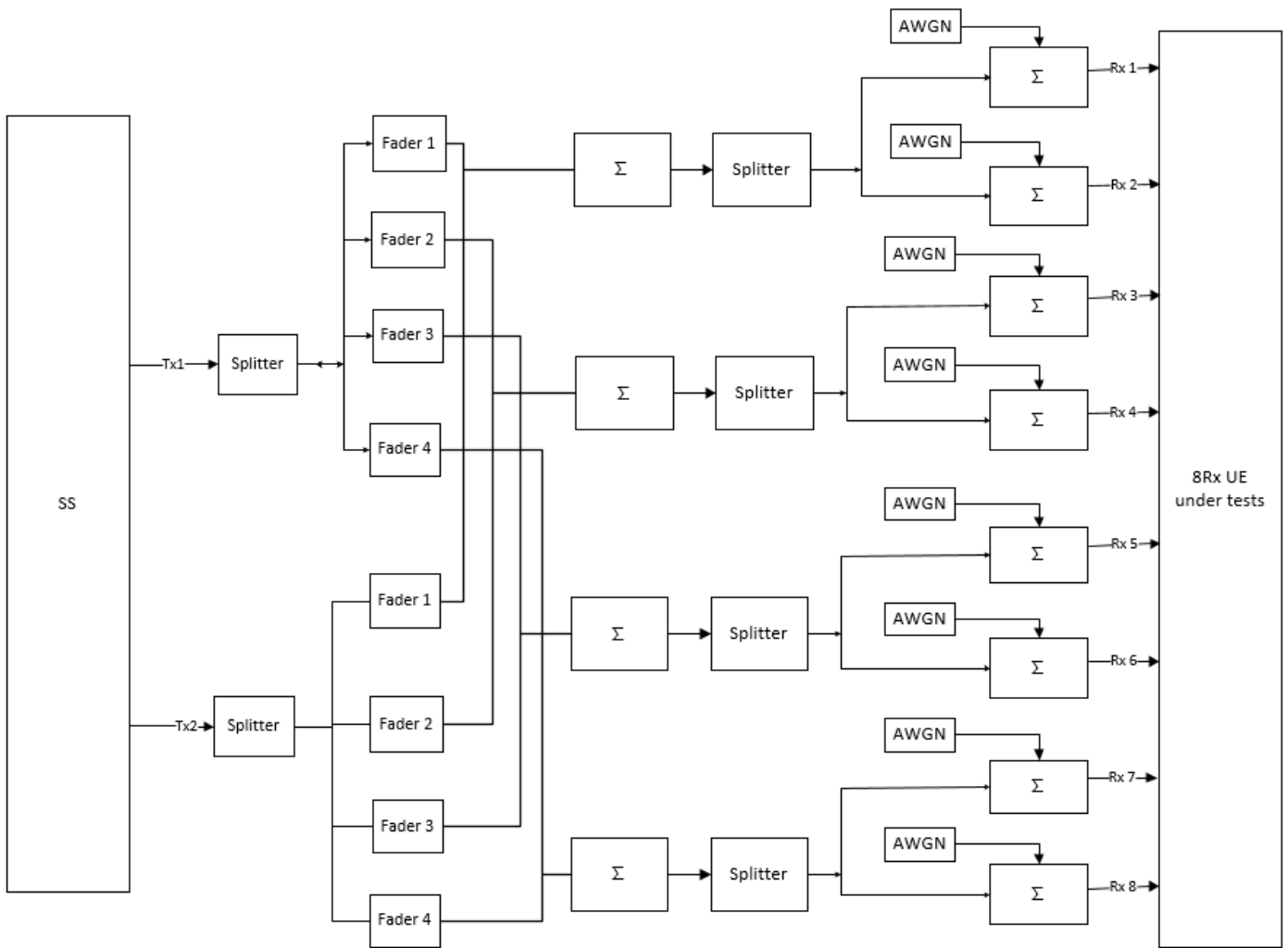
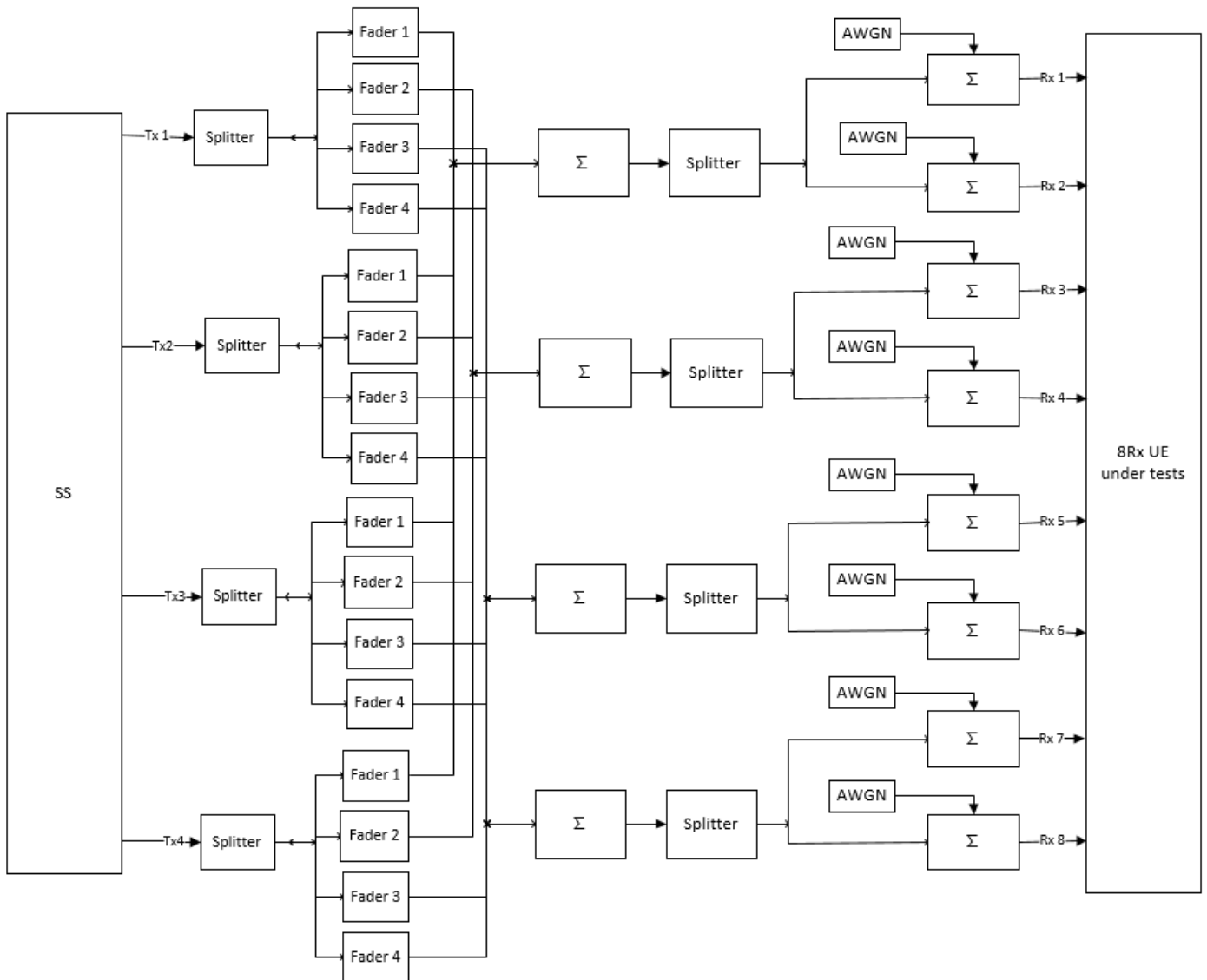


Figure 8.1.2.12.1-3: Antenna connection example for 4Rx tests with antenna configuration as 2x4 without interference (informative)



**Figure 8.1.2.12.1-4: Antenna connection example for 4Rx tests with antenna configuration as 4x4 without interference (informative)**

For 8Rx capable UEs without any 2Rx supported RF bands, for all single carrier tests listed in Table 8.1.2.12.1-1 specified from 8.2 to 8.8 with 2Rx can be skipped.

**Table 8.1.2.12.1-1: Requirement lists with 2Rx not applicable to 8Rx capable UEs**

| Requirement lists  |
|--|
| Enhanced downlink control channel performance requirements type A  |
| Enhanced downlink control channel performance requirements type B  |
| Enhanced performance requirements type A   |
| Enhanced performance requirements type B   |
| Enhanced performance requirements type C   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured |
| Requirements with CRS assistance information configured  |

For 8Rx capable UEs without any 4Rx supported RF bands, for all single carrier tests listed in Table 8.1.2.12.1-2 specified in 8.10 with 4Rx can be skipped.

**Table 8.1.2.12.1-2: Requirement lists with 4Rx not applicable to 8Rx capable UEs**

| Requirement lists   |
|---|
| Enhanced downlink control channel performance requirements type A |
| Enhanced performance requirements type A                          |
| Enhanced performance requirements type C                          |
| Requirements with CRS assistance information configured           |

For 8Rx capable UEs, if corresponding tests listed from the 8Rx test lists from Table 8.1.2.12.1-3 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed from both the 4Rx test lists and the 2Rx test lists from Table 8.1.2.12.1-3.

For 8Rx capable UEs, if corresponding tests listed from the 4Rx test lists from Table 8.1.2.12.1-3 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed from the 2Rx test lists from Table 8.1.2.12.1-3.

**Table 8.1.2.12.1-3: Applicability rules for single carrier tests with 2Rx**

| 8Rx test lists    | 4Rx test lists     | 2Rx test lists    |
|-------------------|--------------------|-------------------|
|                   | 8.10.1.1.1 Test 1  | 8.2.1.2.1 Test 1  |
|                   | 8.10.1.1.2 Test 1  | 8.2.1.3.1 Test 1  |
|                   | 8.10.1.1.3 Test 1  | 8.2.1.4.1B Test 1 |
|                   | 8.10.1.1.4 Test 1  | 8.2.1.4.2 Test 1  |
|                   | 8.10.1.1.4 Test 2  | 8.2.1.4.2 Test 3  |
|                   | 8.10.1.1.5 Test 1  | 8.3.1.1A Test 1   |
|                   | 8.10.1.1.5A Test 1 | 8.3.1.1 Test 2    |
|                   | 8.10.1.1.5B Test 1 | 8.3.1.1H Test 1   |
|                   | 8.10.1.1.6 Test 1  | 8.3.1.2 Test 1    |
| 8.15.1.2.1 Test 1 | 8.10.1.2.1 Test 1  | 8.2.2.2.1 Test 1  |
| 8.15.1.2.2 Test 1 | 8.10.1.2.2 Test 1  | 8.2.2.3.1 Test 1  |
|                   | 8.10.1.2.3 Test 1  | 8.2.2.4.1B Test 1 |
|                   | 8.10.1.2.4 Test 1  | 8.2.2.4.2 Test 1  |
|                   | 8.10.1.2.4 Test 2  | 8.2.2.4.2 Test 3  |
|                   | 8.10.1.2.5 Test 1  | 8.3.2.1B Test 1   |
|                   | 8.10.1.2.5A Test 1 | 8.3.2.1A Test 2   |
|                   | 8.10.1.2.5B Test 1 | 8.3.1.1I Test 1   |
|                   | 8.10.1.2.6 Test 1  | 8.3.2.2 Test 2    |
|                   | 8.10.2.1.1 Test 1  | 8.4.1.1 Test 1    |
|                   | 8.10.2.1.2 Test 1  | 8.4.1.2.1 Test 1  |
|                   | 8.10.2.1.3 Test 1  | 8.4.1.2.2 Test 1  |
|                   | 8.10.2.2.1 Test 1  | 8.4.2.1 Test 1    |
|                   | 8.10.2.2.2 Test 1  | 8.4.2.2.1 Test 1  |
|                   | 8.10.2.2.3 Test 1  | 8.4.2.2.2 Test 1  |
|                   | 8.10.3.1.1 Test 1  | 8.5.1.1 Test 1    |
|                   | 8.10.3.1.2 Test 1  | 8.5.1.2.1 Test 1  |
|                   | 8.10.3.1.3 Test 1  | 8.5.1.2.2 Test 1  |
|                   | 8.10.3.2.1 Test 1  | 8.5.2.1 Test 1    |
|                   | 8.10.3.2.2 Test 1  | 8.5.2.2.1 Test 1  |
|                   | 8.10.3.2.3 Test 1  | 8.5.2.2.2 Test 1  |
|                   | 8.10.4.1.1 Test 1  | 8.8.1.1 Test 1    |
|                   | 8.10.4.1.1 Test 2  | 8.8.1.1 Test 2    |
|                   | 8.10.4.1.2 Test 1  | 8.8.1.2 Test 1    |
|                   | 8.10.4.1.2 Test 2  | 8.8.1.2 Test 2    |
|                   | 8.10.4.2.1 Test 1  | 8.8.2.1 Test 1    |
|                   | 8.10.4.2.1 Test 2  | 8.8.2.1 Test 2    |
|                   | 8.10.4.2.2 Test 1  | 8.8.2.2 Test 1    |
|                   | 8.10.4.2.2 Test 2  | 8.8.2.2 Test 2    |

8.1.2.12.1.2 Applicability rule and antenna connection for single carrier PDSCH tests with 8Rx

For 8Rx capable UEs all single carrier tests specified in 8.14 with 8Rx are tested on any of the 8Rx supported RF bands by connecting all 8Rx with data source from system simulator.

### 8.1.2.12.2 Applicability rule and antenna connection for control channel tests

#### 8.1.2.12.2.1 Applicability rule and antenna connection for control channel tests with 2Rx

For 8Rx capable UEs, all single carrier tests specified in 8.2 to 8.8 for control channel with 2Rx are tested on any of the 2Rx supported RF bands by connecting 2 out of the 8Rx with data source from system simulator, and the other 6 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 2Rx should be applied.

For 8Rx capable UEs without any 2Rx supported RF bands and with 4Rx supported RF bands, all single carrier tests specified in 8.2 to 8.8 for control channel with 2Rx are tested on any of the 4Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna. The SNR requirements should be applied with 1.5 dB less than the number specified for 2Rx tests.

For 8Rx capable UEs without any 2Rx and without 4Rx supported RF bands, all single carrier tests specified in 8.2 to 8.8 for control channel with 2Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna, as illustrated in Figure 8.1.2.12.1-1 and Figure 8.1.2.12.1-2. The SNR requirements should be applied with 1.5 dB less than the number specified for 2Rx tests.

#### 8.1.2.12.2.2 Applicability rule and antenna connection for control channel tests with 4Rx

For 8Rx capable UEs, all single carrier tests specified in 8.10 for control channel with 4Rx are tested on any of the 4Rx supported RF bands by connecting 4 out of the 8Rx with data source from system simulator, and the other 4 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 4Rx should be applied.

For 8Rx capable UEs without any 4Rx supported RF bands, all single carrier tests specified in 8.10 for control channel with 4Rx are tested on any of the 8Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna, as illustrated in Figure 8.1.2.12.1-3 and Figure 8.1.2.12.1-4. Same requirements specified with 4Rx should be applied.

### 8.1.2.12.3 Applicability rule and antenna connection for CA and DC tests

#### 8.1.2.12.3.1 Applicability rule and antenna connection for CA and DC tests with 2Rx

All tests specified in 8.2 to 8.8 with 2Rx with CA, TDD-FDD CA and DC are tested with 8 Rx capable UEs.

Within the CA/DC configuration if any of the PCell and/or the SCells and/or PSCells is a 2Rx supported RF band, the antenna connection should follow the same method as defined in 8.1.2.12.1 and 8.1.2.12.2 for single carrier tests on any of the 2Rx supported RF bands, with the same requirements specified with 2Rx applied.

Within the CA configuration if any of the PCell and/or the SCells and/or PSCells is a 4Rx supported RF band, the antenna connection should follow the same as illustrated in Figure 8.1.2.12.1-1 and Figure 8.1.2.12.1-2 for single carrier tests on any of the 4 Rx supported RF bands, with the SNR requirements applied with 1.5dB less than the number specified with 2Rx.

Within the CA configuration if any of the PCell and/or the SCells and/or PSCells is an 8Rx supported RF band, the antenna connection should follow the same as illustrated in Figure 8.1.2.12.1-1 and Figure 8.1.2.12.1-2 for single carrier tests on any of the 8Rx supported RF bands, with the SNR requirements applied with 3.0dB less than the number specified with 2Rx for PDSCH tests and 1.5dB less than the number specified with 2Rx for control channel tests.

Same applicability rules defined in 8.1.2.3, 8.1.2.3A, and 8.1.2.3B for CA, TDD-FDD CA and DC applied for different CA and DC configurations and bandwidth combination sets should be applied for 8 Rx capable UEs.

#### 8.1.2.12.3.2 Applicability rule and antenna connection for CA tests with 4Rx

All tests specified in 8.13 with 4Rx with FDD CA/DC, TDD CA/DC and TDD-FDD CA/DC are tested with 8 Rx capable UEs.

Within the CA/DC configuration if any of the PCell and/or the SCells and/or PSCells is a 4Rx supported RF band, the antenna connection should follow the same method as defined in 8.1.2.12.1 and 8.1.2.12.2 for single carrier tests on any of the 4Rx supported RF bands, with the same requirements specified with 4Rx applied.

Within the CA configuration if any of the PCell and/or the SCells and/or PSCells is an 8Rx supported RF band, the antenna connection should follow the same as illustrated in Figure 8.1.2.12.1-3 and Figure 8.1.2.12.1-4 for single carrier PDSCH tests on any of the 8Rx supported RF bands, with the SNR requirements applied with 1.5dB less than the number specified with 4Rx for PDSCH tests, and with the same SNR requirements as specified with 4Rx applied for control channel test.

Same applicability rules defined in 8.1.2.6.5 for CA, TDD-FDD CA and DC applied for different CA and DC configurations and bandwidth combination sets should be applied for 8 Rx capable UEs.

### 8.1.2.12.3.3 Applicability rule and antenna connection for CA tests with 8Rx

All tests specified in 8.14.2 with 8Rx with TDD CA are tested with 8 Rx capable UEs.

Within the CA configuration if any of the PCell and/or the SCells and/or PSCells is an 8Rx supported RF band, the antenna connection should follow the same method as defined in 8.1.2.12.1 for single carrier PDSCH tests on any of the 8Rx supported RF bands, with the same requirements specified with 8Rx applied.

For 8Rx capable UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 8.1.2.12.3-1 for TDD CA. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 8.1.2.12.3-1: Applicability and test rules for CA UE demodulation tests**

| Tests   | Step 1  | Step 2   | Step 3 | Step 4 |
|---|---|--|--------|--------|
| CA tests in Clause 8.14.2.2.1   | Select TDD CA configurations with the maximum number of CCs supporting 8 layers MIMO among all supported TDD CA configurations with any CA capability | Select any one of the TDD CA configuration with the largest aggregated CA bandwidth combinations on any 2CCs among all the CCs among all the selected TDD CA configuration from Step 1 | NA     | NA     |
| NOTE 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>NOTE 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>NOTE 3: A single Uplink CC is configured for all CA tests. |   |  |        |        |

## 8.1.3 UE category and UE DL category

UE category and UE DL category refer to *ue-Category* and *ue-CategoryDL* define in 4.1 and 4.1A from [12]. A UE that belongs to either a UE category or a UE DL category indicated in UE performance requirements in subclause 8, 9, 10 shall fulfil the corresponding requirements.

A UE indicating DL category 13 may indicate category 9 or 10 and shall thereby fulfil all requirements in subclause 8, 9, 10 that are indicated for either cat 9 or DL Cat 13 UEs. For SDR tests in section 8.7 both cat 9 and cat 13 test shall be used for this UE while for the other test only Cat 13 tests needs to be done.

## 8.2 Demodulation of PDSCH (Cell-Specific Reference Symbols)

### 8.2.1 FDD (Fixed Reference Channel)

The parameters specified in Table 8.2.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.2.1-1: Common Test Parameters (FDD)**

| Parameter          | Unit | Value |
|--------------------|------|-------|
| Inter-TTI Distance |      | 1     |



|  |              |  |
|--|--------------|--|
| Number of HARQ processes per component carrier         | Processes    | 8  |
| Maximum number of HARQ transmission                    |              | 4  |
| Redundancy version coding sequence                     |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cyclic Prefix  |              | Normal   |
| Cell_ID  |              | 0  |
| Cross carrier scheduling                               |              | Not configured   |

### 8.2.1.1 Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.3 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS. The QPSK and 64QAM cases are also used to verify the performance for all bandwidths specified in Table 5.6.1-1.

#### 8.2.1.1.1 Minimum Requirement

For single carrier, the requirements are specified in Table 8.2.1.1.1-2, with the addition of the parameters in Table 8.2.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.1.1.1-4, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.1.1-6, based on single carrier requirement specified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.1.1.1-7, based on single carrier requirement specified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.1.1.1-8, based on single carrier requirement specified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.1.1.1-9, based on single carrier requirement specified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.1.1.1-10, based on single carrier requirement specified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.1.1.1-1: Test Parameters**

| Parameter                 | Unit      | Test 1- 5     | Test 6- 8     | Test 9- 15    | Test 16- 18   | Test 19       |
|---------------------------|-----------|---------------|---------------|---------------|---------------|---------------|
| Downlink power allocation | $\rho_A$  | dB            | 0             | 0             | 0             | 0             |
|                           | $\rho_B$  | dB            | 0 (NOTE 1)    | 0 (NOTE 1)    | 0 (NOTE 1)    | 0 (NOTE 1)    |
|                           | $\sigma$  | dB            | 0             | 0             | 0             | 0             |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98           | -98           | -98           | -98           | -98           |
| Symbols for unused PRBs   |           | OCNG (NOTE 2) | OCNG (NOTE 2) | OCNG (NOTE 2) | OCNG (NOTE 2) | OCNG (NOTE 2) |

|   |  |      |       |       |       |      |
|---|--|------|-------|-------|-------|------|
| Modulation  |  | QPSK | 16QAM | 64QAM | 16QAM | QPSK |
| PDSCH transmission mode   |  | 1    | 1     | 1     | 1     | 1    |
| NOTE 1: $P_B = 0$ .   |  |      |       |       |       |      |
| NOTE 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |  |      |       |       |       |      |
| NOTE 3: Void.   |  |      |       |       |       |      |
| NOTE 4: Void.   |  |      |       |       |       |      |

Table 8.2.1.1.1-2: Minimum performance (FRC)

| Test num.  | Bandwidth      | Reference channel | OCNB pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|--|----------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|  |                |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1  | 10 MHz         | R.2 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.0     | ≥1          |
| 2  | 10 MHz         | R.2 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 70                                 | -0.4     | ≥1          |
| 3  | 10 MHz         | R.2 FDD           | OP.1 FDD     | ETU300                | 1x2 Low                                | 70                                 | 0.0      | ≥1          |
| 4  | 10 MHz         | R.2 FDD           | OP.1 FDD     | HST                   | 1x2                                    | 70                                 | -2.4     | ≥1          |
| 5  | 1.4 MHz        | R.4 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 0.0      | ≥1          |
| 6  | 10 MHz         | R.3 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 6.7      | ≥2          |
|  | 5 MHz          | R.3-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 6.7      | 1           |
|  | 5 MHz (NOTE 4) | R.3-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 6.7      | ≥2          |
| 7  | 10 MHz         | R.3 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.4      | ≥2          |
|  | 5 MHz          | R.3-1 FDD         | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.4      | 1           |
|  | 5 MHz (NOTE 4) | R.3-1 FDD         | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.4      | ≥2          |
| 8  | 10 MHz         | R.3 FDD           | OP.1 FDD     | ETU300                | 1x2 High                               | 70                                 | 9.4      | ≥2          |
|  | 5 MHz          | R.3-1 FDD         | OP.1 FDD     | ETU300                | 1x2 High                               | 70                                 | 9.4      | 1           |
|  | 5 MHz (NOTE 4) | R.3-1 FDD         | OP.1 FDD     | ETU300                | 1x2 High                               | 70                                 | 9.4      | ≥2          |
| 9  | 3 MHz          | R.5 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.6     | ≥1          |
| 10   | 5 MHz          | R.6 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.4     | ≥2          |
|  | 5 MHz          | R.6-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.5     | 1           |
| 11   | 10 MHz         | R.7 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.7     | ≥2          |
|  | 10 MHz         | R.7-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 16.7     | 1           |
| 12   | 10 MHz         | R.7 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 70                                 | 19.0     | ≥2          |
|  | 10 MHz         | R.7-1 FDD         | OP.1 FDD     | ETU70                 | 1x2 Low                                | 70                                 | 18.1     | 1           |
| 13   | 10 MHz         | R.7 FDD           | OP.1 FDD     | EVA5                  | 1x2 High                               | 70                                 | 19.1     | ≥2          |
|  | 10 MHz         | R.7-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 High                               | 70                                 | 17.8     | 1           |
| 14   | 15 MHz         | R.8 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.7     | ≥2          |
|  | 15 MHz         | R.8-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 16.8     | 1           |
| 15   | 20 MHz         | R.9 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.6     | ≥3          |
|  | 20 MHz         | R.9-2 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.3     | 2           |
|  | 20 MHz         | R.9-1 FDD         | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 16.7     | 1           |
| 16   | 3 MHz          | R.0 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.9      | ≥1          |
| 17   | 10 MHz         | R.1 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.9      | ≥1          |
| 18   | 20 MHz         | R.1 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                | 30                                 | 1.9      | ≥1          |
| 19   | 10 MHz         | R.41 FDD          | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -5.4     | ≥1          |
| NOTE 1: Void.  |                |                   |              |                       |  |                                    |          |             |
| NOTE 2: Void.  |                |                   |              |                       |  |                                    |          |             |
| NOTE 3: Void.  |                |                   |              |                       |  |                                    |          |             |
| NOTE 4: Test case applicability is defined in 8.1.2.1. |                |                   |              |                       |  |                                    |          |             |

Table 8.2.1.1.1-3: Test Parameters for CA

| Parameter                 | Unit     | Value |            |
|---------------------------|----------|-------|------------|
| Downlink power allocation | $\rho_A$ | dB    | 0          |
|                           | $\rho_B$ | dB    | 0 (NOTE 1) |
|                           | $\sigma$ | dB    | 0          |

|   |           |               |
|---|-----------|---------------|
| $N_{oc}$ at antenna port  | dBm/15kHz | -98           |
| Symbols for unused PRBs   |           | OCNG (NOTE 2) |
| Modulation  |           | QPSK          |
| PDSCH transmission mode   |           | 1             |
| NOTE 1: $P_B = 0$ .   |           |               |
| NOTE 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |               |
| NOTE 3: PUCCH format 1b with channel selection is used to feedback ACK/NACK for Tests in Table 8.2.1.1.1-4, PUCCH format 3 is used to feedback ACK/NACK for Tests in Table 8.2.1.1.1-6.   |           |               |
| NOTE 4: The same PDSCH transmission mode is applied to each component carrier.  |           |               |

**Table 8.2.1.1.1-4: Minimum performance (FRC) for CA with 2DL CCs**

| Test num.   | Bandwidth   | Reference channel       | OCNG pattern      | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|---|-------------|-------------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|   |             |                         |                   |                       |  | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1   | 2x10 MHz    | R.2 FDD                 | OP.1 FDD (NOTE 1) | EVA5                  | 1x2 Low                                | 70                                 | -1.1     | ≥3 (NOTE 2) |
| 2   | 2x20 MHz    | R.42 FDD                | OP.1 FDD (NOTE 1) | EVA5                  | 1x2 Low                                | 70                                 | -1.3     | ≥5          |
| 3   | 2x5 MHz     | R.42-2 FDD              | OP.1 FDD          | EVA5                  | 1x2 Low                                | 70                                 | -1.0     | ≥2          |
|   |             |                         | OP.1 FDD          |                       |  | 70                                 | -1.0     |             |
| 4   | 10MHz +5MHz | R.2 FDD for 10MHz CC    | OP.1 FDD          | EVA5                  | 1x2 Low                                | 70                                 | -1.7     | ≥3          |
|   |             | R.42-2 FDD for 5MHz CC  | OP.1 FDD          |                       |  | 70                                 | -1.0     |             |
| 5   | 15MHz +5MHz | R.42-3 FDD for 15MHz CC | OP.1 FDD          | EVA5                  | 1x2 Low                                | 70                                 | -1.6     | ≥3          |
|   |             | R.42-2 FDD for 5MHz CC  | OP.1 FDD          |                       |  | 70                                 | -1.0     |             |
| NOTE 1: The OCNG pattern applies for each CC.   |             |                         |                   |                       |  |                                    |          |             |
| NOTE 2: 30usec timing difference between two CCs is applied in inter-band CA case.  |             |                         |                   |                       |  |                                    |          |             |
| NOTE 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. |             |                         |                   |                       |  |                                    |          |             |

**Table 8.2.1.1.1-5: Single carrier performance for multiple CA configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz    | R.4 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.3     |
| 3MHz      | R.42-1 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.1     |
| 5MHz      | R.42-2 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.0     |
| 10MHz     | R.2 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.7     |

|       |            |          |      |         |    |      |
|-------|------------|----------|------|---------|----|------|
| 15MHz | R.42-3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 20MHz | R.42 FDD   | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |

**Table 8.2.1.1.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 3x20MHz                   | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 2         | 20MHz+20MHz+15MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 3         | 20MHz+20MHz+10MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 4         | 20MHz+15MHz+15MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 5         | 20MHz+15MHz+10MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 6         | 20MHz+10MHz+10MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 7         | 15MHz+15MHz+10MHz         | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 8         | 20MHz+10MHz+5MHz          | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 9         | 20MHz+15MHz+5MHz          | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 10        | 10MHz+10MHz+5MHz          | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 11        | 5MHz+5MHz+20MHz           | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 12        | 3x10MHz                   | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |
| 13        | 5MHz+5MHz+10MHz           | As specified in Table 8.2.1.1.1-5 per CC | ≥5          |

NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

NOTE 2: 30usec timing difference between PCell and any SCell, which is not within the same band or sub-block as PCell, is applied in inter-band CA case, where PCell can be assigned on any CC.

**Table 8.2.1.1.1-7: Minimum performance (FRC) based on single carrier performance for CA with 4DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 2         | 10MHz+20MHz+20MHz+20MHz   | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 3         | 10MHz+10MHz+20MHz+20MHz   | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 4         | 5MHz+10MHz+20MHz+20MHz    | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 5         | 5MHz+10MHz+10MHz+20MHz    | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 6         | 15+3x20MHz                | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 7         | 2x15+2x20MHz              | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 8         | 10+15+2x20MHz             | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 9         | 3x10+20MHz                | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 10        | 2x5+2x20MHz               | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 11        | 2x5+10+20MHz              | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |
| 12        | 4x10MHz                   | As specified in Table 8.2.1.1.1-5 per CC | ≥8          |

NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

NOTE 2: 30usec timing difference between PCell and any SCell, which is not within the same band or sub-block as PCell, is applied in inter-band CA case, where PCell can be assigned on any CC.

**Table 8.2.1.1.1-8: Minimum performance (FRC) based on single carrier performance for CA with 5DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 5x20MHz                   | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| 2         | 15MHz+4x20MHz             | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| 3         | 10MHz+4x20MHz             | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| 4         | 2x10MHz+3x20MHz           | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| 5         | 5MHz+10MHz+3x20MHz        | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| 6         | 3x10MHz+2x20MHz           | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |

|   |               |  |        |
|---|---------------|--|--------|
| 7   | 4x10MHz+20MHz | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11 |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3  |               |  |        |
| NOTE 2: 30usec timing difference between PCell and any SCell, which is not within the same band or sub-block as PCell, is applied in inter-band CA case, where PCell can be assigned on any CC. |               |  |        |

**Table 8.2.1.1.1-9: Minimum performance (FRC) based on single carrier performance for CA with 6DL CCs**

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 6x20MHz                   | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3  |                           |  |             |
| NOTE 2: 30usec timing difference between PCell and any SCell, which is not within the same band or sub-block as PCell, is applied in inter-band CA case, where PCell can be assigned on any CC. |                           |  |             |

**Table 8.2.1.1.1-10: Minimum performance (FRC) based on single carrier performance for CA with 7DL CCs**

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 7x20MHz                   | As specified in Table 8.2.1.1.1-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3  |                           |  |             |
| NOTE 2: 30usec timing difference between PCell and any SCell, which is not within the same band or sub-block as PCell, is applied in inter-band CA case, where PCell can be assigned on any CC. |                           |  |             |

8.2.1.1.2 Void

8.2.1.1.3 Void

8.2.1.1.4 Minimum Requirement 1 PRB allocation in presence of MBSFN

The requirements are specified in Table 8.2.1.1.4-2, with the addition of the parameters in Table 8.2.1.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the single-antenna performance with a single PRB allocated at the lower band edge in presence of MBSFN.

**Table 8.2.1.1.4-1: Test Parameters for Testing 1 PRB allocation**

| Parameter   | Unit      | Test 1        |
|---|-----------|---------------|
| Downlink power allocation                             | $\rho_A$  | dB            |
|   | $\rho_B$  | dB            |
|   | $\sigma$  | dB            |
| $N_{oc}$ at antenna port                              | dBm/15kHz | -98           |
| Symbols for MBSFN portion of MBSFN subframes (NOTE 2) |           | OCNG (NOTE 3) |
| PDSCH transmission mode                               |           | 1             |

|  |
|--|
| NOTE 1: $P_B = 0$  |
| NOTE 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe except the first two symbols in the first slot.  |
| NOTE 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead. |

Table 8.2.1.1.4-2: Minimum performance 1PRB (FRC)

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.29 FDD          | OP.3 FDD     | ETU70                 | 1x2 Low                                      | 30                                 | 2.0      | $\geq 1$    |

#### 8.2.1.1.4A Minimum Requirement 1 PRB allocation in presence of FeMBMS Unicast-mixed Cell under CA

The requirements are specified in Table 8.2.1.1.4A-2, with the addition of the parameters in Table 8.2.1.1.4A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the single-antenna performance with a single PRB allocated at the lower band edge in presence of FeMBMS Unicast-mixed Cell under CA.

Table 8.2.1.1.4A-1: Test Parameters for Testing 1 PRB allocation under CA

| Parameter  | Unit      | Test 1        |            |
|--|-----------|---------------|------------|
| Downlink power allocation  | $\rho_A$  | dB            | 0          |
|  | $\rho_B$  | dB            | 0 (NOTE 1) |
|  | $\sigma$  | dB            | 0          |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98           |            |
| Symbols for MBSFN portion of MBSFN subframes (NOTE 2)  |           | OCNG (NOTE 3) |            |
| PDSCH transmission mode in PCell and SCell   |           | 1             |            |
| Numerology in the MBSFN subframe in SCell  |           | 1.25kHz       |            |
| NOTE 1: $P_B = 0$  |           |               |            |
| NOTE 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe.   |           |               |            |
| NOTE 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead. |           |               |            |

Table 8.2.1.1.4A-2: Minimum performance 1PRB (FRC)

| Test number | Cell  | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |       |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | PCell | 10 MHz    | NA                | OP.3 FDD     | AWGN                  | 1x2 Low                                      | NA                                 | NA       | $\geq 1$    |

|   |       |       |               |              |       |         |    |     |          |
|---|-------|-------|---------------|--------------|-------|---------|----|-----|----------|
|   | SCell | 10MHz | R.29-1<br>FDD | OP.3A<br>FDD | ETU70 | 1x2 Low | 30 | 2.9 | $\geq 1$ |
| Note 1: If Test 1 in Table 8.2.1.1.4A-2 is tested, the test coverage can be considered fulfilled without executing Test 1 in Table 8.2.1.1.4-2. |       |       |               |              |       |         |    |     |          |

## 8.2.1.2 Transmit diversity performance

### 8.2.1.2.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.2.1.2.1-2, with the addition of the parameters in Table 8.2.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.2.1.2.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 |          | Unit      | Test 1-2    |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (NOTE 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| PDSCH transmission mode   |          |           | 2           |
| NOTE 1: $P_B = 1$ .       |          |           |             |

**Table 8.2.1.2.1-2: Minimum performance Transmit Diversity (FRC)**

| Test number  | Band-width     | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|--|----------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|  |                |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1  | 10 MHz         | R.11 FDD          | OP.1 FDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 6.8      | $\geq 2$    |
|  | 5 MHz          | R.11-2 FDD        | OP.1 FDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 5.9      | 1           |
|  | 5 MHz (NOTE 1) | R.11-2 FDD        | OP.1 FDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 5.9      | $\geq 2$    |
| 2  | 10 MHz         | R.10 FDD          | OP.1 FDD     | HST                   | 2x2  | 70                                 | -2.3     | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.1. |                |                   |              |                       |  |                                    |          |             |

### 8.2.1.2.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.2.2-2, with the addition of the parameters in Table 8.2.1.2.2-1 and the downlink physical channel setup according Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC-FSTD) with 4 transmitter antennas.

**Table 8.2.1.2.2-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 |          | Unit      | Test 1-2    |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (NOTE 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |

|                         |  |   |
|-------------------------|--|---|
| PDSCH transmission mode |  | 2 |
| NOTE 1: $P_B = 1$ .     |  |   |

**Table 8.2.1.2.2-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 1.4 MHz    | R.12 FDD          | OP.1 FDD     | EPA5                  | 4x2 Medium                                   | 70                                 | 0.6      | $\geq 1$    |
| 2           | 10 MHz     | R.13 FDD          | OP.1 FDD     | ETU70                 | 4x2 Low                                      | 70                                 | -0.9     | $\geq 1$    |

### 8.2.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

The requirements are specified in Table 8.2.1.2.3-2, with the addition of parameters in Table 8.2.1.2.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Table 8.2.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.1.2.3-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                                     |             | Unit      | Cell 1   | Cell 2   |
|---|-------------|-----------|--|--|
| Downlink power allocation                     | $\rho_A$    | dB        | -3   | -3   |
|   | $\rho_B$    | dB        | -3 (NOTE 1)  | -3   |
|   | $\sigma$    | dB        | 0  | N/A  |
| $N_{oc}$ at antenna port                      | $N_{oc1}$   | dBm/15kHz | -102 (NOTE 2)  | N/A  |
|   | $N_{oc2}$   | dBm/15kHz | -98 (NOTE 3)   | N/A  |
|   | $N_{oc3}$   | dBm/15kHz | -94.8 (NOTE 4)   | N/A  |
| $\widehat{E}_s / N_{oc2}$                     |             | dB        | Reference Value in Table 8.2.1.2.3-2                     | 6  |
| BW <sub>Channel</sub>                         |             | MHz       | 10   | 10   |
| Subframe Configuration                        |             |           | Non-MBSFN  | Non-MBSFN  |
| Time Offset between Cells                     |             | $\mu$ s   | 2.5 (synchronous cells)                                  |  |
| Cell Id                                       |             |           | 0  | 1  |
| ABS pattern (NOTE 5)                          |             |           | N/A  | 11000100<br>11000000<br>11000000<br>11000000<br>11000000 |
| RLM/RRM Measurement Subframe Pattern (NOTE 6) |             |           | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  |
| CSI Subframe Sets (NOTE7)                     | $C_{CSI,0}$ |           | 11000100<br>11000000<br>11000000<br>11000000<br>11000000 | N/A  |



|  |                    |  |  |        |
|--|--------------------|--|--|--------|
|  | C <sub>CSI,1</sub> |  | 00111011<br>00111111<br>00111111<br>00111111<br>00111111 | N/A    |
| Number of control OFDM symbols   |                    |  | 2  | 2      |
| PDSCH transmission mode  |                    |  | 2  | N/A    |
| Cyclic prefix  |                    |  | Normal   | Normal |
| <p>NOTE 1: <math>P_B = 1</math>.</p> <p>NOTE 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>NOTE 5: ABS pattern as defined in [9].</p> <p>NOTE 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>NOTE 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>NOTE 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>NOTE 9: SIB-1 will not be transmitted in Cell2 in this test.</p> |                    |  |  |        |

**Table 8.2.1.2.3-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number  | Reference Channel   | OCNG Pattern |          | Propagation Conditions (NOTE 1) |        | Correlation Matrix and Antenna Configuration | Reference Value                           |                   | UE Category |
|--|---------------------|--------------|----------|---------------------------------|--------|--|---|-------------------|-------------|
|  |                     | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Fraction of Maximum Throughput (%) NOTE 5 | SNR (dB) (Note 2) |             |
| 1  | R.11-4 FDD (NOTE 4) | OP.1 FDD     | OP.1 FDD | EVA5                            | EVA 5  | 2x2 Medium                                   | 70  | 3.4               | ≥2          |
| <p>NOTE 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.</p> <p>NOTE 2: SNR corresponds to <math>\hat{E}_s / N_{oc2}</math> of cell 1.</p> <p>NOTE 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.</p> <p>NOTE 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>NOTE 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.</p> |                     |              |          |                                 |        |  |   |                   |             |

**8.2.1.2.3A Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

The requirements are specified in Table 8.2.1.2.3A-2, with the addition of parameters in Table 8.2.1.2.3A-1. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cells with CRS assistance information. In Table 8.2.1.2.3A-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.1.2.3A-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 |           | Unit      | Cell 1       | Cell 2      | Cell 3      |
|---------------------------|-----------|-----------|--------------|-------------|-------------|
| Downlink power allocation | $\rho_A$  | dB        | -3           | -3          | -3          |
|                           | $\rho_B$  | dB        | -3 (NOTE 1)  | -3 (NOTE 1) | -3 (NOTE 1) |
|                           | $\sigma$  | dB        | 0            | N/A         | N/A         |
| $N_{oc}$ at antenna port  | $N_{oc1}$ | dBm/15kHz | -98 (NOTE 2) | N/A         | N/A         |

|  |             |           |  |  |  |
|--|-------------|-----------|--|--|--|
|  | $N_{oc2}$   | dBm/15kHz | -98 (NOTE 3)   | N/A  | N/A  |
|  | $N_{oc3}$   | dBm/15kHz | -93 (NOTE 4)   | N/A  | N/A  |
| $\hat{E}_s/N_{oc2}$  |             | dB        | Reference Value in Table 8.2.1.2.3 A-2                   | 12   | 10   |
| $BW_{Channel}$   |             | MHz       | 10   | 10   | 10   |
| Subframe Configuration   |             |           | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  |
| Time Offset between Cells  |             | $\mu s$   | N/A  | 3  | -1   |
| Frequency shift between Cells  |             | Hz        | N/A  | 300  | -100   |
| Cell Id  |             |           | 0  | 126  | 1  |
| ABS pattern (NOTE 5)   |             |           | N/A  | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 |
| RLM/RRM Measurement Subframe Pattern (NOTE 6)  |             |           | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  | N/A  |
| CSI Subframe Sets (NOTE 7)   | $C_{CSI,0}$ |           | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | N/A  | N/A  |
|  | $C_{CSI,1}$ |           | 00111111<br>00111111<br>00111111<br>00111111<br>00111111 | N/A  | N/A  |
| Number of control OFDM symbols   |             |           | 2  | NOTE 8   | NOTE 8   |
| PDSCH transmission mode  |             |           | 2  | NOTE 9   | NOTE 9   |
| Cyclic prefix  |             |           | Normal   | Normal   | Normal   |
| <p>NOTE 1: <math>P_B = 1</math>.</p> <p>NOTE 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>NOTE 5: ABS pattern as defined in [9].</p> <p>NOTE 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>NOTE 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>NOTE 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>NOTE 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNB pattern as defined in Annex A.5.</p> <p>NOTE 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>NOTE 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> |             |           |  |  |  |

**Table 8.2.1.2.3A-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNB Pattern |        |        | Propagation Conditions (NOTE 1) |        |        | Correlation Matrix and Antenna Configuration (NOTE 2) | Reference Value                           |                   | UE Cat gor |
|-------------|-------------------|--------------|--------|--------|---------------------------------|--------|--------|---|---|-------------------|------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                          | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) NOTE 5 | SNR (dB) (NOTE 3) |            |

|   |                      |             |             |             |      |      |      |            |    |     |    |
|---|----------------------|-------------|-------------|-------------|------|------|------|------------|----|-----|----|
| 1   | R.11-4 FDD<br>NOTE 4 | OP.1<br>FDD | OP.1<br>FDD | OP.1<br>FDD | EVA5 | EVA5 | EVA5 | 2x2 Medium | 70 | 3.4 | ≥2 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.   |                      |             |             |             |      |      |      |            |    |     |    |
| NOTE 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                      |             |             |             |      |      |      |            |    |     |    |
| NOTE 3: SNR corresponds to $\widehat{E}_s/N_{oc2}$ of cell 1.   |                      |             |             |             |      |      |      |            |    |     |    |
| NOTE 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |                      |             |             |             |      |      |      |            |    |     |    |
| NOTE 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.   |                      |             |             |             |      |      |      |            |    |     |    |

#### 8.2.1.2.4 Enhanced Performance Requirement Type A - 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.2.1.2.4-2, with the addition of parameters in Table 8.2.1.2.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.2.1.2.4-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.4-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter  |          | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|--|----------|-----------|----------------------|---------------------------------|---------------------------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3                   | -3                              | -3                              |
|  | $\rho_B$ | dB        | -3 (NOTE 1)          | -3                              | -3                              |
|  | $\sigma$ | dB        | 0                    | 0                               | 0                               |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  | N/A                             | N/A                             |
| DIP (NOTE 2)   |          | dB        | N/A                  | -2.23                           | -8.06                           |
| $BW_{Channel}$   |          | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |          |           | Normal               | Normal                          | Normal                          |
| Cell Id  |          |           | 0                    | 1                               | 2                               |
| Number of control OFDM symbols   |          |           | 2                    | 2                               | 2                               |
| PDSCH transmission mode  |          |           | 2                    | N/A                             | N/A                             |
| Interference model   |          |           | N/A                  | As specified in<br>clause B.5.2 | As specified in<br>clause B.5.2 |
| Probability of occurrence of<br>transmission rank in<br>interfering cells  | Rank 1   | %         | N/A                  | 80                              | 80                              |
|  | Rank 2   | %         | N/A                  | 20                              | 20                              |
| Reporting interval   |          | ms        | 5                    | N/A                             | N/A                             |
| Reporting mode   |          |           | PUCCH 1-0            | N/A                             | N/A                             |
| Physical channel for CQI reporting   |          |           | PUSCH(Note<br>5)     | N/A                             | N/A                             |
| cqi-pmi-ConfigurationIndex   |          |           | 2                    | N/A                             | N/A                             |
| NOTE 1: $P_B = 1$  |          |           |                      |                                 |                                 |
| NOTE 2: The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |          |           |                      |                                 |                                 |
| NOTE 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.   |          |           |                      |                                 |                                 |
| NOTE 4: Cell 2 transmission is delayed with respect to Cell 1 by 0.33 ms and Cell 3 transmission is delayed with respect to Cell 1 by 0.67 ms.   |          |           |                      |                                 |                                 |
| NOTE 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 and #0. |          |           |                      |                                 |                                 |

**Table 8.2.1.2.4-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value                    |                    | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|--------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SINR (dB) (NOTE 2) |             |
| 1           | R.46 FDD          | OP. 1 FDD    | N/A    | N/A    | EV A70                 | EV A70 | EV A70 | 2x2 Low   | 70                                 | -1.1               | ≥1          |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
 NOTE 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

**8.2.1.2.5 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model**

The requirements are specified in Table 8.2.1.2.5-2, with the addition of parameters in Table 8.2.1.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 2 interference model defined in clause B.6.1. In Table 8.2.1.2.5-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.5-1: Test Parameters for Transmit Diversity Performance (FRC) with TM2 interference model**

| Parameter                       |                           | Unit      | Cell 1            | Cell 2                       | Cell 3                       |
|---------------------------------|---------------------------|-----------|-------------------|------------------------------|------------------------------|
| Downlink power allocation       | $\rho_A$                  | dB        | -3                | -3                           | -3                           |
|                                 | $\rho_B$                  | dB        | -3 (Note 1)       | -3                           | -3                           |
|                                 | $\sigma$                  | dB        | 0                 | 0                            | 0                            |
| Cell-specific reference signals |                           |           | Antenna ports 0,1 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port        |                           | dBm/15kHz | -98               |                              |                              |
| $\hat{E}_s/N_{oc}$              |                           | dB        | N/A               | 13.91                        | 3.34                         |
| $BW_{Channel}$                  |                           | MHz       | 10                | 10                           | 10                           |
| Cyclic Prefix                   |                           |           | Normal            | Normal                       | Normal                       |
| Cell Id                         |                           |           | 0                 | 6                            | 1                            |
| Number of control OFDM symbols  |                           |           | 3                 | 3                            | 3                            |
| CFI indicated in PCFICH         |                           |           | 3                 | 3                            | 3                            |
| PDSCH transmission mode         |                           |           | 2                 | 2                            | 2                            |
| Interference model              |                           |           | N/A               | As specified in clause B.6.1 | As specified in clause B.6.1 |
| MBSFN                           |                           |           | Not configured    | Not configured               | Not configured               |
| Time offset to cell 1           |                           | us        | N/A               | 2                            | 3                            |
| Frequency offset to cell 1      |                           | Hz        | N/A               | 200                          | 300                          |
| NeighCellsInfo-r12 (Note 3)     | p-aList-r12               |           | N/A               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|                                 | transmissionModelList-r12 |           | N/A               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |

Note 1:  $P_B = 1$   
 Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.  
 Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 8.2.1.2.5-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM2 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1           | R.11-10 FDD       | OP. 1 FDD    | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 15.5              | ≥1          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.1.2.6 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model

The requirements are specified in Table 8.2.1.2.6-2, with the addition of parameters in Table 8.2.1.2.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In Table 8.2.1.2.6-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.6-1: Test Parameters for Transmit Diversity Performance (FRC) with TM9 interference model**

| Parameter   | Unit               | Cell 1            | Cell 2                       | Cell 3                       |    |
|---|--------------------|-------------------|------------------------------|------------------------------|----|
| Downlink power allocation   | $\rho_A$           | dB                | -3                           | 0                            | 0  |
|   | $\rho_B$           | dB                | -3 (Note 1)                  | 0                            | 0  |
|   | $\sigma$           | dB                | 0                            | -3                           | -3 |
| Cell-specific reference signals                                       |                    | Antenna ports 0,1 | Antenna ports 0,1            | Antenna ports 0,1            |    |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98               |                              |                              |    |
| $\hat{E}_s/N_{oc}$  | dB                 | N/A               | 3.28                         | 0.74                         |    |
| $BW_{Channel}$  | MHz                | 10                | 10                           | 10                           |    |
| Cyclic Prefix   |                    | Normal            | Normal                       | Normal                       |    |
| Cell Id   |                    | 0                 | 1                            | 6                            |    |
| Number of control OFDM symbols  |                    | 3                 | 3                            | 3                            |    |
| CFI indicated in PCFICH   |                    | 3                 | Random from set {1,2,3}      | Random from set {1,2,3}      |    |
| PDSCH transmission mode   |                    | 2                 | 9                            | 9                            |    |
| Interference model  |                    | N/A               | As specified in clause B.6.4 | As specified in clause B.6.4 |    |
| CSI reference signals   |                    | N/A               | Antenna ports 15,16          | Antenna ports 15,16          |    |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes          | N/A               | 10 / 1                       | 10 / 1                       |    |
| CSI reference signal configuration                                    |                    | N/A               | 6                            | 7                            |    |
| Zero-power CSI-RS configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap | Subframes / bitmap | N/A               | 6 / 0100000000000000         | 6 / 0010000000000000         |    |
| Time offset to cell 1   | us                 | N/A               | 5                            | -5                           |    |
| Frequency offset to cell 1  | Hz                 | N/A               | 600                          | -600                         |    |

|   |                          |  |                |                   |                   |
|---|--------------------------|--|----------------|-------------------|-------------------|
| MBSFN   |                          |  | Not configured | Not configured    | Not configured    |
| NeighCellsInfo-r12 (Note 4)   | p-aList-r12              |  | N/A            | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
|   | transmissionModeList-r12 |  | N/A            | {2,3,4,8,9}       | {2,3,4,8,9}       |
| Note 1: $P_B = 1$<br>Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. |                          |  |                |                   |                   |

**Table 8.2.1.2.6-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM9 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.11-9 FDD        | OP. 1 FDD    | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 8.4               | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

8.2.1.2.7 Minimum Requirement 2 Tx Antenna Port (Superposed transmission)

The requirements are specified in Table 8.2.1.2.7-2, with the addition of the parameters in Table 8.2.1.2.7-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of transmit diversity (SFBC) with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.1.2.7-1: Test Parameters for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  | Unit     | Test 1    |             |
|--|----------|-----------|-------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3          |
|  | $\rho_B$ | dB        | -3 (NOTE 1) |
|  | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98         |
| PDSCH transmission mode  |          |           | 2           |
| MUSTIdx (Note 2)   |          |           | 11          |
| p-a-must-r14 (Note 3)  |          |           | N/A         |
| Note 1: $P_B = 1$ .<br>Note 2: MUSTIdx is described in subclause 6.3.3 of [4].<br>Note 3: p-a-must-r14 is described in subclause 6.3.2 of [7]. |          |           |             |

**Table 8.2.1.2.7-2: Minimum Performance for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

|  |  |  |  |  |  |                 |  |
|--|--|--|--|--|--|-----------------|--|
|  |  |  |  |  |  | Reference value |  |
|--|--|--|--|--|--|-----------------|--|

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Fraction of Maximum Throughput (%) | SNR (dB) | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
| 1           | 10 MHz    | R.aa FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | 14.1     | ≥1          |

### 8.2.1.3 Open-loop spatial multiplexing performance

#### 8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.1.3.1-2, with the addition of the parameters in Table 8.2.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CC, the requirements are specified in Table 8.2.1.3.1-4, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.3.1-6, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.1.3.1-7, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.1.3.1-8, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.1.3.1-9, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.1.3.1-10, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.1.3.1-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 | Unit      | Test 1-4 |
|---------------------------|-----------|----------|
| Downlink power allocation | $\rho_A$  | dB       |
|                           | $\rho_B$  | dB       |
|                           | $\sigma$  | dB       |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98      |
| PD SCH transmission mode  |           | 3        |
| NOTE 1: $P_B = 1$ .       |           |          |
| NOTE 2: Void.             |           |          |
| NOTE 3: Void.             |           |          |

**Table 8.2.1.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test num   | Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|            |           |                   |              |                       |  | Fraction of maximum Throughput (%) | SNR (dB) |             |
| 1 (NOTE 4) | 10 MHz    | R.11 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70                                 | 13.0     | ≥2          |

|               |        |            |          |        |         |    |      |    |
|---------------|--------|------------|----------|--------|---------|----|------|----|
| 2<br>(NOTE 3) | 5 MHz  | R.11-2 FDD | OP.1 FDD | EVA70  | 2x2 Low | 70 | 12.7 | ≥2 |
| 3             | 10 MHz | R.35 FDD   | OP.1 FDD | EVA200 | 2x2 Low | 70 | 20.2 | ≥2 |
| 4             | 10 MHz | R.35-4 FDD | OP.1 FDD | ETU600 | 2x2 Low | 70 | 20.8 | ≥2 |

NOTE 1: Void.  
 NOTE 2: Test 1 may not be executed for UE-s for which Test 1 or 2 in Table 8.2.1.3.1-4 is applicable.  
 NOTE 3: Test case applicability is defined in 8.1.2.1.  
 NOTE 4: For UE that supports CRS interference handling, the CRS assistance information defined in [7] is provided. The CRS assistance information includes two aggressor cells with 2 CRS ports and cell ID of aggressor cells are 1 and 128. For UE that does not support CRS interference handling, CRS assistance information is not provided.

**Table 8.2.1.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter                 | Unit      | Value |
|---------------------------|-----------|-------|
| Downlink power allocation | $\rho_A$  | dB    |
|                           | $\rho_B$  | dB    |
|                           | $\sigma$  | dB    |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |
| PDSCH transmission mode   |           | 3     |

NOTE 1:  $P_B = 1$ .  
 NOTE 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-4, PUCCH format 3 is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-6.  
 NOTE 3: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.1.3.1-4: Minimum performance Large Delay CDD (FRC) for CA with 2DL CCs**

| Test num      | Bandwidth   | Reference channel       | OCNG pattern      | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|---------------|-------------|-------------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|               |             |                         |                   |                       |  | Fraction of maximum Throughput (%) | SNR (dB) |             |
| 1<br>(NOTE 2) | 2x10 MHz    | R.11 FDD                | OP.1 FDD (NOTE 1) | EVA70                 | 2x2 Low                                | 70                                 | 13.7     | ≥3          |
| 2<br>(NOTE 2) | 2x20 MHz    | R.30 FDD                | OP.1 FDD (NOTE 1) | EVA70                 | 2x2 Low                                | 70                                 | 13.2     | ≥5          |
| 3             | 2x5 MHz     | R.11-2 FDD              | OP.1 FDD          | EVA70                 | 2x2 Low                                | 70                                 | 12.7     | ≥2          |
| 4             | 10MHz+5 MHz | R.11 FDD for 10MHz CC,  | OP.1 FDD (NOTE 1) | EVA70                 | 2x2 Low                                | 70                                 | 13.0     | ≥3          |
|               |             | R.11-2 FDD for 5MHz CC  | OP.1 FDD (NOTE 1) |                       |  | 70                                 | 12.7     |             |
| 5             | 15MHz+5 MHz | R.11-7 FDD for 15MHz CC | OP.1 FDD (NOTE 1) | EVA70                 | 2x2 Low                                | 70                                 | 12.8     | ≥3          |
|               |             | R.11-2 FDD for 5MHz CC  | OP.1 FDD (NOTE 1) |                       |  | 70                                 | 12.7     |             |

NOTE 1: The OCNG pattern applies for each CC.  
 NOTE 2: Void  
 NOTE 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.



**Table 8.2.1.3.1-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|------------------------|--|------------------------------------|----------|
|            |                   |              |                        |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.11-5 FDD        | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 13.6     |
| 3MHz       | R.11-6 FDD        | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 12.3     |
| 5MHz       | R.11-2 FDD        | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 12.3     |
| 10 MHz     | R.11 FDD          | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 12.9     |
| 15MHz      | R.11-7 FDD        | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 12.8     |
| 20MHz      | R.30 FDD          | OP. 1 FDD    | EVA70                  | 2x2 Low                                | 70                                 | 12.9     |

**Table 8.2.1.3.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 3x20MHz                   | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 2         | 20MHz+20MHz+15MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 3         | 20MHz+20MHz+10MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 4         | 20MHz+15MHz+15MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 5         | 20MHz+15MHz+10MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 6         | 20MHz+10MHz+10MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 7         | 15MHz+15MHz+10MHz         | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 8         | 20MHz+10MHz+5MHz          | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 9         | 20MHz+15MHz+5MHz          | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 10        | 10MHz+10MHz+5MHz          | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 11        | 5MHz+5MHz+20MHz           | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 12        | 3x10MHz                   | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |
| 13        | 5MHz+5MHz+10MHz           | As specified in Table 8.2.1.3.1-5 per CC | ≥5          |

NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

**Table 8.2.1.3.1-7: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 2         | 10MHz+20MHz+20MHz+20MHz   | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 3         | 10MHz+10MHz+20MHz+20MHz   | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 4         | 5MHz+10MHz+20MHz+20MHz    | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 5         | 5MHz+10MHz+10MHz+20MHz    | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 6         | 15+3x20MHz                | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 7         | 2x15+2x20MHz              | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 8         | 10+15+2x20MHz             | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 9         | 3x10+20MHz                | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 10        | 2x5+2x20MHz               | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 11        | 2x5+10+20MHz              | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 12        | 4x10MHz                   | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |

NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

**Table 8.2.1.3.1-8: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 5x20MHz                   | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 2  | 15MHz+4x20MHz             | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 3  | 10MHz+4x20MHz             | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 4  | 2x10MHz+3x20MHz           | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 5  | 5MHz+10MHz+3x20MHz        | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 6  | 3x10MHz+2x20MHz           | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| 7  | 4x10MHz+20MHz             | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.1.3.1-9: Minimum performance (FRC) based on single carrier performance for CA with 6 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 6x20MHz                   | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.1.3.1-10: Minimum performance (FRC) based on single carrier performance for CA with 7 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 7x20MHz                   | As specified in Table 8.2.1.3.1-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

### 8.2.1.3.1A Soft buffer management test

For CA, the requirements are specified in Table 8.2.1.3.1A-2, with the addition of the parameters in Table 8.2.1.3.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.2.1.3.1A-3.

**Table 8.2.1.3.1A-1: Test Parameters for soft buffer management test (FRC) for CA**

| Parameter   | Unit      | Test 1-7 |
|---|-----------|----------|
| Downlink power allocation   | $\rho_A$  | dB       |
|   | $\rho_B$  | dB       |
|   | $\sigma$  | dB       |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98      |
| PDSCH transmission mode   |           | 3        |
| NOTE 1: $P_B = 1$ .   |           |          |
| NOTE 2: For CA test cases, PUCCH format 1b with channel selection is used to feedback ACK/NACK.   |           |          |
| NOTE 3: For CA test cases, the same PDSCH transmission mode is applied to each component carrier. |           |          |

**Table 8.2.1.3.1A-2: Minimum performance soft buffer management test (FRC) for CA**

| Test num | Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and | Reference value     |          |
|----------|-----------|-------------------|--------------|-----------------------|------------------------|---------------------|----------|
|          |           |                   |              |                       |                        | Fraction of maximum | SNR (dB) |

|   |               |                         |                   |       | antenna config. | Throughput (%) |      |
|---|---------------|-------------------------|-------------------|-------|-----------------|----------------|------|
| 1 | 2x20 MHz      | R.30 FDD                | OP.1 FDD (NOTE 1) | EVA70 | 2x2 Low         | 70             | 13.2 |
| 2 | 15MHz + 10MHz | R.35-2 FDD for 15MHz CC | OP.1 FDD (NOTE 1) | EVA5  | 2x2 Low         | 70             | 15.1 |
|   |               | R.35-3 FDD for 10MHz CC | OP.1 FDD (NOTE 1) |       |                 | 70             | 15.1 |
| 3 | 20MHz + 10MHz | R.30 FDD for 20MHz CC   | OP.1 FDD (NOTE 1) | EVA70 | 2x2 Low         | 70             | 13.5 |
|   |               | R.11 FDD for 10MHz CC   | OP.1 FDD (NOTE 1) |       |                 | 70             | 13.5 |
| 4 | 20MHz + 15MHz | R.30 FDD for 20MHz CC   | OP.1 FDD (NOTE 1) | EVA70 | 2x2 Low         | 70             | 13.5 |
|   |               | R.30-1 FDD for 15MHz CC | OP.1 FDD (NOTE 1) |       |                 | 70             | 13.5 |
| 5 | 2x20 MHz      | R.35-1 FDD              | OP.1 FDD (NOTE 1) | EVA5  | 2x2 Low         | 70             | 15.8 |
| 6 | 20MHz + 10MHz | R.35-1 FDD for 20MHz CC | OP.1 FDD (NOTE 1) | EVA5  | 2x2 Low         | 70             | 15.9 |
|   |               | R.35-3 FDD for 10MHz CC | OP.1 FDD (NOTE 1) |       |                 | 70             | 15.9 |
| 7 | 20MHz + 15MHz | R.35-1 FDD for 20MHz CC | OP.1 FDD (NOTE 1) | EVA5  | 2x2 Low         | 70             | 15.9 |
|   |               | R.35-2 FDD for 15MHz CC | OP.1 FDD (NOTE 1) |       |                 | 70             | 15.9 |

NOTE 1: For CA test cases, the OCNNG pattern applies for each CC.  
 NOTE 2: For Test 2, 3, 4, 6, 7 the Fraction of maximum Throughput applies to each CC.  
 NOTE 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

Table 8.2.1.3.1A-3: Test points for soft buffer management tests for CA

| UE category | Bandwidth combination with maximum aggregated bandwidth (NOTE 1) |             |             |             |
|-------------|--|-------------|-------------|-------------|
|             | 2x20MHz  | 15MHz+10MHz | 20MHz+10MHz | 20MHz+15MHz |
| 3           | 1  | 2           | 3           | 4           |
| 4           | 5  | N/A         | 6           | 7           |

NOTE 1: Maximum over all supported CA configurations and bandwidth combination sets according to Table 5.6A.1-1 and Table 5.6A.1-2.

8.2.1.3.1B Enhanced Performance Requirement Type C –2Tx Antenna Ports

The requirements are specified in Table 8.2.1.3.1B-2, with the addition of the parameters in Table 8.2.1.3.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

Table 8.2.1.3.1B-1: Test Parameters for Large Delay CDD (FRC)

| Parameter                 | Unit      | Test 1 |
|---------------------------|-----------|--------|
| Downlink power allocation | $\rho_A$  | dB     |
|                           | $\rho_B$  | dB     |
|                           | $\sigma$  | dB     |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98    |
| PDSCH transmission mode   |           | 3      |
| NOTE 1: $P_B = 1$ .       |           |        |

Table 8.2.1.3.1B-2: Enhanced Performance Requirement Type C for Large Delay CDD (FRC)

| Test num | Bandwidth | Reference channel | OCNG pattern | Propa- | Correlation matrix and | Reference value     |          | UE category |
|----------|-----------|-------------------|--------------|--------|------------------------|---------------------|----------|-------------|
|          |           |                   |              |        |                        | Fraction of maximum | SNR (dB) |             |

|   |        |          |          | gation<br>condi-<br>tion | antenna<br>config. | Throughput<br>(%) |      |    |
|---|--------|----------|----------|--------------------------|--------------------|-------------------|------|----|
| 1 | 10 MHz | R.11 FDD | OP.1 FDD | EVA70                    | 2x2 Medium         | 70                | 17.8 | ≥2 |

### 8.2.1.3.1C Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference

The requirements are specified in Table 8.2.1.3.1C-2, with the addition of parameters in Table 8.2.1.3.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performance with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell with transmission mode 1. In Table 8.2.1.3.1C-1, Cell 1 is the serving cell, and Cell 2 is interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.

**Table 8.2.1.3.1C-1 Test parameters for Larger Delay CDD (FRC) with TM1 interference**

| Parameter   | Unit      | Cell 1                                | Cell 2         |
|---|-----------|---------------------------------------|----------------|
| Bandwidth   | MHz       | 10 MHz                                |                |
| Downlink power allocation   | $\rho_A$  | -3                                    | 0              |
|   | $\rho_B$  | -3 (NOTE 1)                           | 0              |
|   | $\sigma$  | 0                                     | 0              |
| Cell-specific reference signals   |           | Antenna ports 0,1                     | Antenna port 0 |
| Cyclic Prefix   |           | Normal                                | Normal         |
| Cell ID   |           | 0                                     | 1              |
| Transmission mode   |           | 3                                     | NOTE 2         |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98                                   | N/A            |
| $\hat{E}_s/N_{oc}$ (NOTE 3)   | dB        | Reference Value in Table 8.2.1.3.1C-2 | 12.95          |
| Correlation and antenna configuration   |           | Medium (2x2)                          | Medium(1x2)    |
| Number of OFDM symbols for PDCCH  |           | 2                                     | N/A            |
| Max number of HARQ transmissions  |           | 4                                     | N/A            |
| Redundancy version coding sequence  |           | {0,1,2,3}                             | N/A            |
| NOTE 1: $P_B = 1$   |           |                                       |                |
| NOTE 2: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.2 applying OCNNG pattern OP.5 FDD as defined in Annex A.5.1.5. |           |                                       |                |
| NOTE 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.   |           |                                       |                |
| NOTE 4: All cells are time-synchronous.   |           |                                       |                |
| NOTE 5: SIB-1 will not be transmitted in Cell2 in this test.  |           |                                       |                |

**Table 8.2.1.3.1C-2 Enhanced Performance Requirement Type C, Larger Delay CDD (FRC) with TM1 interference**

| Test Number | Reference Channel | OCNG Pattern |        | Propagation Conditions (NOTE 1) |        | Reference Value     |          | UE Category |
|-------------|-------------------|--------------|--------|---------------------------------|--------|---------------------|----------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 1                          | Cell 2 | Fraction of Maximum | SNR (dB) |             |
|             |                   |              |        |                                 |        |                     |          |             |

|   |            |          |          |        |        | Throughput (%) | (NOTE 2) |    |
|---|------------|----------|----------|--------|--------|----------------|----------|----|
| 1   | R.11-8 FDD | OP.1 FDD | OP.5 FDD | EVA7 0 | EVA7 0 | 70             | 19.9     | ≥2 |
| NOTE 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |            |          |          |        |        |                |          |    |
| NOTE 2: SNR corresponds to $\bar{E}_s/N_{oc}$ of Cell 1.                                |            |          |          |        |        |                |          |    |

### 8.2.1.3.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.3.2-2, with the addition of the parameters in Table 8.2.1.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 4 transmitter antennas.

**Table 8.2.1.3.2-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 | Unit      | Test 1 |
|---------------------------|-----------|--------|
| Downlink power allocation | $\rho_A$  | dB     |
|                           | $\rho_B$  | dB     |
|                           | $\sigma$  | dB     |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98    |
| PDSCH transmission mode   |           | 3      |
| NOTE 1: $P_B = 1$         |           |        |

**Table 8.2.1.3.2-2: Minimum performance Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.14 FDD          | OP.1 FDD     | EVA70                 | 4x2 Low                                      | 70                                 | 14.3     | ≥2          |

### 8.2.1.3.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

The requirements for non-MBSFN ABS are specified in Table 8.2.1.3.3-2, with the addition of parameters in Table 8.2.1.3.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The requirements for MBSFN ABS are specified in Table 8.2.1.3.3-4, with the addition of parameters in Table 8.2.1.3.3-3 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Tables 8.2.1.3.3-1 and 8.2.1.3.3-3, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.1.3.3-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter                 | Unit      | Cell 1    | Cell 2         |
|---------------------------|-----------|-----------|----------------|
| Downlink power allocation | $\rho_A$  | dB        | -3             |
|                           | $\rho_B$  | dB        | -3 (NOTE 1)    |
|                           | $\sigma$  | dB        | 0              |
| $N_{oc}$ at antenna port  | $N_{oc1}$ | dBm/15kHz | -102 (NOTE 2)  |
|                           | $N_{oc2}$ | dBm/15kHz | -98 (NOTE 3)   |
|                           | $N_{oc3}$ | dBm/15kHz | -94.8 (NOTE 4) |

|  |                    |     |  |  |
|--|--------------------|-----|--|--|
| $\widehat{E}_s/N_{oc2}$  |                    | dB  | Reference Value in Table 8.2.1.3.3-2                     | 6  |
| BW <sub>Channel</sub>  |                    | MHz | 10   | 10   |
| Subframe Configuration   |                    |     | Non-MBSFN  | Non-MBSFN  |
| Cell Id  |                    |     | 0  | 1  |
| Time Offset between Cells  |                    | μs  | 2.5 (synchronous cells)                                  |  |
| ABS pattern (NOTE 5)   |                    |     | N/A  | 11000100,<br>11000000,<br>11000000,<br>11000000,<br>11000000 |
| RLM/RRM Measurement Subframe Pattern(NOTE 6)   |                    |     | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  |
| CSI Subframe Sets (NOTE 7)   | C <sub>CSI,0</sub> |     | 11000100<br>11000000<br>11000000<br>11000000<br>11000000 | N/A  |
|  | C <sub>CSI,1</sub> |     | 00111011<br>00111111<br>00111111<br>00111111<br>00111111 | N/A  |
| Number of control OFDM symbols   |                    |     | 2  | 2  |
| PDSCH transmission mode  |                    |     | 3  | N/A  |
| Cyclic prefix  |                    |     | Normal   | Normal   |
| <p>NOTE 1: <math>P_B = 1</math>.</p> <p>NOTE 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>NOTE 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>NOTE 5: ABS pattern as defined in [9].</p> <p>NOTE 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].</p> <p>NOTE 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>NOTE 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>NOTE 9: SIB-1 will not be transmitted in Cell2 in this test.</p> |                    |     |  |  |

**Table 8.2.1.3.3-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number  | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value                           |                   | UE Category |
|--|-------------------|--------------|----------|---------------------------------|--------|--|---|-------------------|-------------|
|  |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 2) |             |
| 1  | R.11 FDD Note 4   | OP.1 FDD     | OP.1 FDD | EVA 5                           | EVA 5  | 2x2 Low                                      | 70  | 13.3              | ≥2          |
| <p>Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.</p> <p>Note 2: SNR corresponds to <math>\widehat{E}_s/N_{oc2}</math> of cell 1.</p> <p>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.</p> <p>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.</p> |                   |              |          |                                 |        |  |   |                   |             |

Table 8.2.1.3.3-3: Test Parameters for Large Delay CDD (FRC) – MBSFN ABS

| Parameter   |             | Unit      | Cell 1   | Cell 2   |
|---|-------------|-----------|--|--|
| Downlink power allocation   | $\rho_A$    | dB        | -3   | -3   |
|   | $\rho_B$    | dB        | -3 (Note 1)  | -3   |
|   | $\sigma$    | dB        | 0  | N/A  |
| $N_{oc}$ at antenna port  | $N_{oc1}$   | dBm/15kHz | -102 (Note 2)  | N/A  |
|   | $N_{oc2}$   | dBm/15kHz | -98 (Note 3)   | N/A  |
|   | $N_{oc3}$   | dBm/15kHz | -94.8 (Note 4)                                       | N/A  |
| $\widehat{E}_s/N_{oc2}$   |             | dB        | Reference Value in Table 8.2.1.3.3-4                 | 6  |
| $BW_{Channel}$  |             | MHz       | 10   | 10   |
| Subframe Configuration  |             |           | Non-MBSFN  | MBSFN  |
| Cell Id   |             |           | 0  | 126  |
| Time Offset between Cells   |             | $\mu$ s   | 2.5 (synchronous cells)                              |  |
| ABS pattern (Note 5)  |             |           | N/A  | 0001000000<br>0100000010<br>0000001000<br>0000000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6)   |             |           | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A  |
| CSI Subframe Sets (Note 7)  | $C_{CSI,0}$ |           | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A  |
|   | $C_{CSI,1}$ |           | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A  |
| MBSFN Subframe Allocation (Note 10)   |             |           | N/A  | 001000<br>100001<br>000100<br>000000                 |
| Number of control OFDM symbols  |             |           | 2  | 2  |
| PDSCH transmission mode   |             |           | 3  | N/A  |
| Cyclic prefix   |             |           | Normal   | Normal   |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbol #0 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.</p> <p>Note 5: ABS pattern as defined in [9]. The 4<sup>th</sup>, 12<sup>th</sup>, 19<sup>th</sup> and 27<sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes.</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>Note 9: SIB-1 will not be transmitted in Cell2 in this test.</p> <p>Note 10: MBSFN Subframe Allocation as defined in [7], four frames with 24 bits is chosen for MBSFN subframe allocation.</p> <p>Note 11: The maximum number of uplink HARQ transmission is <math>\leq 2</math> so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test.</p> |             |           |  |  |

**Table 8.2.1.3.3-4: Minimum Performance Large Delay CDD (FRC) – MBSFN ABS**

| Test Number  | Reference Channel  | OCNG Pattern |          | Propagation Conditions (Note 2) |        | Correlation Matrix and Antenna Configuration | Reference Value                           |                   | UE Category |
|--|--------------------|--------------|----------|---------------------------------|--------|--|---|-------------------|-------------|
|  |                    | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 2) |             |
| 1  | R.11 FDD<br>Note 4 | OP.1 FDD     | OP.1 FDD | EVA 5                           | EVA 5  | 2x2 Low                                      | 70  | 12.0              | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.<br>Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.<br>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.<br>Note 5: The maximum Throughput is calculated from the total Payload in 4 subframes, averaged over 40ms. |                    |              |          |                                 |        |  |   |                   |             |

#### 8.2.1.3.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements for non-MBSFN ABS are specified in Table 8.2.1.3.4-2, with the addition of parameters in Table 8.2.1.3.4-1. The purpose is to verify the performance of large delay CDD with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cells with CRS assistance information. In Table 8.2.1.3.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell3.

**Table 8.2.1.3.4-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter                                     | Unit      | Cell 1   | Cell 2   | Cell 3   |             |
|---|-----------|--|--|--|-------------|
| Downlink power allocation                     | $\rho_A$  | dB   | -3   | -3   | -3          |
|   | $\rho_B$  | dB   | -3 (Note 1)  | -3 (Note 1)  | -3 (Note 1) |
|   | $\sigma$  | dB   | 0  | N/A  | N/A         |
| $N_{oc}$ at antenna port                      | $N_{oc1}$ | dBm/15kHz  | -98 (Note 2)   | N/A  | N/A         |
|   | $N_{oc2}$ | dBm/15kHz  | -98 (Note 3)   | N/A  | N/A         |
|   | $N_{oc3}$ | dBm/15kHz  | -93 (Note 4)   | N/A  | N/A         |
| $\hat{E}_s/N_{oc2}$                           | dB        | Reference Value in Table 8.2.1.3.4-2                     | Reference Value in Table 8.2.1.3.4-2                     | Reference Value in Table 8.2.1.3.4-2                     |             |
| $BW_{Channel}$                                | MHz       | 10   | 10   | 10   |             |
| Subframe Configuration                        |           | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  |             |
| Time Offset between Cells                     | μs        | N/A  | 3  | -1   |             |
| Frequency shift between Cells                 | Hz        | N/A  | 300  | -100   |             |
| Cell Id                                       |           | 0  | 1  | 126  |             |
| ABS pattern (Note 5)                          |           | N/A  | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 |             |
| RLM/RRM Measurement Subframe Pattern (Note 6) |           | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  | N/A  |             |



|   |                    |  |  |        |        |
|---|--------------------|--|--|--------|--------|
| CSI Subframe Sets<br>(Note7)  | C <sub>CSI,0</sub> |  | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | N/A    | N/A    |
|   | C <sub>CSI,1</sub> |  | 00111111<br>00111111<br>00111111<br>00111111<br>00111111 | N/A    | N/A    |
| Number of control OFDM symbols  |                    |  | 2  | Note 8 | Note 8 |
| PDSCH transmission mode   |                    |  | 3  | Note 9 | Note 9 |
| Cyclic prefix   |                    |  | Normal   | Normal | Normal |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 5: ABS pattern as defined in [9].</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNB pattern as defined in Annex A.5.</p> <p>Note 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> |                    |  |  |        |        |

**Table 8.2.1.3.4-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel  | $\hat{E}_s/N_{oc2}$ |        | OCNB Pattern |          |          | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                              |                      | UE Category |
|-------------|--------------------|---------------------|--------|--------------|----------|----------|--------------------------------|--------|--------|---|--|----------------------|-------------|
|             |                    | Cell 2              | Cell 3 | Cell 1       | Cell 2   | Cell 3   | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%)<br>Note 5 | SNR (dB)<br>(Note 3) |             |
| 1           | R.11 FDD<br>Note 4 | 9                   | 7      | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EVA5                           | EVA5   | EVA5   | 2x2 Low   | 70   | 13.9                 | ≥2          |
| 2           | R.35 FDD<br>Note 4 | 9                   | 1      | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EVA5                           | EVA5   | EVA5   | 2x2 Low   | 70   | 22.6                 | ≥2          |

- Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
- Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
- Note 3: SNR corresponds to  $\hat{E}_s/N_{oc2}$  of cell 1.
- Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
- Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.

**8.2.1.3.5 Minimum Requirement 2 Tx Antenna Port (Superposed transmission)**

The requirements are specified in Table 8.2.1.3.5-2, with the addition of the parameters in Table 8.2.1.3.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of open-loop spatial multiplexing with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.1.3.5-1: Test Parameters for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  |          | Unit      | Test 1     |
|--|----------|-----------|------------|
| Downlink power allocation                                    | $\rho_A$ | dB        | 0          |
|  | $\rho_B$ | dB        | 0 (NOTE 1) |
|  | $\sigma$ | dB        | 0          |
|  | PDSCH_RA | dB        | -3         |
|  | PDSCH_RB | dB        | -3         |
| $N_{oc}$ at antenna port                                     |          | dBm/15kHz | -98        |
| PDSCH transmission mode                                      |          |           | 3          |
| MUSTIdx (Note 2)   |          |           | 10         |
| p-a-must-r14 (Note 3)  |          |           | -3         |
| Note 1: $P_B = 1$ .  |          |           |            |
| Note 2: MUSTIdx is described in subclause 6.3.3 of [4].      |          |           |            |
| Note 3: p-a-must-r14 is described in subclause 6.3.2 of [7]. |          |           |            |

**Table 8.2.1.3.5-2: Minimum Performance for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.bb FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | 19.3     | $\geq 2$    |

### 8.2.1.3.6 Minimum Requirement 2 Tx Antenna Port (network-based CRS interference mitigation)

The requirements are specified in Table 8.2.1.3.6-2, with the addition of parameters in Table 8.2.1.3.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performance with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by CRS of one dominant interfering cell with network-based CRS interference mitigation. In Table 8.2.1.3.6-1, Cell 1 is the serving cell, and Cell 2 is interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.

**Table 8.2.1.3.6-1: Test parameters for Larger Delay CDD (FRC) with network-based CRS interference mitigation**

| Parameter                             |          | Unit      | Cell 1                               | Cell 2           |
|---------------------------------------|----------|-----------|--------------------------------------|------------------|
| Bandwidth                             |          | MHz       | 10 MHz                               |                  |
| Downlink power allocation             | $\rho_A$ | dB        | -3                                   | 0                |
|                                       | $\rho_B$ |           | -3 (Note 1)                          | 0                |
|                                       | $\sigma$ |           | 0                                    | 0                |
| Cell-specific reference signals       |          |           | Antenna ports 0,1                    | Antenna port 0,1 |
| Cyclic Prefix                         |          |           | Normal                               | Normal           |
| Cell ID                               |          |           | 0                                    | 1                |
| Transmission mode                     |          |           | 3                                    | NA (Note 4)      |
| $N_{oc}$ at antenna port              |          | dBm/15kHz | -98                                  | -98              |
| $\hat{E}_s/N_{oc}$ (Note 2)           |          | dB        | Reference Value in Table 8.2.1.3.6-2 | 10               |
| Correlation and antenna configuration |          |           | Low (2x2)                            | Low (2x2)        |

|   |  |           |   |
|---|--|-----------|---|
| Max number of HARQ transmissions  |  | 4         | N/A   |
| Redundancy version coding sequence  |  | {0,1,2,3} | N/A   |
| nw-BasedCRS-InterferenceMitigation-r15  |  | Disabled  | Enabled   |
| CRS transmission  |  | On        | CRS is configured with CRS muting pattern as '0000001111111111000' where every 20 subframes consist of 11 subframes with full system BW CRS and 9 subframes with CRS only on the center 6 PRBs (Note 5) |
| <p>Note 1: <math>P_B=1</math></p> <p>Note 2: Cell 1 is the serving cell. Cell 2 is the interfering cell.</p> <p>Note 3: All cells are time-synchronous.</p> <p>Note 4: Cell 2 has no PDSCH/PDCCH configured</p> <p>Note 5: In the muting pattern '0000001111111111000', 1 indicates DL subframes with full system BW CRS configured and 0 indicates DL subframes with CRS only on the center 6 PRBs configured.</p> |  |           |   |

**Table 8.2.1.3.6-2: Minimum performance Large Delay CDD (FRC) with network-based CRS interference mitigation**

| Test Number   | Reference Channel | OCNG Pattern |        | Propagation Conditions (Note 1) |        | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|---------------------------------|--------|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 1                          | Cell 2 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1   | R.11-13 FDD       | OP.1 FDD     | NA     | EVA5                            | EVA5   | 70                                 | 15.1              | ≥2          |
| <p>Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.</p> <p>Note 2: SNR corresponds to <math>\hat{E}_s/N_{oc}</math> of Cell 1.</p> |                   |              |        |                                 |        |                                    |                   |             |

## 8.2.1.4 Closed-loop spatial multiplexing performance

### 8.2.1.4.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.1.4.1-2, with the addition of the parameters in Table 8.2.1.4.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.1.4.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter                        | Unit      | Test 1    | Test 1A     | Test 2      |             |
|----------------------------------|-----------|-----------|-------------|-------------|-------------|
| Downlink power allocation        | $\rho_A$  | dB        | -3          | -3          | -3          |
|                                  | $\rho_B$  | dB        | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
|                                  | $\sigma$  | dB        | 0           | 0           | 0           |
| $N_{oc}$ at antenna port         | dBm/15kHz | -98       | -98         | -98         |             |
| Precoding granularity            | PRB       | 6         | 4           | 50          |             |
| PMI delay (Note 2)               | ms        | 8         | 8           | 8           |             |
| Reporting interval               | ms        | 1         | 1           | 1           |             |
| Reporting mode                   |           | PUSCH 1-2 | PUSCH 1-2   | PUSCH 3-1   |             |
| CodeBookSubsetRestriction bitmap |           | 001111    | 001111      | 001111      |             |
| PDSCH transmission mode          |           | 4         | 4           | 4           |             |

Note 1:  $P_B = 1$ .

Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).

**Table 8.2.1.4.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number  | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|--|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|  |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1  | 10 MHz    | R.10 FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -2.5     | ≥1          |
| 1A (Note 1)  | 5 MHz     | R.10-2 FDD        | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -2.9     | ≥1          |
| 2  | 10 MHz    | R.10 FDD          | OP.1 FDD     | EPA5                  | 2x2 High                                     | 70                                 | -2.3     | ≥1          |
| Note 1: Test case applicability is defined in 8.1.2.1. |           |                   |              |                       |  |                                    |          |             |

**8.2.1.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port**

The requirements are specified in Table 8.2.1.4.1A-2, with the addition of the parameters in Table 8.2.1.4.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.1.4.1A-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1   | Test 2   |
|---|-----------|--|--|
| Downlink power allocation   | $\rho_A$  | dB   | -6   |
|   | $\rho_B$  | dB   | -6 (Note 1)  |
|   | $\sigma$  | dB   | 3  |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  | -98  |
| Precoding granularity   | PRB       | 6  | 50   |
| PMI delay (Note 2)  | ms        | 8  | 8  |
| Reporting interval  | ms        | 1  | 1  |
| Reporting mode  |           | PUSCH 1-2  | PUSCH 3-1  |
| CodeBookSubsetRestriction on bitmap   |           | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111 | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111 |
| PDSCH transmission mode   |           | 4  | 4  |
| Note 1: $P_B = 1$ .   |           |  |  |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |  |  |

**Table 8.2.1.4.1A-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth     | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL category |
|-------------|---------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|             |               |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1           | 10 MHz        | R.13 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | -3.2     | ≥1          | ≥4             |
| 2           | 10MHz 1024QAM | R.101 FDD         | OP.1 FDD     | EPA5                  | 4x2 Low                                      | 70                                 | 25.1     | TBD         | 20, ≥ 22       |

### 8.2.1.4.1B Enhanced Performance Requirement Type A - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.1.4.1B-2, with the addition of the parameters in Table 8.2.1.4.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.2.1.4.1B-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.4.1B-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter  |          | Unit      | Cell 1            | Cell 2                       | Cell 3                       |
|--|----------|-----------|-------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3                | -3                           | -3                           |
|  | $\rho_B$ | dB        | -3 (Note 1)       | -3                           | -3                           |
|  | $\sigma$ | dB        | 0                 | 0                            | 0                            |
| Cell-specific reference signals  |          |           | Antenna ports 0,1 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98               | N/A                          | N/A                          |
| DIP (Note 2)   |          | dB        | N/A               | -1.73                        | -8.66                        |
| BW <sub>Channel</sub>  |          | MHz       | 10                | 10                           | 10                           |
| Cyclic Prefix  |          |           | Normal            | Normal                       | Normal                       |
| Cell Id  |          |           | 0                 | 1                            | 2                            |
| Number of control OFDM symbols   |          |           | 2                 | 2                            | 2                            |
| PDSCH transmission mode  |          |           | 6                 | N/A                          | N/A                          |
| Interference model   |          |           | N/A               | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1   | %         | N/A               | 80                           | 80                           |
|  | Rank 2   | %         | N/A               | 20                           | 20                           |
| Precoding granularity  |          | PRB       | 50                | 6                            | 6                            |
| PMI delay (Note 4)   |          | ms        | 8                 | N/A                          | N/A                          |
| Reporting interval   |          | ms        | 5                 | N/A                          | N/A                          |
| Reporting mode   |          |           | PUCCH 1-1         | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap   |          |           | 1111              | N/A                          | N/A                          |
| Physical channel for CQI reporting   |          |           | PUSCH(Not e 6)    | N/A                          | N/A                          |
| cqi-pmi-ConfigurationIndex   |          |           | 2                 | N/A                          | N/A                          |
| Note 1: $P_B = 1$  |          |           |                   |                              |                              |
| Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |          |           |                   |                              |                              |
| Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.   |          |           |                   |                              |                              |
| Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |          |           |                   |                              |                              |
| Note 5: All cells are time-synchronous.  |          |           |                   |                              |                              |
| Note 6: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 and #0. |          |           |                   |                              |                              |

**Table 8.2.1.4.1B-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|--------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1           | R.47 FDD          | OP. 1 FDD    | N/A    | N/A    | EV A5                  | EV A5  | EV A5  | 2x2 Low   | 70                                 | 0.8                | ≥1          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

**8.2.1.4.1C Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

The requirements are specified in Table 8.2.1.4.1C-2, with the addition of parameters in Table 8.2.1.4.1C-1. The purpose is to verify the closed loop rank-one performance with wideband precoding if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.1.4.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.1.4.1C-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) – Non-MBSFN ABS**

| Parameter                                     | Unit      | Cell 1   | Cell 2   | Cell 3   |             |
|---|-----------|--|--|--|-------------|
| Downlink power allocation                     | $\rho_A$  | dB   | -3   | -3   | -3          |
|   | $\rho_B$  | dB   | -3 (Note 1)  | -3 (Note 1)  | -3 (Note 1) |
|   | $\sigma$  | dB   | 0  | N/A  | N/A         |
| $N_{oc}$ at antenna port                      | $N_{oc1}$ | dBm/15kHz  | -98 (Note 2)   | N/A  | N/A         |
|   | $N_{oc2}$ | dBm/15kHz  | -98 (Note 3)   | N/A  | N/A         |
|   | $N_{oc3}$ | dBm/15kHz  | -93 (Note 4)   | N/A  | N/A         |
| $\hat{E}_s/N_{oc2}$                           | dB        | Reference Value in Table 8.2.1.4.1C-2                    | 12   | 10   |             |
| $BW_{Channel}$                                | MHz       | 10   | 10   | 10   |             |
| Subframe Configuration                        |           | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  |             |
| Time Offset between Cells                     | μs        | N/A  | 3  | -1   |             |
| Frequency shift between Cells                 | Hz        | N/A  | 300  | -100   |             |
| Cell Id                                       |           | 0  | 126  | 1  |             |
| ABS pattern (Note 5)                          |           | N/A  | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 |             |
| RLM/RRM Measurement Subframe Pattern (Note 6) |           | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  | N/A  |             |

|  |                    |     |  |        |        |
|--|--------------------|-----|--|--------|--------|
| CSI Subframe Sets (Note7)  | C <sub>csi,0</sub> |     | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | N/A    | N/A    |
|  | C <sub>csi,1</sub> |     | 00111111<br>00111111<br>00111111<br>00111111<br>00111111 | N/A    | N/A    |
| Number of control OFDM symbols   |                    |     | 2  | Note 8 | Note 8 |
| PDSCH transmission mode  |                    |     | 6  | Note 9 | Note 9 |
| Precoding granularity  |                    | PRB | 50   | N/A    | N/A    |
| PMI delay (Note 10)  |                    | ms  | 8  | N/A    | N/A    |
| Reporting interval   |                    | ms  | 1  | N/A    | N/A    |
| Reporting mode   |                    |     | PUSCH 3-1  | N/A    | N/A    |
| CodeBookSubsetRestriction bitmap   |                    |     | 1111   | N/A    | N/A    |
| Cyclic prefix  |                    |     | Normal   | Normal | Normal |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 5: ABS pattern as defined in [9].</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNB pattern as defined in Annex A.5.</p> <p>Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 11: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 12: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> |                    |     |  |        |        |

**Table 8.2.1.4.1C-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)– Non-MBSFN ABS**

| Test Number   | Reference Channel  | OCNB Pattern |             |             | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                           |                   | UE Category |
|---|--------------------|--------------|-------------|-------------|--------------------------------|--------|--------|---|---|-------------------|-------------|
|   |                    | Cell 1       | Cell 2      | Cell 3      | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) |             |
| 1   | R.11 FDD<br>Note 4 | OP.1<br>FDD  | OP.1<br>FDD | OP.1<br>FDD | EPA5                           | EPA5   | EPA5   | 2x2 High  | 70  | 6.1               | ≥2          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s / N_{oc2}</math> of cell 1.</p> <p>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.</p> |                    |              |             |             |                                |        |        |   |   |                   |             |

**8.2.1.4.1D Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model**

The requirements are specified in Table 8.2.1.4.1D-2, with the addition of the parameters in Table 8.2.1.4.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-

one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 4 interference model defined in clause B.6.3. In Table 8.2.1.4.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.4.1D-1: Test Parameters for Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter   |                          | Unit       | Cell 1                            | Cell 2                       | Cell 3                       |        |                         |
|---|--------------------------|------------|-----------------------------------|------------------------------|------------------------------|--------|-------------------------|
| Downlink power allocation   | $\rho_A$                 | dB         | -3                                | -3                           | -3                           |        |                         |
|   | $\rho_B$                 | dB         | -3 (Note 1)                       | -3                           | -3                           |        |                         |
|   | $\sigma$                 | dB         | 0                                 | 0                            | 0                            |        |                         |
| Cell-specific reference signals   |                          |            | Antenna ports 0,1                 | Antenna ports 0,1            | Antenna ports 0,1            |        |                         |
| $N_{oc}$ at antenna port  |                          | dBm/15 kHz | -98                               |                              |                              |        |                         |
| Test number (Note 4)  |                          |            |                                   | Test 1                       | Test 2                       | Test 1 | Test 2                  |
| $\widehat{E}_s/N_{oc}$  |                          | dB         | N/A                               | 13.91                        | 3.28                         | 3.34   | 0.74                    |
| Cell Id   |                          |            |                                   | 6                            | 1                            | 1      | 6                       |
| CFI indicated in PCFICH   |                          |            |                                   | 3                            | Random from set {1,2,3}      | 3      | Random from set {1,2,3} |
| BW <sub>Channel</sub>   |                          | MHz        | 10                                | 10                           | 10                           |        |                         |
| Cyclic Prefix   |                          |            | Normal                            | Normal                       | Normal                       |        |                         |
| Number of control OFDM symbols  |                          |            | 3                                 | 3                            | 3                            |        |                         |
| PDSCH transmission mode   |                          |            | 4                                 | 4                            | 4                            |        |                         |
| Interference model  |                          |            | N/A                               | As specified in clause B.6.3 | As specified in clause B.6.3 |        |                         |
| Precoding   |                          |            | Random wideband precoding per TTI | As specified in clause B.6.3 | As specified in clause B.6.3 |        |                         |
| Time offset to cell 1   |                          | us         | N/A                               | 2                            | 3                            |        |                         |
| Frequency offset to cell 1  |                          | Hz         | N/A                               | 200                          | 300                          |        |                         |
| MBSFN   |                          |            | Not configured                    | Not configured               | Not configured               |        |                         |
| NeighCellsInfo-r12 (Note 3)   | p-aList-r12              |            | N/A                               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |        |                         |
|   | transmissionModeList-r12 |            | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |        |                         |
| Note 1: $P_b = 1$<br>Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].<br>Note 4: Test 1 and Test 2 are defined in Table 8.2.1.4.1D-2. |                          |            |                                   |                              |                              |        |                         |

**Table 8.2.1.4.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Num   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.11-10 FDD       | OP.1 FDD     | N/A    | N/A    | EVA 5                  | EVA 5  | EVA 5  | 2x2 Low   | 85                                 | 17.0              | ≥1          |
| 2  | R.11-9 FDD        | OP.1 FDD     | N/A    | N/A    | EPA 5                  | EPA 5  | EPA 5  | 2x2 Low   | 85                                 | 10.1              | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: SNR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |



### 8.2.1.4.1E Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.2.1.4.1E-2, with the addition of parameters in Table 8.2.1.4.1E-1. The purpose is to verify the closed loop rank-one performance with wideband precoding when CRS assistance information [7] is configured. In Table 8.2.1.4.1E-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.1.4.1E-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   |          | Unit      | Cell 1                                | Cell 2                       | Cell 3                       |
|---|----------|-----------|---------------------------------------|------------------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3                                    | -3                           | -3                           |
|   | $\rho_B$ | dB        | -3 (Note 1)                           | -3 (Note 1)                  | -3 (Note 1)                  |
|   | $\sigma$ | dB        | 0                                     | 0                            | 0                            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                                   | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$  |          | dB        | Reference Value in Table 8.2.1.4.1E-2 | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>   |          | MHz       | 10                                    | 10                           | 10                           |
| Subframe Configuration  |          |           | Non-MBSFN                             | Non-MBSFN                    | Non-MBSFN                    |
| Time Offset to Cell 1   |          | μs        | N/A                                   | 3                            | -1                           |
| Frequency shift to Cell 1   |          | Hz        | N/A                                   | 300                          | -100                         |
| Cell Id   |          |           | 0                                     | 1                            | 128                          |
| Cell-specific reference signals   |          |           | Antenna ports 0,1                     |                              |                              |
| Number of control OFDM symbols  |          |           | 2                                     | 2                            | 2                            |
| PDSCH transmission mode   |          |           | 4                                     | N/A                          | N/A                          |
| Precoding granularity   |          | PRB       | 50                                    | N/A                          | N/A                          |
| PMI delay (Note 2)  |          | ms        | 8                                     | N/A                          | N/A                          |
| Reporting interval  |          | ms        | 1                                     | N/A                          | N/A                          |
| Reporting mode  |          |           | PUSCH 3-1                             | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 001111                                | N/A                          | N/A                          |
| Cyclic prefix   |          |           | Normal                                | Normal                       | Normal                       |
| Interference model  |          |           | N/A                                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells   |          | %         | N/A                                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1   | %         | N/A                                   | 80                           | 80                           |
|   | Rank 2   | %         | N/A                                   | 20                           | 20                           |
| Note 1: $P_B = 1$ .   |          |           |                                       |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |                                       |                              |                              |

**Table 8.2.1.4.1E-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |

|  |               |             |     |     |      |      |      |         |    |      |    |
|--|---------------|-------------|-----|-----|------|------|------|---------|----|------|----|
| 1  | R.10-3<br>FDD | OP.1<br>FDD | N/A | N/A | EVA5 | EVA5 | EVA5 | 2x2 low | 70 | 10.8 | ≥2 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1. |               |             |     |     |      |      |      |         |    |      |    |

### 8.2.1.4.1F Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.2.1.4.1F-2, with the addition of parameters in Table 8.2.1.4.1F-1. In Table 8.2.1.4.1F-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

**Table 8.2.1.4.1F-1: Test Parameters**

| Parameter  |          | Unit      | Cell 1                                | Cell 2                       | Cell 3                       |
|--|----------|-----------|---------------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_A$ | dB        | -6                                    | -6                           | -6                           |
|  | $\rho_B$ | dB        | -6 (Note 1)                           | -6 (Note 1)                  | -6 (Note 1)                  |
|  | $\sigma$ | dB        | 3                                     | 3                            | 3                            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                                   | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$   |          | dB        | Reference Value in Table 8.2.1.4.1F-2 | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>  |          | MHz       | 10                                    | 10                           | 10                           |
| Cyclic prefix  |          |           | Normal                                | Normal                       | Normal                       |
| Subframe Configuration   |          |           | Non-MBSFN                             | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID  |          |           | 0                                     | 1                            | 6                            |
| Cell-specific reference signals  |          |           | Antenna ports 0,1,2,3                 |                              |                              |
| Number of control OFDM symbols (CFI)   |          |           | 2                                     | 2                            | 2                            |
| PDSCH transmission mode  |          |           | 4                                     | N/A                          | N/A                          |
| Precoding granularity  |          | PRB       | 50                                    | N/A                          | N/A                          |
| PMI delay (Note 2)   |          | ms        | 8                                     | N/A                          | N/A                          |
| Reporting interval   |          | ms        | 1                                     | N/A                          | N/A                          |
| Reporting mode   |          |           | PUSCH 3-1                             | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap   |          |           | 000000000000<br>FFFF                  | N/A                          | N/A                          |
| Time Offset relative to Cell 1   |          | μs        | N/A                                   | 3                            | -1                           |
| Frequency shift relative to Cell 1   |          | Hz        | N/A                                   | 300                          | -100                         |
| Interference model   |          |           | N/A                                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells  |          | %         | N/A                                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1   | %         | N/A                                   | 80                           | 80                           |
|  | Rank 2   | %         | N/A                                   | 20                           | 20                           |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |                                       |                              |                              |

**Table 8.2.1.4.1F-2: Minimum Performance for PDSCH**

| Test Number | Reference Channel | OCNG Pattern | Propagation Conditions (Note1) | Correlation Matrix and | Reference Value |
|-------------|-------------------|--------------|--------------------------------|------------------------|-----------------|
|-------------|-------------------|--------------|--------------------------------|------------------------|-----------------|

|  |          | Cell 1   | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Antenna Configuration (Note 2) | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | UE Category |
|--|----------|----------|--------|--------|--------|--------|--------|--------------------------------|------------------------------------|-------------------|-------------|
| 1  | R.36 FDD | OP.1 FDD | N/A    | N/A    | EVA5   | EVA5   | EVA5   | 4x2 low                        | 70                                 | 14.0              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1. |          |          |        |        |        |        |        |                                |                                    |                   |             |

#### 8.2.1.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.1.4.2-2, with the addition of the parameters in Table 8.2.1.4.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.1.4.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter  | Unit        | Test 1-2  | Test 2A     | Test 3      |             |
|--|-------------|-----------|-------------|-------------|-------------|
| Downlink power allocation  | $\rho_A$    | dB        | -3          | -3          | -3          |
|  | $\rho_B$    | dB        | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
|  | $\sigma$    | dB        | 0           | 0           | 0           |
| $N_{oc}$ at antenna port   | dBm/15kHz   | -98       | -98         | -98         |             |
| Precoding granularity  | PRB         | 50        | 25          | 6           |             |
| PMI delay (Note 2)   | ms          | 8         | 8           | 8           |             |
| Reporting interval   | ms          | 1         | 1           | 1           |             |
| Reporting mode   |             | PUSCH 3-1 | PUSCH 3-1   | PUSCH 1-2   |             |
| CodeBookSubsetRestriction bitmap   |             | 110000    | 110000      | 110000      |             |
| PDSCH transmission mode  |             | 4         | 4           | 4           |             |
| Number of OFDM symbols for PDCCH per component carrier   | OFDM symbol | 2         | 3           | 1           |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |             |           |             |             |             |

**Table 8.2.1.4.2-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)**

| Test number  | Bandwidth    | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL category |
|--|--------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|  |              |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1  | 10 MHz       | R.35 FDD          | OP.1 FDD     | EPA5                  | 2x2 Low                                      | 70                                 | 18.9     | ≥2          | ≥6             |
| 2  | 10 MHz       | R.11 FDD          | OP.1 FDD     | ETU70                 | 2x2 Low                                      | 70                                 | 14.3     | ≥2          | ≥6             |
| 2A (Note 1)  | 5 MHz        | R.11-2 FDD        | OP.1 FDD     | ETU70                 | 2x2 Low                                      | 70                                 | 14.0     | ≥2          | ≥6             |
| 3  | 10MHz 256QAM | R. 65 FDD         | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | 25.3     | 11-12       | ≥11            |
| Note 1: Test case applicability is defined in 8.1.2.1. |              |                   |              |                       |  |                                    |          |             |                |

#### 8.2.1.4.2A Enhanced Performance Requirement Type C – Multi-layer Spatial Multiplexing 2Tx Antenna Ports

The requirements are specified in Table 8.2.1.4.2A-2, with the addition of the parameters in Table 8.2.1.4.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

**Table 8.2.1.4.2A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1    |             |
|---|-----------|-----------|-------------|
| Downlink power allocation   | $\rho_A$  | dB        | -3          |
|   | $\rho_B$  | dB        | -3 (Note 1) |
|   | $\sigma$  | dB        | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98       |             |
| Precoding granularity   | PRB       | 50        |             |
| PMI delay (Note 2)  | ms        | 8         |             |
| Reporting interval  | ms        | 1         |             |
| Reporting mode  |           | PUSCH 3-1 |             |
| CodeBookSubsetRestriction bitmap  |           | 110000    |             |
| PDSCH transmission mode   |           | 4         |             |
| Note 1: $P_B = 1$ .   |           |           |             |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |           |             |

**Table 8.2.1.4.2A-2: Enhanced Performance Requirement Type C for Multi-Layer Spatial Multiplexing with TM4 (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz     | R.11 FDD          | OP.1 FDD     | ETU70                 | 2x2 Medium                                   | 70                                 | 18.3     | $\geq 2$    |

#### 8.2.1.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.1.4.3-2, with the addition of the parameters in Table 8.2.1.4.3-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.1.4.3-4, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.4.3-6, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.1.4.3-7, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.1.4.3-8, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.1.4.3-9, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.1.4.3-10, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.1.4.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter   |          | Unit      | Test 1   |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | 6  |
| PMI delay (Note 2)  |          | ms        | 8  |
| Reporting interval  |          | ms        | 1  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>000011111111111111111000000000<br>00000000 |
| PDSCH transmission mode   |          |           | 4  |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: Void.<br>Note 4: Void.<br>Note 5: Void. |          |           |  |

**Table 8.2.1.4.3-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)**

| Test num      | Bandwidth | Referenc echannel | OCNG pattern | Propa- gation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|---------------|-----------|-------------------|--------------|-------------------------|--|------------------------------------|----------|-------------|
|               |           |                   |              |                         |  | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1             | 10 MHz    | R.36 FDD          | OP.1 FDD     | EPA5                    | 4x2 Low                                | 70                                 | 14.7     | $\geq 2$    |
| Note 1: Void. |           |                   |              |                         |  |                                    |          |             |

**Table 8.2.1.4.3-3: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                        |          | Unit      | Value  |
|----------------------------------|----------|-----------|--|
| Downlink power allocation        | $\rho_A$ | dB        | -6   |
|                                  | $\rho_B$ | dB        | -6 (Note 1)  |
|                                  | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port         |          | dBm/15kHz | -98  |
| Precoding granularity            |          | PRB       | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs          |
| PMI delay (Note 2)               |          | ms        | 8  |
| Reporting interval               |          | ms        | 1  |
| Reporting mode                   |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap |          |           | 00000000000000000000000000000000<br>00111111111111111111100000000000<br>0000 |
| CSI request field (Note 3)       |          |           | '10'   |
| PDSCH transmission mode          |          |           | 4  |

|         |   |
|---------|---|
| Note 1: | $P_B = 1$ .   |
| Note 2: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 3: | Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.   |
| Note 4: | ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for Tests in Table 8.2.1.4.3-4, and with PUCCH format 3 for Tests in Table 8.2.1.4.3-6.                                |
| Note 5: | The same PDSCH transmission mode is applied to each component carrier.  |

**Table 8.2.1.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA with 2DL CCs**

| Test num | Bandwidth   | Reference channel       | OCNG pattern      | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|----------|-------------|-------------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|          |             |                         |                   |                       |  | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1        | 2x10 MHz    | R.14 FDD                | OP.1 FDD (Note 1) | EVA5                  | 4x2 Low                                | 70                                 | 10.8     | ≥3          |
| 2        | 2x20 MHz    | R.14-3 FDD              | OP.1 FDD (Note 1) | EVA5                  | 4x2 Low                                | 70                                 | 10.9     | ≥5          |
| 3        | 2x5 MHz     | R.14-6 FDD              | OP.1 FDD (Note 1) | EVA5                  | 4x2 Low                                | 70                                 | 9.5      | ≥2          |
|          |             |                         | OP.1 FDD (Note 1) |                       |  | 70                                 | 9.5      |             |
| 4        | 10MHz+5 MHz | R.14 FDD for 10MHz CC   | OP.1 FDD (Note 1) | EVA5                  | 4x2 Low                                | 70                                 | 10.1     | ≥3          |
|          |             | R.14-6 FDD for 5MHz CC  | OP.1 FDD (Note 1) |                       |  | 70                                 | 9.5      |             |
| 5        | 15MHz+5 MHz | R.14-7 FDD for 15MHz CC | OP.1 FDD (Note 1) | EVA5                  | 4x2 Low                                | 70                                 | 10.1     | ≥3          |
|          |             | R.14-6 FDD for 5MHz CC  | OP.1 FDD (Note 1) |                       |  | 70                                 | 9.5      |             |

NOTE 1: The OCNG pattern applies for each CC.  
 NOTE 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.1.4.3-5: Single carrier performance for multiple CA configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz    | R.14-4 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.4     |
| 3MHz      | R.14-5 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 5MHz      | R.14-6 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 10 MHz    | R.14 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 15MHz     | R.14-7 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 20MHz     | R.14-3 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.3     |

**Table 8.2.1.4.3-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 3x20MHz                   | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 2  | 20MHz+20MHz+15MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 3  | 20MHz+20MHz+10MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 4  | 20MHz+15MHz+15MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 5  | 20MHz+15MHz+10MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 6  | 20MHz+10MHz+10MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 7  | 15MHz+15MHz+10MHz         | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 8  | 20MHz+10MHz+5MHz          | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 9  | 20MHz+15MHz+5MHz          | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 10   | 10MHz+10MHz+5MHz          | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 11   | 5MHz+5MHz+20MHz           | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 12   | 3x10MHz                   | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| 13   | 5MHz+5MHz+10MHz           | As specified in Table 8.2.1.4.3-5 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.1.4.3-7: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 4x20MHz                   | As specified in Table 8.2.1.4.3-5 per CC | ≥8          |
| 2  | 10MHz+20MHz+20MHz+20MHz   | As specified in Table 8.2.1.4.3-5 per CC | ≥8          |
| 3  | 10MHz+10MHz+20MHz+20MHz   | As specified in Table 8.2.1.4.3-5 per CC | ≥8          |
| 4  | 5MHz+10MHz+20MHz+20MHz    | As specified in Table 8.2.1.4.3-5 per CC | ≥8          |
| 5  | 5MHz+10MHz+10MHz+20MHz    | As specified in Table 8.2.1.4.3-5 per CC | ≥8          |
| 6  | 15+3x20MHz                | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 7  | 2x15+2x20MHz              | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 8  | 10+15+2x20MHz             | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 9  | 3x10+20MHz                | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 10   | 2x5+2x20MHz               | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 11   | 2x5+10+20MHz              | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| 12   | 4x10MHz                   | As specified in Table 8.2.1.3.1-5 per CC | ≥8          |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.1.4.3-8: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 5x20MHz                   | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 2  | 15MHz+4x20MHz             | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 3  | 10MHz+4x20MHz             | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 4  | 2x10MHz+3x20MHz           | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 5  | 5MHz+10MHz+3x20MHz        | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 6  | 3x10MHz+2x20MHz           | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| 7  | 4x10MHz+20MHz             | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.1.4.3-9: Minimum performance (FRC) based on single carrier performance for CA with 6 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 6x20MHz                   | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |

NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

**Table 8.2.1.4.3-10: Minimum performance (FRC) based on single carrier performance for CA with 7 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 7x20MHz                   | As specified in Table 8.2.1.4.3-5 per CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

#### 8.2.1.4.3A Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.2.1.4.3A-3 for 2DL CCs and Table 8.2.1.4.3A-4 for 3DL CCs, based on single carrier requirement specified in Table 8.2.1.4.3A-2, with the addition of the parameters in Table 8.2.1.4.3A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity transmission.

**Table 8.2.1.4.3A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Parameter   | Unit      | Values   |             |
|---|-----------|--|-------------|
| Downlink power allocation   | $\rho_A$  | dB   | -6          |
|   | $\rho_B$  | dB   | -6 (Note 1) |
|   | $\sigma$  | dB   | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  |             |
| Precoding granularity   | PRB       | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs  |             |
| PMI delay (Note 2)  | ms        | 8  |             |
| Reporting interval  | ms        | 1  |             |
| Reporting mode  |           | PUSCH 1-2  |             |
| CodeBookSubsetRestriction bitmap  |           | 00000000000000000000000000000000<br>000011111111111111111100000000<br>00000000   |             |
| PDSCH transmission mode   |           | 4  |             |
| ACK/NACK transmission   |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |             |
| CSI feedback  |           | Separate PUSCH feedbacks on the MCG and SCG  |             |
| Time offset between MCG CC and SCG CC   | $\mu$ s   | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 4) |             |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: The same PDSCH transmission mode is applied to each component carrier.</p> <p>Note 4: As defined in TS36.300 [11].</p> <p>Note 5: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.</p> |           |  |             |



**Table 8.2.1.4.3A-2: Single carrier performance for multiple dual connectivity configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.14-4 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.36    |
| 3MHz       | R.14-5 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 5MHz       | R.14-6 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 10 MHz     | R.14 FDD          | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 15MHz      | R.14-7 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 20MHz      | R.14-3 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.3     |

**Table 8.2.1.4.3A-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity with 2 DL CCs**

| Test num. | Band-width combination | Requirement                               | UE category |
|-----------|------------------------|---|-------------|
| 1         | 2x20 MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 2         | 15+20 MHz              | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 3         | 10+20MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 4         | 2x15 MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 5         | 2x10 MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥3          |
| 6         | 15+5 MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥3          |
| 7         | 10+15 MHz              | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |

Note 1: The OCNG pattern applies for each CC.  
Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A.

**Table 8.2.1.4.3A-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity with 3DL CCs**

| Test num. | Band-width combination | Requirement                               | UE category |
|-----------|------------------------|---|-------------|
| 1         | 20+20+15MHz            | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 2         | 20+15+15MHz            | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 3         | 3x20 MHz               | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 4         | 20+20+10 MHz           | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 5         | 20+15+10 MHz           | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 6         | 20+10+10 MHz           | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |
| 7         | 15+15+10 MHz           | As specified in Table 8.2.1.4.3A-2 per CC | ≥5          |

Note 1: The OCNG pattern applies for each CC.  
Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A.

#### 8.2.1.4.4 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port (Superposed transmission)

The requirements are specified in Table 8.2.1.4.4-2, with the addition of the parameters in Table 8.2.1.4.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of closed-loop spatial multiplexing with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.1.4.4-1: Test Parameters for Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  | Unit     | Test 1    |                                   |
|--|----------|-----------|-----------------------------------|
| Downlink power allocation                                    | $\rho_A$ | dB        | 0                                 |
|  | $\rho_B$ | dB        | 0 (NOTE 1)                        |
|  | $\sigma$ | dB        | 0                                 |
|  | PDSCH_RA | dB        | -3                                |
|  | PDSCH_RB | dB        | -3                                |
| $N_{oc}$ at antenna port                                     |          | dBm/15kHz | -98                               |
| PDSCH transmission mode                                      |          |           | 4                                 |
| Precoding  |          |           | Random wideband precoding per TTI |
| MUSTIdx for transport block 1 (Note 2)                       |          |           | 10                                |
| MUSTIdx for transport block 2 (Note 2)                       |          |           | 00                                |
| p-a-must-r14 (Note 3)  |          |           | -3                                |
| Note 1: $P_B = 1$ .  |          |           |                                   |
| Note 2: MUSTIdx is described in subclause 6.3.3 of [4].      |          |           |                                   |
| Note 3: p-a-must-r14 is described in subclause 6.3.2 of [7]. |          |           |                                   |

**Table 8.2.1.4.4-2: Minimum Performance for Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port - Superposed transmission (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.bb FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | 17.3     | $\geq 2$    |

### 8.2.1.5 MU-MIMO

### 8.2.1.6 [Control channel performance: D-BCH and PCH]

### 8.2.1.7 Carrier aggregation with power imbalance

For CA, the requirements in this section verify the ability of an intraband adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only.

#### 8.2.1.7.1 Minimum Requirement

The requirements are specified in Table 8.2.1.7.1-2, with the addition of the parameters in Table 8.2.1.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.7.1-1: Test Parameters for CA**

| Parameter                 | Unit     | Test 1 | Test 2-3   |
|---------------------------|----------|--------|------------|
| Downlink power allocation | $\rho_A$ | dB     | 0          |
|                           | $\rho_B$ | dB     | 0 (Note 1) |
|                           | $\sigma$ | dB     | 0          |

|   |       |           |               |               |
|---|-------|-----------|---------------|---------------|
| $N_{oc}$ at antenna port  |       | dBm/15kHz | Off (Note 2)  | Off (Note 2)  |
| Symbols for unused PRBs   |       |           | OCNG (Note 3) | OCNG (Note 3) |
| Modulation  |       |           | 64 QAM        | 64 QAM        |
| Maximum number of HARQ transmission   |       |           | 1             | 1             |
| Redundancy version coding sequence  |       |           | {0}           | {0}           |
| PDSCH transmission mode of PCell  |       |           | 1             | 3             |
| PDSCH transmission mode of SCell  |       |           | 3             | 1             |
| OCNG Pattern  | PCell |           | OP.1 FDD      | OP.5 FDD      |
|   | SCell |           | OP.5 FDD      | OP.1 FDD      |
| Propagation Conditions  | PCell |           | Clause B.1    | Clause B.1    |
|   | SCell |           | Clause B.1    | Clause B.1    |
| Correlation Matrix and Antenna  | PCell |           | 1x2           | 2x2           |
|   | SCell |           | 2x2           | 1x2           |
| Note 1: $P_B = 0$ for 1x2 and $P_B = 1$ for 2x2 antenna configuration.  |       |           |               |               |
| Note 2: No external noise sources are applied   |       |           |               |               |
| Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated. pseudo random data. |       |           |               |               |
| Note 4: Void  |       |           |               |               |

Table 8.2.1.7.1-2: Minimum performance (FRC) for CA

| Test Number | Bandwidth (MHz)   |       | Reference channel |            | Power at antenna port (dBm/15KHz) |                                   | Reference value Fraction of Maximum Throughput (%) |       | UE Category |
|-------------|---|-------|-------------------|------------|-----------------------------------|-----------------------------------|--|-------|-------------|
|             | PCell   | SCell | PCell             | SCell      | $\hat{E}_{s\_PCell}$<br>for PCell | $\hat{E}_{s\_SCell}$<br>for SCell | PCell  | SCell |             |
| 1           | 20  | 20    | R.49 FDD          | NA         | -85                               | -79                               | 85   | NA    | $\geq 5$    |
| 2           | 10  | 10    | NA                | R.49-1 FDD | -79                               | -85.8                             | NA   | 85    | $\geq 5$    |
| 3           | 5   | 5     | NA                | R.49-2 FDD | -79                               | -85.9                             | NA   | 85    | $\geq 5$    |
| Note 1:     | The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH. |       |                   |            |                                   |                                   |  |       |             |
| Note 2:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.                   |       |                   |            |                                   |                                   |  |       |             |

### 8.2.1.8 Intra-band non-contiguous carrier aggregation with timing offset

The requirements in this section verify the ability of an intraband non-contiguous carrier aggregation UE to demodulate the signal transmitted by the PCell and SCell in the presence of timing offset between the cells. Throughput is measured on both cells.

#### 8.2.1.8.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.1.8.1-2, with the addition of the parameters in Table 8.2.1.8.1-1 and the downlink physical channel setup according to Annex C.3.2.

Table 8.2.1.8.1-1: Test Parameters for CA

| Parameter                 | Unit      | Test 1 |             |
|---------------------------|-----------|--------|-------------|
| Downlink power allocation | $\rho_A$  | dB     | -3          |
|                           | $\rho_B$  | dB     | -3 (Note 1) |
|                           | $\sigma$  | dB     | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98    |             |

|  |  |           |
|--|--|-----------|
| Modulation   |  | 64 QAM    |
| Maximum number of HARQ transmission  |  | 4         |
| Redundancy version coding sequence   |  | {0,0,1,2} |
| PDSCH transmission mode of PCell   |  | 3         |
| PDSCH transmission mode of SCell   |  | 3         |
| Note 1: $P_B = 1$ .  |  |           |
| Note 2: The OCNG pattern is used to fill unused control channel and PDSCH. |  |           |

**Table 8.2.1.8.1-2: Minimum performance (FRC) for CA**

| Test Number   | Cell  | Bandwidth | Reference Channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and Antenna | Reference value                    |          | Timing relative to PCell (µs) | UE Category |
|---|-------|-----------|-------------------|--------------|------------------------|--------------------------------|------------------------------------|----------|-------------------------------|-------------|
|   |       |           |                   |              |                        |                                | Fraction of Maximum Throughput (%) | SNR (dB) |                               |             |
| 1   | PCell | 10MHz     | R.35-4 FDD        | OP.1 FDD     | EPA200                 | 2x2 Low                        | 70                                 | 21.15    | N/A                           | ≥3          |
|   | SCell | 10MHz     | R.35-3 FDD        |              | EPA200                 | 2x2 Low                        | 60                                 | 15.18    | -30.26                        |             |
| Note 1: The EPA200 propagation channels applied to PCell and SCell are statistically independent.   |       |           |                   |              |                        |                                |                                    |          |                               |             |
| Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3. |       |           |                   |              |                        |                                |                                    |          |                               |             |

### 8.2.1.9 HST-SFN performance

#### 8.2.1.9.1 Minimum Requirement

The purpose of this test is to verify UE performance in the HST-SFN scenario defined in B.3A when *highSpeedEnhancedDemodulationFlag* [7] is received.

For single carrier, the requirements are specified in Table 8.2.1.9.1-2, with the addition of the parameters in Table 8.2.1.9.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CC, the requirements are specified in Table 8.2.1.9.1-5, based on single carrier requirement specified in Table 8.2.1.9.1-4, with the addition of the parameters in Table 8.2.1.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.9.1-6, based on single carrier requirement specified in Table 8.2.1.9.1-4, with the addition of the parameters in Table 8.2.1.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.1.9.1-7, based on single carrier requirement specified in Table 8.2.1.9.1-4, with the addition of the parameters in Table 8.2.1.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.1.9.1-8, based on single carrier requirement specified in Table 8.2.1.9.1-4, with the addition of the parameters in Table 8.2.1.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.1.9.1-1: Test Parameters for UE performance in HST-SFN scenario (FRC)**

| Parameter                 | Unit     | Test 1 |             |
|---------------------------|----------|--------|-------------|
| Downlink power allocation | $\rho_A$ | dB     | -3          |
|                           | $\rho_B$ | dB     | -3 (NOTE 1) |

|                          |          |           |     |
|--------------------------|----------|-----------|-----|
|                          | $\sigma$ | dB        | 0   |
| $N_{oc}$ at antenna port |          | dBm/15kHz | -98 |
| PDSCH transmission mode  |          |           | 3   |
| NOTE 1: $P_B = 1$ .      |          |           |     |

Table 8.2.1.9.1-2: Minimum performance UE in HST-SFN scenario (FRC)

| Test number   | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz     | R.87 FDD          | OP.1 FDD     | HST-SFN               | 2x2  | 70                                 | 13.3     | $\geq 1$    |
| NOTE 1: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |            |                   |              |                       |  |                                    |          |             |

Table 8.2.1.9.1-3: Test Parameters for Large Delay CDD (FRC) for CA

| Parameter   | Unit      | Value |             |
|---|-----------|-------|-------------|
| Downlink power allocation   | $\rho_A$  | dB    | -3          |
|   | $\rho_B$  | dB    | -3 (NOTE 1) |
|   | $\sigma$  | dB    | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |             |
| PDSCH transmission mode   |           | 3     |             |
| NOTE 1: $P_B = 1$ .   |           |       |             |
| NOTE 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-4, PUCCH format 3 is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-6. |           |       |             |
| NOTE 3: The same PDSCH transmission mode is applied to each component carrier.  |           |       |             |

Table 8.2.1.9.1-4: Single carrier performance for multiple CA configurations

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 5 MHz      | R.87-2 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.9]   |
| 10 MHz     | R.87 FDD          | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.3]   |
| 15 MHz     | R.87-3 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.9]   |
| 20 MHz     | R.87-4 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [14.1]   |

Table 8.2.1.9.1-5: Minimum performance Large Delay CDD (FRC) for CA with 2DL CCs

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x10MHz                   | As specified in Table 8.2.1.9.1-4 per CC | $\geq 5$    |
| 2         | 2x20MHz                   | As specified in Table 8.2.1.9.1-4 per CC | $\geq 5$    |
| 3         | 2x5MHz                    | As specified in Table 8.2.1.9.1-4 per CC | $\geq 5$    |

|   |            |  |    |
|---|------------|--|----|
| 4 | 10MHz+5MHz | As specified in Table 8.2.1.9.1-4 per CC | ≥5 |
| 5 | 15MHz+5MHz | As specified in Table 8.2.1.9.1-4 per CC | ≥5 |

**Table 8.2.1.9.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 3x20MHz                   | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 2         | 20MHz+20MHz+15MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 3         | 20MHz+20MHz+10MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 4         | 20MHz+15MHz+15MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 5         | 20MHz+15MHz+10MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 6         | 20MHz+10MHz+10MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 7         | 15MHz+15MHz+10MHz         | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 8         | 20MHz+10MHz+5MHz          | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 9         | 20MHz+15MHz+5MHz          | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 10        | 10MHz+10MHz+5MHz          | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 11        | 5MHz+5MHz+20MHz           | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 12        | 3x10MHz                   | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |
| 13        | 5MHz+5MHz+10MHz           | As specified in Table 8.2.1.9.1-4 per CC | ≥5          |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3

**Table 8.2.1.9.1-7: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 2         | 10MHz+20MHz+20MHz+20MHz   | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 3         | 10MHz+10MHz+20MHz+20MHz   | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 4         | 5MHz+10MHz+20MHz+20MHz    | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 5         | 5MHz+10MHz+10MHz+20MHz    | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 6         | 15+3x20MHz                | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 7         | 2x15+2x20MHz              | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 8         | 10+15+2x20MHz             | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 9         | 3x10+20MHz                | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 10        | 2x5+2x20MHz               | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 11        | 2x5+10+20MHz              | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |
| 12        | 4x10MHz                   | As specified in Table 8.2.1.9.1-4 per CC | ≥8          |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3

**Table 8.2.1.9.1-8: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 5x20MHz                   | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 2         | 15MHz+4x20MHz             | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 3         | 10MHz+4x20MHz             | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 4         | 2x10MHz+3x20MHz           | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 5         | 5MHz+10MHz+3x20MHz        | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 6         | 3x10MHz+2x20MHz           | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |
| 7         | 4x10MHz+20MHz             | As specified in Table 8.2.1.9.1-4 per CC | 8, ≥11      |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3

### 8.2.1.9.2 Minimum Requirement for Rel-16 further enhanced HST

The requirements are specified in Table 8.2.1.9.2-2, with the addition of the parameters in Table 8.2.1.9.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify UE performance in the HST-SFN-500 and HST-500 scenario. The test for HST-SFN-500 scenario defined in B.3B is applied when *highSpeedEnhDemodFlag2-r16* [7] is received. The test for HST-500 scenario defined in B.3C is applied when *highSpeedEnhDemodFlag2-r16* [7] is not received. HST-500 test is not applicable to UE that has passed HST-SFN-500 test.

**Table 8.2.1.9.2-1: Test Parameters for UE performance in HST-SFN-500 and HST-500 scenario (FRC)**

| Parameter                 | Unit     | Test 1            |
|---------------------------|----------|-------------------|
| Downlink power allocation | $\rho_A$ | dB<br>-3          |
|                           | $\rho_B$ | dB<br>-3 (NOTE 1) |
|                           | $\sigma$ | dB<br>0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>-98  |
| PDSCH transmission mode   |          | 3                 |
| NOTE 1: $P_B = 1$ .       |          |                   |

**Table 8.2.1.9.2-2: Minimum performance UE in HST-SFN-500 and HST-500 scenario (FRC)**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1 NOTE 2  | 10 MHz    | R.87-1 FDD        | OP.1 FDD     | HST-SFN-500           | 2x2  | 70                                 | 9.7      | $\geq 1$    |
| 2   | 10 MHz    | R.87 FDD          | OP.1 FDD     | HST-500               | 2x2  | 70                                 | 11.4     | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.6.  |           |                   |              |                       |  |                                    |          |             |
| NOTE 2: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |           |                   |              |                       |  |                                    |          |             |

### 8.2.1.10 Intra-band contiguous carrier aggregation with minimum channel spacing

The requirements in this section verify the ability of an UE supporting intra-band contiguous carrier aggregation with minimum channel spacing to demodulate the signal transmitted by the PCell and SCell(s). Throughput is measured on each cell. The minimum channel spacing of intra-band contiguous carrier aggregation refers to the possible minimum channel spacing as any multiple of 300 kHz less than the nominal channel spacing defined in 5.7.1A.

#### 8.2.1.10.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.1.10.1-2, with the addition of the parameters in Table 8.2.1.10.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.10.1-1: Test Parameters for CA**

| Parameter                 | Unit     | Test 1-2         |
|---------------------------|----------|------------------|
| Downlink power allocation | $\rho_A$ | dB<br>0          |
|                           | $\rho_B$ | dB<br>0 (Note 1) |
|                           | $\sigma$ | dB<br>0          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>-98 |
| Symbols for unused PRBs   |          | OCNG (Note 2)    |
| Modulation                |          | 64QAM            |

|                         |   |  |
|-------------------------|---|--|
| ACK/NACK feedback mode  |   | PUCCH format 1b with channel selection |
| PDSCH transmission mode |   | 1                                      |
| Note 1:                 | $P_B = 0$   |  |
| Note 2:                 | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |  |
| Note 3:                 | The same PDSCH transmission mode is applied to each component carrier.  |  |

**Table 8.2.1.10.1-2: Single carrier performance for multiple CA configurations with minimum channel spacing**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.6 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.4     |
| 10MHz      | R.7 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.7     |
| 15MHz      | R.8 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.7     |
| 20MHz      | R.9 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                | 70                                 | 17.6     |

**Table 8.2.1.10.1-3: Minimum performance (FRC) for intra-band CA with minimum channel spacing for CA with 2DL CCs**

| Test num. | CA Band-width combination   | Requirement                               | UE category |
|-----------|---|---|-------------|
| 1         | 20MHz+20MHz   | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 2         | 20MHz+15MHz   | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 3         | 20MHz+10MHz   | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 4         | 20MHz+5MHz  | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 5         | 15MHz+15MHz   | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 6         | 10MHz+10MHz   | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| 7         | 5MHz+10MHz  | As specified in Table 8.2.1.10.1-2 per CC | ≥5          |
| Note 1:   | The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3. |   |             |

## 8.2.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.2.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.2.2-1: Common Test Parameters (TDD)**

| Parameter                                      | Unit      | Value   |
|--|-----------|---|
| Uplink downlink configuration (Note 1)         |           | 1   |
| Special subframe configuration (Note 2)        |           | 4   |
| Cyclic prefix                                  |           | Normal  |
| Cell ID  |           | 0   |
| Inter-TTI Distance                             |           | 1   |
| Number of HARQ processes per component carrier | Processes | 7   |
| Maximum number of HARQ transmission            |           | 4   |
| Redundancy version coding sequence             |           | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM |



|  |   |   |
|--|---|---|
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols                                  | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cross carrier scheduling                               |   | Not configured  |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4]. |   |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4]. |   |

### 8.2.2.1 Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.4 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS. The QPSK and 64QAM cases are also used to verify the performance for all bandwidths specified in Table 5.6.1-1.

#### 8.2.2.1.1 Minimum Requirement

For single carrier, the requirements are specified in Table 8.2.2.1.1-2, with the addition of the parameters in Table 8.2.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.1.1-4, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.1.1-7, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.2.1.1-8, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.1.1.1-9, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.1.1.1-10, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.1.1.1-11, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.2.1.1-1: Test Parameters**

| Parameter                 |          | Unit      | Test 1- 5     | Test 6- 8     | Test 9- 15    | Test 16- 18   | Test 19       |
|---------------------------|----------|-----------|---------------|---------------|---------------|---------------|---------------|
| Downlink power allocation | $\rho_A$ | dB        | 0             | 0             | 0             | 0             | 0             |
|                           | $\rho_B$ | dB        | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)    |
|                           | $\sigma$ | dB        | 0             | 0             | 0             | 0             | 0             |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98           | -98           | -98           | -98           | -98           |
| Symbols for unused PRBs   |          |           | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Modulation                |          |           | QPSK          | 16QAM         | 64QAM         | 16QAM         | QPSK          |
| ACK/NACK feedback mode    |          |           | Multiplexing  | Multiplexing  | Multiplexing  | Multiplexing  | Multiplexing  |
| PDSCH transmission mode   |          |           | 1             | 1             | 1             | 1             | 1             |

|         |   |
|---------|---|
| Note 1: | $P_B = 0$   |
| Note 2: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |
| Note 3: | Void  |
| Note 4: | Void  |

Table 8.2.2.1.1-2: Minimum performance (FRC)

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.2 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.2     | $\geq 1$    |
| 2           | 10 MHz    | R.2 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 70                                 | -0.6     | $\geq 1$    |
| 3           | 10 MHz    | R.2 TDD           | OP.1 TDD     | ETU300                | 1x2 Low                                      | 70                                 | -0.2     | $\geq 1$    |
| 4           | 10 MHz    | R.2 TDD           | OP.1 TDD     | HST                   | 1x2  | 70                                 | -2.6     | $\geq 1$    |
| 5           | 1.4 MHz   | R.4 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 0.0      | $\geq 1$    |
| 6           | 10 MHz    | R.3 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 6.7      | $\geq 2$    |
|             | 5 MHz     | R.3-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 6.7      | 1           |
| 7           | 10 MHz    | R.3 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.4      | $\geq 2$    |
|             | 5 MHz     | R.3-1 TDD         | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.4      | 1           |
| 8           | 10 MHz    | R.3 TDD           | OP.1 TDD     | ETU300                | 1x2 High                                     | 70                                 | 9.3      | $\geq 2$    |
|             | 5 MHz     | R.3-1 TDD         | OP.1 TDD     | ETU300                | 1x2 High                                     | 70                                 | 9.3      | 1           |
| 9           | 3 MHz     | R.5 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | $\geq 1$    |
| 10          | 5 MHz     | R.6 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | $\geq 2$    |
|             | 5 MHz     | R.6-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 1           |
| 11          | 10 MHz    | R.7 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | $\geq 2$    |
|             | 10 MHz    | R.7-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 1           |
| 12          | 10 MHz    | R.7 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 70                                 | 19.1     | $\geq 2$    |
|             | 10 MHz    | R.7-1 TDD         | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 70                                 | 19.1     | 1           |
| 13          | 10 MHz    | R.7 TDD           | OP.1 TDD     | EVA5                  | 1x2 High                                     | 70                                 | 19.1     | $\geq 2$    |
|             | 10 MHz    | R.7-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 High                                     | 70                                 | 19.1     | 1           |
| 14          | 15 MHz    | R.8 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.8     | $\geq 2$    |
|             | 15 MHz    | R.8-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.8     | 1           |
| 15          | 20 MHz    | R.9 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | $\geq 3$    |
|             | 20 MHz    | R.9-2 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | 2           |
|             | 20 MHz    | R.9-1 TDD         | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | 1           |

|    |        |          |          |       |         |    |      |    |
|----|--------|----------|----------|-------|---------|----|------|----|
| 16 | 3 MHz  | R.0 TDD  | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1  | ≥1 |
| 17 | 10 MHz | R.1 TDD  | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.0  | ≥1 |
| 18 | 20 MHz | R.1 TDD  | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1  | ≥1 |
| 19 | 10 MHz | R.41 TDD | OP.1 TDD | EVA5  | 1x2 Low | 70 | -5.3 | ≥1 |

Note 1: Void.

**Table 8.2.2.1.1-3: Test Parameters for CA**

| Parameter                 |          | Unit      | Value  |
|---------------------------|----------|-----------|--|
| Downlink power allocation | $\rho_A$ | dB        | 0  |
|                           | $\rho_B$ | dB        | 0 (Note 1)   |
|                           | $\sigma$ | dB        | 0  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Symbols for unused PRBs   |          |           | OCNG (Note 2)  |
| Modulation                |          |           | QPSK   |
| ACK/NACK feedback mode    |          |           | PUCCH format 1b with channel selection for Tests in Table 8.2.2.1.1-4; PUCCH format 3 for Tests in Table 8.2.2.1.1-7 |
| PDSCH transmission mode   |          |           | 1  |

Note 1:  $P_B = 0$   
 Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.  
 Note 3: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.2.1.1-4: Minimum performance (FRC) for CA with 2DL CCs**

| Test number | Bandwidth   | Reference Channel       | OCNG Pattern      | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------|-------------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|             |             |                         |                   |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 2x20MHz     | R.42 TDD                | OP.1 TDD (Note 1) | EVA5                  | 1x2 Low                                      | 70                                 | -1.2     | ≥5          |
| 2           | 20MHz+15MHz | R.42 TDD for 20MHz CC   | OP.1 TDD (Note 1) | EVA5                  | 1x2 Low                                      | 70                                 | -1.4     | ≥5          |
|             |             | R.42-3 TDD for 15MHz CC | OP.1 TDD (Note 1) |                       |  | 70                                 | -1.4     |             |

Note 1: The OCNG pattern applies for each CC.  
 Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.  
 Note 3: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC.

**Table 8.2.2.1.1-5: Single carrier performance for multiple CA configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz    | R.4 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                | 70                                 | -0.6     |
| 3MHz      | R.42-1 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                | 70                                 | -0.8     |
| 5MHz      | R.42-2 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.2     |
| 10MHz     | R.2 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.6     |
| 15MHz     | R.42-3 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                | 70                                 | -1.4     |

|       |          |          |      |         |    |      |
|-------|----------|----------|------|---------|----|------|
| 20MHz | R.42 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |
|-------|----------|----------|------|---------|----|------|

Table 8.2.2.1.1-6: Void

Table 8.2.2.1.1-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 3x20MHz                   | As specified in Table 8.2.2.1.1-5 per CC | ≥5          |
| 2   | 20MHz+20MHz+15MHz         | As specified in Table 8.2.2.1.1-5 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3        |                           |  |             |
| Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. |                           |  |             |

Table 8.2.2.1.1-8: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 4x20MHz                   | As specified in Table 8.2.2.1.1-5 per CC | ≥8          |
| 2  | 20MHz+20MHz+20MHz+15MHz   | As specified in Table 8.2.2.1.1-5 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

Table 8.2.2.1.1-9: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 5x20MHz                   | As specified in Table 8.2.2.1.1-5 per CC | 8, ≥11      |
| 2  | 15MHz+4x20MHz             | As specified in Table 8.2.2.1.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

Table 8.2.2.1.1-10: Minimum performance (FRC) based on single carrier performance for CA with 6 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 6x20MHz                   | As specified in Table 8.2.2.1.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

Table 8.2.2.1.1-11: Minimum performance (FRC) based on single carrier performance for CA with 7 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 7x20MHz                   | As specified in Table 8.2.2.1.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

8.2.2.1.2 Void

8.2.2.1.3 Void

8.2.2.1.4 Minimum Requirement 1 PRB allocation in presence of MBSFN

The requirements are specified in Table 8.2.2.1.4-2, with the addition of the parameters in Table 8.2.2.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the single-antenna performance with a single PRB allocated at the lower band edge in presence of MBSFN.

**Table 8.2.2.1.4-1: Test Parameters for Testing 1 PRB allocation**

| Parameter  | Unit     | Test 1           |
|--|----------|------------------|
| Downlink power allocation  | $\rho_A$ | dB<br>0          |
|  | $\rho_B$ | dB<br>0 (Note 1) |
|  | $\sigma$ | dB<br>0          |
| $N_{oc}$ at antenna port   |          | dBm/15kHz<br>-98 |
| Symbols for MBSFN portion of MBSFN subframes (Note 2)  |          | OCNG (Note 3)    |
| ACK/NACK feedback mode   |          | Multiplexing     |
| PDSCH transmission mode  |          | 1                |
| Note 1: $P_B = 0$ .<br>Note 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe except the first two symbols in the first slot.<br>Note 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead. |          |                  |

**Table 8.2.2.1.4-2: Minimum performance 1PRB (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.29 TDD          | OP.3 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 2.0      | $\geq 1$    |

8.2.2.2 Transmit diversity performance

8.2.2.2.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.2.1-2, with the addition of the parameters in Table 8.2.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.2.2.2.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 | Unit     | Test 1-2          |
|---------------------------|----------|-------------------|
| Downlink power allocation | $\rho_A$ | dB<br>-3          |
|                           | $\rho_B$ | dB<br>-3 (Note 1) |

|                          |          |           |              |
|--------------------------|----------|-----------|--------------|
|                          | $\sigma$ | dB        | 0            |
| $N_{oc}$ at antenna port |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode   |          |           | Multiplexing |
| PDSCH transmission mode  |          |           | 2            |
| Note 1: $P_B = 1$        |          |           |              |

Table 8.2.2.2.1-2: Minimum performance Transmit Diversity (FRC)

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.11 TDD          | OP.1 TDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 6.8      | $\geq 2$    |
|             | 5 MHz     | R.11-2 TDD        | OP.1 TDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 6.8      | 1           |
| 2           | 10 MHz    | R.10 TDD          | OP.1 TDD     | HST                   | 2x2  | 70                                 | -2.3     | $\geq 1$    |

## 8.2.2.2.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.2.2.2-2, with the addition of the parameters in Table 8.2.2.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC-FSTD) with 4 transmitter antennas.

Table 8.2.2.2.2-1: Test Parameters for Transmit diversity Performance (FRC)

| Parameter                 | Unit     | Test 1-2  |              |
|---------------------------|----------|-----------|--------------|
| Downlink power allocation | $\rho_A$ | dB        | -3           |
|                           | $\rho_B$ | dB        | -3 (Note 1)  |
|                           | $\sigma$ | dB        | 0            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode    |          |           | Multiplexing |
| PDSCH transmission mode   |          |           | 2            |
| Note 1: $P_B = 1$         |          |           |              |

Table 8.2.2.2.2-2: Minimum performance Transmit Diversity (FRC)

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 1.4 MHz   | R.12 TDD          | OP.1 TDD     | EPA5                  | 4x2 Medium                                   | 70                                 | 0.2      | $\geq 1$    |
| 2           | 10 MHz    | R.13 TDD          | OP.1 TDD     | ETU70                 | 4x2 Low                                      | 70                                 | -0.5     | $\geq 1$    |

## 8.2.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

The requirements are specified in Table 8.2.2.2.3-2, with the addition of parameters in Table 8.2.2.2.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Table 8.2.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is

the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.2.3-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                                     |             | Unit      | Cell 1                             | Cell 2                   |
|---|-------------|-----------|------------------------------------|--------------------------|
| Uplink downlink configuration                 |             |           | 1                                  | 1                        |
| Special subframe configuration                |             |           | 4                                  | 4                        |
| Downlink power allocation                     | $\rho_A$    | dB        | -3                                 | -3                       |
|   | $\rho_B$    | dB        | -3 (Note 1)                        | -3 (Note 1)              |
|   | $\sigma$    | dB        | 0                                  | N/A                      |
| $N_{oc}$ at antenna port                      | $N_{oc1}$   | dBm/15kHz | -102 (Note 2)                      | N/A                      |
|   | $N_{oc2}$   | dBm/15kHz | -98 (Note 3)                       | N/A                      |
|   | $N_{oc3}$   | dBm/15kHz | -94.8 (Note 4)                     | N/A                      |
| $\widehat{E}_s/N_{oc2}$                       |             | dB        | Reference Value in Table 8.2.2.3-2 | 6                        |
| $BW_{Channel}$                                |             | MHz       | 10                                 | 10                       |
| Subframe Configuration                        |             |           | Non-MBSFN                          | Non-MBSFN                |
| Time Offset between Cells                     |             | $\mu s$   | 2.5 (synchronous cells)            |                          |
| Cell Id                                       |             |           | 0                                  | 1                        |
| ABS pattern (Note 5)                          |             |           | N/A                                | 0000010001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) |             |           | 0000000001<br>0000000001           | N/A                      |
| CSI Subframe Sets (Note 7)                    | $C_{CSI,0}$ |           | 0000010001<br>0000000001           | N/A                      |
|   | $C_{CSI,1}$ |           | 1100101000<br>1100111000           | N/A                      |
| Number of control OFDM symbols                |             |           | 2                                  | 2                        |
| ACK/NACK feedback mode                        |             |           | Multiplexing                       | N/A                      |
| PDSCH transmission mode                       |             |           | 2                                  | N/A                      |
| Cyclic prefix                                 |             |           | Normal                             | Normal                   |

- Note 1:  $P_B = 1$ .
- Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.
- Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
- Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.
- Note 5: ABS pattern as defined in [9].
- Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
- Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
- Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
- Note 9: SIB-1 will not be transmitted in Cell2 in this test.

**Table 8.2.2.3-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern | Propagation Conditions (Note 1) | Correlation Matrix and | Reference Value | UE Category |
|-------------|-------------------|--------------|---------------------------------|------------------------|-----------------|-------------|
|-------------|-------------------|--------------|---------------------------------|------------------------|-----------------|-------------|

|  |                   | Cell 1   | Cell 2   | Cell 1 | Cell 2 | Antenna Configuration | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 2) |    |
|--|-------------------|----------|----------|--------|--------|-----------------------|---|-------------------|----|
| 1  | R.11-4 TDD Note 4 | OP.1 TDD | OP.1 TDD | EVA5   | EVA5   | 2x2 Medium            | 70  | 3.8               | ≥2 |
| Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.<br>Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.<br>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.<br>Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms. |                   |          |          |        |        |                       |   |                   |    |

### 8.2.2.2.3A Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.2.2.2.3A-2, with the addition of parameters in Table 8.2.2.2.3A-1. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.2.3A-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.2.3A-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                                     | Unit               | Cell 1                                | Cell 2                 | Cell 3                 |
|---|--------------------|---------------------------------------|------------------------|------------------------|
| Uplink downlink configuration                 |                    | 1                                     | 1                      | 1                      |
| Special subframe configuration                |                    | 4                                     | 4                      | 4                      |
| Downlink power allocation                     | $\rho_A$           | dB                                    | -3                     | -3                     |
|   | $\rho_B$           | dB                                    | -3 (Note 1)            | -3 (Note 1)            |
|   | $\sigma$           | dB                                    | 0                      | N/A                    |
| $N_{oc}$ at antenna port                      | $N_{oc1}$          | dBm/15kHz                             | -98 (Note 2)           | N/A                    |
|   | $N_{oc2}$          | dBm/15kHz                             | -98 (Note 3)           | N/A                    |
|   | $N_{oc3}$          | dBm/15kHz                             | -93 (Note 4)           | N/A                    |
| $\hat{E}_s / N_{oc2}$                         | dB                 | Reference Value in Table 8.2.2.2.3A-2 | 12                     | 10                     |
| BW <sub>Channel</sub>                         | MHz                | 10                                    | 10                     | 10                     |
| Subframe Configuration                        |                    | Non-MBSFN                             | Non-MBSFN              | Non-MBSFN              |
| Time Offset between Cells                     | μs                 | N/A                                   | 3                      | -1                     |
| Frequency shift between Cells                 | Hz                 | N/A                                   | 300                    | -100                   |
| Cell Id                                       |                    | 0                                     | 126                    | 1                      |
| ABS pattern (Note 5)                          |                    | N/A                                   | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) |                    | 000000001<br>000000001                | N/A                    | N/A                    |
| CSI Subframe Sets (Note7)                     | C <sub>CSI,0</sub> | 000000001<br>000000001                | N/A                    | N/A                    |
|   | C <sub>CSI,1</sub> | 1100111000<br>1100111000              | N/A                    | N/A                    |
| Number of control OFDM symbols                |                    | 2                                     | Note 8                 | Note 8                 |
| ACK/NACK feedback mode                        |                    | Multiplexing                          | N/A                    | N/A                    |
| PDSCH transmission mode                       |                    | 2                                     | Note 9                 | Note 9                 |
| Cyclic prefix                                 |                    | Normal                                | Normal                 | Normal                 |



|          |  |
|----------|--|
| Note 1:  | $P_B = 1$ .  |
| Note 2:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.  |
| Note 3:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.                            |
| Note 4:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS   |
| Note 5:  | ABS pattern as defined in [9].   |
| Note 6:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]                                      |
| Note 7:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].           |
| Note 8:  | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.             |
| Note 9:  | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5. |
| Note 10: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.  |
| Note 11: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.   |

**Table 8.2.2.3A-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                           |                   | UE Category |
|-------------|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|---|-------------------|-------------|
|             |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) |             |
| 1           | R.11-4 TDD Note 4 | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                            | EVA5   | EVA5   | 2x2 Medium  | 70  | 3.5               | ≥2          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
 Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3..  
 Note 3: SNR corresponds to  $\hat{E}_s / N_{oc2}$  of cell 1.  
 Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.  
 Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

**8.2.2.2.4 Enhanced Performance Requirement Type A – 2 Tx Antenna Ports with TM3 interference model**

The requirements are specified in Table 8.2.2.2.4-2, with the addition of parameters in Table 8.2.2.2.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.2.2.2.4-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.4-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter                       | Unit      | Cell 1            | Cell 2            | Cell 3            |    |
|---------------------------------|-----------|-------------------|-------------------|-------------------|----|
| Downlink power allocation       | $\rho_A$  | dB                | -3                | -3                | -3 |
|                                 | $\rho_B$  | dB                | -3 (Note 1)       | -3                | -3 |
|                                 | $\sigma$  | dB                | 0                 | 0                 | 0  |
| Cell-specific reference signals |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |    |
| $N_{oc}$ at antenna port        | dBm/15kHz | -98               | N/A               | N/A               |    |
| DIP (Note 2)                    | dB        | N/A               | -1.73             | -8.66             |    |
| $BW_{Channel}$                  | MHz       | 10                | 10                | 10                |    |

|  |        |    |               |                              |                              |
|--|--------|----|---------------|------------------------------|------------------------------|
| Cyclic Prefix  |        |    | Normal        | Normal                       | Normal                       |
| Cell Id  |        |    | 0             | 1                            | 2                            |
| Number of control OFDM symbols   |        |    | 2             | 2                            | 2                            |
| PDSCH transmission mode  |        |    | 2             | N/A                          | N/A                          |
| Interference model   |        |    | N/A           | As specified in clause B.5.2 | As specified in clause B.5.2 |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | %  | N/A           | 80                           | 80                           |
|  | Rank 2 | %  | N/A           | 20                           | 20                           |
| Reporting interval   |        | ms | 5             | N/A                          | N/A                          |
| Reporting mode   |        |    | PUCCH 1-0     | N/A                          | N/A                          |
| ACK/NACK feedback mode   |        |    | Multiplexing  | N/A                          | N/A                          |
| Physical channel for CQI reporting   |        |    | PUSCH(Note 5) | N/A                          | N/A                          |
| cqi-pmi-ConfigurationIndex   |        |    | 4             | N/A                          | N/A                          |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.</p> <p>Note 4: All cells are time-synchronous.</p> <p>Note 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |    |               |                              |                              |

**Table 8.2.2.4-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|---|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|--------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1   | R.46 TDD          | OP. 1 TD D   | N/A    | N/A    | EV A70                 | EV A70 | EV A70 | 2x2 Low   | 70                                 | -1.4               | ≥1          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> <p>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.</p> |                   |              |        |        |                        |        |        |   |                                    |                    |             |

**8.2.2.2.5 Minimum Requirement 2 Tx Antenna Port (when *EIMTA-MainConfigServCell-r12* is configured)**

The requirements are specified in Table 8.2.2.2.5-2 with the addition of the parameters in Table 8.2.2.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The test purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas in case of using eIMTA TDD UL-DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI on a PCell.

**Table 8.2.2.2.5-1: Test Parameters for Transmit diversity Performance (FRC) when *EIMTA-MainConfigServCell-r12* is configured**

| Parameter                                      | Unit      | Value       |
|--|-----------|-------------|
| Downlink power allocation                      | $\rho_A$  | -3          |
|  | $\rho_B$  | -3 (Note 1) |
|  | $\sigma$  | 0           |
| $N_{oc}$ at antenna port                       | dBm/15kHz | -98         |
| Uplink downlink configuration in SIB1 (Note 2) |           | 0           |

|  |           |                       |
|--|-----------|-----------------------|
| Downlink HARQ reference configuration (eimta-HarqReferenceConfig-r12) (Note 2)   |           | 5                     |
| Set of dynamic TDD UL-DL configurations (NOTES 2,3)  |           | {0, 1, 2, 3, 4, 5, 6} |
| Periodicity of monitoring the L1 reconfiguration DCI (eimta-CommandPeriodicity-r12)  | ms        | 10                    |
| Set of subframes to monitor the L1 reconfiguration DCI (eimta-CommandSubframeSet-r12) (Note 4)   |           | {0,1,5,6}             |
| Number of DL HARQ processes  | Processes | 15                    |
| PDSCH transmission mode  |           | 2                     |
| ACK/NACK feedback mode (Note 5)  |           | Multiplexing          |
| <p>Note 1: <math>P_b = 1</math></p> <p>Note 2: As specified in Table 4.2-2 in TS 36.211.</p> <p>Note 3: UL/DL configuration in PDCCH with eIMTA-RNTI is randomly selected from the given set on a per-DCI basis with equal probability.</p> <p>Note 4: The set of subframes to monitor PDCCH with eIMTA-RNTI for frame n includes subframes {1,5,6} in frame n-1 and subframe 0 in frame n. Subframes for reconfiguration DCI transmission are chosen in a random way on a per-DCI basis with equal probability.</p> <p>Note 5: PUCCH Format 3 is used for DL HARQ feedback.</p> |           |                       |

**Table 8.2.2.2.5-2: Minimum performance Transmit diversity when EIMTA-MainConfigServCell-r12 is configured**

| Test | Reference channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|------|-------------------|--------------|------------------------|--|------------------------------------|----------|-------------|
|      |                   |              |                        |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1    | R.67 TDD          | OP.1 TDD     | EVA5                   | 2x2 Medium                                   | 70                                 | 5.0      | $\geq 1$    |

#### 8.2.2.2.6 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model

The requirements are specified in Table 8.2.2.2.6-2, with the addition of parameters in Table 8.2.2.2.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 2 interference model defined in clause B.6.1. In Table 8.2.2.2.6-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.6-1: Test Parameters for Transmit Diversity Performance (FRC) with TM2 interference model**

| Parameter  | Unit      | Cell 1               | Cell 2               | Cell 3               |
|--|-----------|----------------------|----------------------|----------------------|
| Uplink downlink Configuration                      |           | 1                    | 1                    | 1                    |
| Special subframe configuration                     |           | 4                    | 4                    | 4                    |
| Downlink power allocation                          | $\rho_A$  | dB                   | -3                   | -3                   |
|  | $\rho_B$  | dB                   | -3 (Note 1)          | -3                   |
|  | $\sigma$  | dB                   | 0                    | 0                    |
| Cell-specific reference signals                    |           | Antenna ports<br>0,1 | Antenna ports<br>0,1 | Antenna ports<br>0,1 |
| $N_{oc}$ at antenna port                           | dBm/15kHz | -98                  |                      |                      |
| $\hat{E}_s/N_{oc}$                                 | dB        | N/A                  | 13.91                | 3.34                 |
| $BW_{Channel}$                                     | MHz       | 10                   | 10                   | 10                   |
| Cyclic Prefix                                      |           | Normal               | Normal               | Normal               |
| Cell Id  |           | 0                    | 6                    | 1                    |
| Number of control OFDM symbols in normal subframes |           | 3                    | 3                    | 3                    |

|  |                          |                |                              |                              |
|--|--------------------------|----------------|------------------------------|------------------------------|
| CFI indicated in PCFICH in normal subframes                              |                          | 3              | 3                            | 3                            |
| Number of control OFDM symbols in special subframes                      |                          | 2              | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes                             |                          | 2              | 2                            | 2                            |
| PDSCH transmission mode  |                          | 2              | 2                            | 2                            |
| Interference model   |                          | N/A            | As specified in clause B.6.1 | As specified in clause B.6.1 |
| MBSFN  |                          | Not configured | Not configured               | Not configured               |
| Time offset to cell 1  | us                       | N/A            | 2                            | 3                            |
| Frequency offset to cell 1   | Hz                       | N/A            | 200                          | 300                          |
| NeighCellsInfo-r12 (Note 3)  | p-aList-r12              | N/A            | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|  | transmissionModeList-r12 | N/A            | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$  |                          |                |                              |                              |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |                |                              |                              |
| Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |                |                              |                              |

**Table 8.2.2.6-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM2 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.11-12 TDD       | OP. 1 TD D   | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 15.3              | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.              |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                          |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

### 8.2.2.2.7 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model

The requirements are specified in Table 8.2.2.2.7-2, with the addition of parameters in Table 8.2.2.2.7-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In Table 8.2.2.2.7-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.7-1: Test Parameters for Transmit Diversity Performance (FRC) with TM9 interference model**

| Parameter                       | Unit      | Cell 1            | Cell 2            | Cell 3            |    |
|---------------------------------|-----------|-------------------|-------------------|-------------------|----|
| Uplink downlink Configuration   |           | 1                 | 1                 | 1                 |    |
| Special subframe configuration  |           | 4                 | 4                 | 4                 |    |
| Downlink power allocation       | $\rho_A$  | dB                | -3                | 0                 | 0  |
|                                 | $\rho_B$  | dB                | -3 (Note 1)       | 0                 | 0  |
|                                 | $\sigma$  | dB                | 0                 | -3                | -3 |
| Cell-specific reference signals |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |    |
| $N_{oc}$ at antenna port        | dBm/15kHz | -98               |                   |                   |    |

|   |                          |                |                              |                              |
|---|--------------------------|----------------|------------------------------|------------------------------|
| $\widehat{E}_s/N_{oc}$  | dB                       | N/A            | 3.28                         | 0.74                         |
| BW <sub>Channel</sub>   | MHz                      | 10             | 10                           | 10                           |
| Cyclic Prefix   |                          | Normal         | Normal                       | Normal                       |
| Cell Id   |                          | 0              | 1                            | 6                            |
| Number of control OFDM symbols in normal subframes  |                          | 3              | 3                            | 3                            |
| CFI indicated in PCFICH in normal subframes   |                          | 3              | Random from set {1,2,3}      | Random from set {1,2,3}      |
| Number of control OFDM symbols in special subframes   |                          | 2              | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes  |                          | 2              | Random from set {1,2}        | Random from set {1,2}        |
| PDSCH transmission mode   |                          | 2              | 9                            | 9                            |
| Interference model  |                          | N/A            | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals   |                          | N/A            | Antenna ports 15,16          | Antenna ports 15,16          |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes                | N/A            | 10 / 4                       | 10 / 4                       |
| CSI reference signal configuration  |                          | N/A            | 6                            | 7                            |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap  | Subframes / bitmap       | N/A            | 9 /<br>010000000000<br>0000  | 9 /<br>001000000000<br>0000  |
| Time offset to cell 1   | us                       | N/A            | 5                            | -5                           |
| Frequency offset to cell 1  | Hz                       | N/A            | 600                          | -600                         |
| MBSFN   |                          | Not configured | Not configured               | Not configured               |
| NeighCellsInfo-r12<br>(Note 4)  | p-aList-r12              | N/A            | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|   | transmissionModeList-r12 | N/A            | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$<br>Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. |                          |                |                              |                              |

**Table 8.2.2.2.7-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM9 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.11-11 TDD       | OP. 1 TD     | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 8.1               | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: SNR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

**8.2.2.2.8 Minimum Requirement 2 Tx Antenna Port (Superposed transmission)**

The requirements are specified in Table 8.2.2.2.8-2, with the addition of the parameters in Table 8.2.2.2.8-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of transmit diversity (SFBC) with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.2.8-1: Test Parameters for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  | Unit     | Test 1-2  |              |
|--|----------|-----------|--------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3           |
|  | $\rho_B$ | dB        | -3 (Note 1)  |
|  | $\sigma$ | dB        | 0            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode   |          |           | Multiplexing |
| PDSCH transmission mode  |          |           | 2            |
| MUSTIdx (Note 2)   |          |           | 11           |
| p-a-must-r14 (Note 3)  |          |           | N/A          |
| Note 1: $P_B = 1$<br>Note 2: MUSTIdx is deccribed in subclause 6.3.3 of [4].<br>Note 3: p-a-must-r14 is deccribed in subclause 6.3.2 of [7]. |          |           |              |

**Table 8.2.2.8-2: Minimum Performance for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.aa TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 13.9     | $\geq 1$    |

### 8.2.2.3 Open-loop spatial multiplexing performance

#### 8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.2.3.1-2, with the addition of the parameters in Table 8.2.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.3.1-4, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.3.1-7, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.2.3.1-8, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.2.3.1-9, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.2.3.1-10, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.2.3.1-11, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.2.3.1-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 |          | Unit      | Test 1-3    |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| ACK/NACK feedback mode    |          |           | Bundling    |
| PDSCH transmission mode   |          |           | 3           |
| Note 1: $P_B = 1$         |          |           |             |
| Note 2: Void.             |          |           |             |
| Note 3: Void.             |          |           |             |

**Table 8.2.2.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1 (Note 2)  | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.1     | $\geq 2$    |
| 2   | 10 MHz    | R.35 TDD          | OP.1 TDD     | EVA200                | 2x2 Low                                      | 70                                 | 20.3     | $\geq 2$    |
| 3   | 10 MHz    | R.35-2 TDD        | OP.1 TDD     | ETU600                | 2x2 Low                                      | 70                                 | 21.1     | $\geq 2$    |
| Note 1: Void.   |           |                   |              |                       |  |                                    |          |             |
| Note 2: For UE that supports CRS interference handling, the CRS assistance information defined in [7] is provided. The CRS assistance information includes two aggressor cells with 2 CRS ports and cell ID of aggressor cells are 1 and 128. For UE that does not support CRS interference handling, CRS assistance information is not provided. |           |                   |              |                       |  |                                    |          |             |

**Table 8.2.2.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter  |          | Unit      | Value  |
|--|----------|-----------|--|
| Downlink power allocation  | $\rho_A$ | dB        | -3   |
|  | $\rho_B$ | dB        | -3 (Note 1)  |
|  | $\sigma$ | dB        | 0  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98  |
| ACK/NACK feedback mode   |          |           | PUCCH format 1b with channel selection for Tests in Table 8.2.2.3.1-4; PUCCH format 3 for Tests in Table 8.2.2.3.1-7 |
| PDSCH transmission mode  |          |           | 3  |
| Note 1: $P_B = 1$  |          |           |  |
| Note 2: Void   |          |           |  |
| Note 3: The same PDSCH transmission mode is applied to each component carrier. |          |           |  |

**Table 8.2.2.3.1-4: Minimum performance Large Delay CDD (FRC) for CA with 2DL CCs**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |

|   |             |                         |                   |       |         |    |      |    |
|---|-------------|-------------------------|-------------------|-------|---------|----|------|----|
| 1   | 2x20 MHz    | R.30-1 TDD              | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.7 | ≥5 |
| 2   | 20MHz+15MHz | R.30-1 TDD for 20MHz CC | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.0 | ≥5 |
|   |             | R.11-9 TDD for 15MHz CC | OP.1 TDD (Note 1) | EVA70 |         | 70 | 12.9 |    |
| Note 1: The OCNB pattern applies for each CC.   |             |                         |                   |       |         |    |      |    |
| Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. |             |                         |                   |       |         |    |      |    |

Table 8.2.2.3.1-5: Single carrier performance for multiple CA configurations

| Band-width | Reference channel | OCNB pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.11-5 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 13.2     |
| 3MHz       | R.11-6 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 12.8     |
| 5MHz       | R.11-7 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 12.6     |
| 10 MHz     | R.11-8 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 12.8     |
| 15MHz      | R.11-9 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 12.9     |
| 20MHz      | R.30-1 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                | 70                                 | 13.0     |

Table 8.2.2.3.1-6: Void

Table 8.2.2.3.1-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 3x20MHz                   | As specified in Table 8.2.2.3.1-5 per CC | ≥5          |
| 2  | 20MHz+20MHz+15MHz         | As specified in Table 8.2.2.3.1-5 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

Table 8.2.2.3.1-8: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 4x20MHz                   | As specified in Table 8.2.2.3.1-5 per CC | ≥8          |
| 2  | 20MHz+20MHz+20MHz+15MHz   | As specified in Table 8.2.2.3.1-5 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

Table 8.2.2.3.1-9: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 5x20MHz                   | As specified in Table 8.2.2.3.1-5 per CC | 8, ≥11      |
| 2  | 15MHz+4x20MHz             | As specified in Table 8.2.2.3.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |



**Table 8.2.2.3.1-10: Minimum performance (FRC) based on single carrier performance for CA with 6 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 6x20MHz                   | As specified in Table 8.2.2.3.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.2.3.1-11: Minimum performance (FRC) based on single carrier performance for CA with 7 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 7x20MHz                   | As specified in Table 8.2.2.3.1-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**8.2.2.3.1A Soft buffer management test**

For CA, the requirements are specified in Table 8.2.2.3.1A-2, with the addition of the parameters in Table 8.2.2.3.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify UE performance with proper instantaneous buffer implementation.

**Table 8.2.2.3.1A-1: Test Parameters for soft buffer management test (FRC) for CA**

| Parameter   | Unit      | Test 1-2      |             |
|---|-----------|---------------|-------------|
| Downlink power allocation   | $\rho_A$  | dB            | -3          |
|   | $\rho_B$  | dB            | -3 (Note 1) |
|   | $\sigma$  | dB            | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98           |             |
| ACK/NACK feedback mode  |           | -<br>(Note 2) |             |
| PDSCH transmission mode   |           | 3             |             |
| Note 1: $P_B = 1$   |           |               |             |
| Note 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK.                      |           |               |             |
| Note 3: For CA test cases, the same PDSCH transmission mode is applied to each component carrier. |           |               |             |

**Table 8.2.2.3.1A-2: Minimum performance soft buffer management test (FRC) for CA**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern      | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |                   |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 2x20 MHz  | R.30-2 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                                      | 70                                 | 13.2     | 3           |
| 2   | 2x20 MHz  | R.35-1 TDD        | OP.1 TDD (Note 1) | EVA5                  | 2x2 Low                                      | 70                                 | 15.7     | 4           |
| Note 1: For CA test cases, the OCNG pattern applies for each CC.  |           |                   |                   |                       |  |                                    |          |             |
| Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. |           |                   |                   |                       |  |                                    |          |             |

## 8.2.2.3.1B Enhanced Performance Requirement Type C - 2Tx Antenna Ports

The requirements are specified in Table 8.2.2.3.1B-2, with the addition of the parameters in Table 8.2.2.3.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

**Table 8.2.2.3.1B-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 | Unit      | Test 1   |             |
|---------------------------|-----------|----------|-------------|
| Downlink power allocation | $\rho_A$  | dB       | -3          |
|                           | $\rho_B$  | dB       | -3 (Note 1) |
|                           | $\sigma$  | dB       | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98      |             |
| ACK/NACK feedback mode    |           | Bundling |             |
| PDSCH transmission mode   |           | 3        |             |
| Note 1: $P_B = 1$         |           |          |             |

**Table 8.2.2.3.1B-2: Enhanced Performance Requirement Type C for Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | EVA70                 | 2x2 Medium                                   | 70                                 | 17.4     | ≥2          |

## 8.2.2.3.1C Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference

The requirements are specified in Table 8.2.2.3.1C-2, with the addition of parameters in Table 8.2.2.3.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performance with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell with transmission mode 1. In Table 8.2.2.3.1C-1, Cell 1 is the serving cell, and Cell 2 is interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.

**Table 8.2.2.3.1C-1 Test parameters for Larger Delay CDD (FRC) with TM1 interference**

| Parameter                             | Unit      | Cell 1                                |                |   |
|---------------------------------------|-----------|---------------------------------------|----------------|---|
| Bandwidth                             | MHz       | 10 MHz                                |                |   |
| Downlink power allocation             | $\rho_A$  | -3                                    | 0              |   |
|                                       |           | $\rho_B$                              | -3 (Note 1)    | 0 |
|                                       |           | $\sigma$                              | 0              | 0 |
| Cell-specific reference signals       |           | Antenna ports 0,1                     | Antenna port 0 |   |
| Cyclic Prefix                         |           | Normal                                | Normal         |   |
| Cell ID                               |           | 0                                     | 1              |   |
| Transmission mode                     |           | 3                                     | Note 2         |   |
| $N_{oc}$ at antenna port              | dBm/15kHz | -98                                   | N/A            |   |
| $\hat{E}_s/N_{oc}$ (Note 3)           | dB        | Reference Value in Table 8.2.2.3.1C-2 | 12.95          |   |
| Correlation and antenna configuration |           | Medium (2x2)                          | Medium(1x2)    |   |
| Number of OFDM symbols for PDCCH      |           | 2                                     | N/A            |   |
| Max number of HARQ transmissions      |           | 4                                     | N/A            |   |

|                                    |  |           |     |
|------------------------------------|--|-----------|-----|
| Redundancy version coding sequence |  | {0,1,2,3} | N/A |
| Note 1:                            | $P_B=1$  |           |     |
| Note 2:                            | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.2 applying OCNG pattern OP.5 TDD as defined in Annex A.5.2.5. |           |     |
| Note 3:                            | Cell 1 is the serving cell. Cell 2 is the interfering cell.  |           |     |
| Note 4:                            | All cells are time-synchronous.  |           |     |
| Note 5:                            | SIB-1 will not be transmitted in Cell2 in this test.   |           |     |

**Table 8.2.2.3.1C-2 Enhanced Performance Requirement Type C, Larger Delay CDD (FRC) with TM1 interference**

| Test Number   | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|----------|---------------------------------|--------|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1   | R.11-10 TDD       | OP.1 TDD     | OP.5 TDD | EVA70                           | EVA70  | 70                                 | 19.6              | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |              |          |                                 |        |                                    |                   |             |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1.                                |                   |              |          |                                 |        |                                    |                   |             |

**8.2.2.3.2 Minimum Requirement 4 Tx Antenna Port**

The requirements are specified in Table 8.2.2.3.2-2, with the addition of the parameters in Table 8.2.2.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 4 transmitter antennas.

**Table 8.2.2.3.2-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 | Unit      | Test 1      |
|---------------------------|-----------|-------------|
| Downlink power allocation | $\rho_A$  | -6          |
|                           | $\rho_B$  | -6 (Note 1) |
|                           | $\sigma$  | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98         |
| ACK/NACK feedback mode    |           | Bundling    |
| PDSCH transmission mode   |           | 3           |
| Note 1: $P_B = 1$ .       |           |             |

**Table 8.2.2.3.2-2: Minimum performance Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.14 TDD          | OP.1 TDD     | EVA70                 | 4x2 Low                                      | 70                                 | 14.2     | ≥2          |

**8.2.2.3.3 Minimum Requirement 2Tx antenna port (demodulation subframe overlaps with aggressor cell ABS)**

The requirements for non-MBSFN ABS are specified in Table 8.2.2.3.3-2, with the addition of parameters in Table 8.2.2.3.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The requirements for MBSFN ABS are specified in Table 8.2.2.3.3-4, with the addition of parameters in Table 8.2.2.3.3-3 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Tables 8.2.2.3.3-1 and 8.2.2.3.3-3, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.2.3.3-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter   |             | Unit      | Cell 1                               | Cell 2                    |
|---|-------------|-----------|--------------------------------------|---------------------------|
| Uplink downlink configuration   |             |           | 1                                    | 1                         |
| Special subframe configuration  |             |           | 4                                    | 4                         |
| Downlink power allocation   | $\rho_A$    | dB        | -3                                   | -3                        |
|   | $\rho_B$    | dB        | -3 (Note 1)                          | -3 (Note 1)               |
|   | $\sigma$    | dB        | 0                                    | N/A                       |
| $N_{oc}$ at antenna port  | $N_{oc1}$   | dBm/15kHz | -102 (Note 2)                        | N/A                       |
|   | $N_{oc2}$   | dBm/15kHz | -98 (Note 3)                         | N/A                       |
|   | $N_{oc3}$   | dBm/15kHz | -94.8 (Note 4)                       | N/A                       |
| $\widehat{E}_s/N_{oc2}$   |             | dB        | Reference Value in Table 8.2.2.3.3-2 | 6                         |
| BW <sub>Channel</sub>   |             | MHz       | 10                                   | 10                        |
| Subframe Configuration  |             |           | Non-MBSFN                            | Non-MBSFN                 |
| Cell Id   |             |           | 0                                    | 1                         |
| Time Offset between Cells   |             | $\mu$ s   | 2.5 (synchronous cells)              |                           |
| ABS pattern (Note 5)  |             |           | N/A                                  | 0000010001,<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6)   |             |           | 0000000001,<br>0000000001            | N/A                       |
| CSI Subframe Sets (Note 7)  | $C_{CSI,0}$ |           | 0000010001,<br>0000000001            | N/A                       |
|   | $C_{CSI,1}$ |           | 1100101000<br>1100111000             | N/A                       |
| Number of control OFDM symbols  |             |           | 2                                    | 2                         |
| ACK/NACK feedback mode  |             |           | Multiplexing                         | N/A                       |
| PDSCH transmission mode   |             |           | 3                                    | N/A                       |
| Cyclic prefix   |             |           | Normal                               | Normal                    |
| Note 1: $P_B = 1$ .<br>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.<br>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.<br>Note 5: ABS pattern as defined in [9].<br>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].<br>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.<br>Note 9: SIB-1 will not be transmitted in Cell2 in this test. |             |           |                                      |                           |

**Table 8.2.2.3.3-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | Propagation Conditions (Note 1) | Correlation Matrix and | Reference Value | UE Category |
|-------------|-------------------|--------------|---------------------------------|------------------------|-----------------|-------------|
|             |                   |              |                                 |                        |                 |             |

|  |                 | Cell 1   | Cell 2   | Cell 1 | Cell 2 | Antenna Configuration | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 2) |    |
|--|-----------------|----------|----------|--------|--------|-----------------------|---|-------------------|----|
| 1  | R.11 TDD Note 4 | OP.1 TDD | OP.1 TDD | EVA 5  | EVA 5  | 2x2 Low               | 70  | 14.0              | ≥2 |
| <p>Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.</p> <p>Note 2: SNR corresponds to <math>\widehat{E}_s/N_{oc2}</math> of cell 1.</p> <p>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.</p> <p>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.</p> |                 |          |          |        |        |                       |   |                   |    |

**Table 8.2.2.3.3-3: Test Parameters for Large Delay CDD (FRC) – MBSFN ABS**

| Parameter                                     | Unit        | Cell 1                               | Cell 2                 |
|---|-------------|--------------------------------------|------------------------|
| Uplink downlink configuration                 |             | 1                                    | 1                      |
| Special subframe configuration                |             | 4                                    | 4                      |
| Downlink power allocation                     | $\rho_A$    | dB                                   | -3                     |
|   | $\rho_B$    | dB                                   | -3 (Note 1)            |
|   | $\sigma$    | dB                                   | 0                      |
| $N_{oc}$ at antenna port                      | $N_{oc1}$   | dBm/15kHz                            | -102 (Note 2)          |
|   | $N_{oc2}$   | dBm/15kHz                            | -98 (Note 3)           |
|   | $N_{oc3}$   | dBm/15kHz                            | -94.8 (Note 4)         |
| $\widehat{E}_s/N_{oc2}$                       | dB          | Reference Value in Table 8.2.2.3.3-4 | 6                      |
| $BW_{Channel}$                                | MHz         | 10                                   | 10                     |
| Subframe Configuration                        |             | Non-MBSFN                            | MBSFN                  |
| Cell Id                                       |             | 0                                    | 126                    |
| Time Offset between Cells                     | μs          | 2.5 (synchronous cells)              |                        |
| ABS pattern (Note 5)                          |             | N/A                                  | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) |             | 000000001<br>000000001               | N/A                    |
| CSI Subframe Sets (Note 7)                    | $C_{CSI,0}$ | 000000001<br>000000001               | N/A                    |
|   | $C_{CSI,1}$ | 1100111000<br>1100111000             | N/A                    |
| MBSFN Subframe Allocation (Note 10)           |             | N/A                                  | 000010                 |
| Number of control OFDM symbols                |             | 2                                    | 2                      |
| ACK/NACK feedback mode                        |             | Multiplexing                         | N/A                    |
| PDSCH transmission mode                       |             | 3                                    | N/A                    |
| Cyclic prefix                                 |             | Normal                               | Normal                 |

|          |  |
|----------|--|
| Note 1:  | $P_B = 1$ .  |
| Note 2:  | This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 3:  | This noise is applied in OFDM symbol #0 of a subframe overlapping with the aggressor ABS.  |
| Note 4:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.  |
| Note 5:  | ABS pattern as defined in [9]. The 10 <sup>th</sup> and 20 <sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes.           |
| Note 6:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |
| Note 7:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].                       |
| Note 8:  | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.                          |
| Note 9:  | SIB-1 will not be transmitted in Cell2 in this test.   |
| Note 10: | MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.                                    |

**Table 8.2.2.3.3-4: Minimum Performance Large Delay CDD (FRC) – MBSFN ABS**

| Test Number  | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value                           |                   | UE Category |
|--|-------------------|--------------|----------|---------------------------------|--------|--|---|-------------------|-------------|
|  |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 2) |             |
| 1  | R.11 TDD Note 4   | OP.1 TDD     | OP.1 TDD | EVA 5                           | EVA 5  | 2x2 Low                                      | 70  | 12.2              | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.<br>Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.<br>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.<br>Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms. |                   |              |          |                                 |        |  |   |                   |             |

#### 8.2.2.3.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements for non-MBSFN ABS are specified in Table 8.2.2.3.4-2, with the addition of parameters in Table 8.2.2.3.4-1. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.3.4-1, Cell 1 is the serving cell, and Cell 2 and Cell3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.3.4-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter                      | Unit      | Cell 1    | Cell 2       | Cell 3      |
|--------------------------------|-----------|-----------|--------------|-------------|
| Uplink downlink configuration  |           | 1         | 1            | 1           |
| Special subframe configuration |           | 4         | 4            | 4           |
| Downlink power allocation      | $\rho_A$  | dB        | -3           | -3          |
|                                | $\rho_B$  | dB        | -3 (Note 1)  | -3 (Note 1) |
|                                | $\sigma$  | dB        | 0            | N/A         |
| $N_{oc}$ at antenna port       | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A         |
|                                | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A         |

|   |                    |           |                                      |                                      |                                      |
|---|--------------------|-----------|--------------------------------------|--------------------------------------|--------------------------------------|
|   | $N_{oc3}$          | dBm/15kHz | -93 (Note 4)                         | N/A                                  | N/A                                  |
| $\hat{E}_s/N_{oc2}$   |                    | dB        | Reference Value in Table 8.2.2.3.4-2 | Reference Value in Table 8.2.2.3.4-2 | Reference Value in Table 8.2.2.3.4-2 |
| BW <sub>Channel</sub>   |                    | MHz       | 10                                   | 10                                   | 10                                   |
| Subframe Configuration  |                    |           | Non-MBSFN                            | Non-MBSFN                            | Non-MBSFN                            |
| Time Offset between Cells   |                    | μs        | N/A                                  | 3                                    | -1                                   |
| Frequency shift between Cells   |                    | Hz        | N/A                                  | 300                                  | -100                                 |
| Cell Id   |                    |           | 0                                    | 1                                    | 126                                  |
| ABS pattern (Note 5)  |                    |           | N/A                                  | 000000001<br>000000001               | 000000001<br>000000001               |
| RLM/RRM Measurement Subframe Pattern (Note 6)   |                    |           | 000000001<br>000000001               | N/A                                  | N/A                                  |
| CSI Subframe Sets (Note7)   | C <sub>CSI,0</sub> |           | 000000001<br>000000001               | N/A                                  | N/A                                  |
|   | C <sub>CSI,1</sub> |           | 1100111000<br>1100111000             | N/A                                  | N/A                                  |
| Number of control OFDM symbols  |                    |           | 2                                    | Note 8                               | Note 8                               |
| ACK/NACK feedback mode  |                    |           | Multiplexing                         | N/A                                  | N/A                                  |
| PDSCH transmission mode   |                    |           | 3                                    | Note 9                               | Note 9                               |
| Cyclic prefix   |                    |           | Normal                               | Normal                               | Normal                               |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 5: ABS pattern as defined in [9].</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.</p> <p>Note 10: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.</p> <p>Note 11: SIB-1 will not be transmitted in Cell2 and Cell 3 in this test.</p> |                    |           |                                      |                                      |                                      |

**Table 8.2.2.3.4-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | $\hat{E}_s/N_{oc2}$ |        | OCNG Pattern |          |          | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                           |                   | UE Category |
|-------------|-------------------|---------------------|--------|--------------|----------|----------|--------------------------------|--------|--------|---|---|-------------------|-------------|
|             |                   | Cell 2              | Cell 3 | Cell 1       | Cell 2   | Cell 3   | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) |             |
| 1           | R.11 TDD Note 4   | 9                   | 7      | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                           | EVA5   | EVA5   | 2x2 Low   | 70  | 14.2              | ≥2          |
| 2           | R.35 TDD Note 4   | 9                   | 1      | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                           | EVA5   | EVA5   | 2x2 Low   | 70  | 22.7              | ≥2          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
 Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.  
 Note 3: SNR corresponds to  $\hat{E}_s / N_{oc2}$  of cell 1.  
 Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.  
 Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

8.2.2.3.5 Minimum Requirement 2 Tx Antenna Port (Superposed transmission)

The requirements are specified in Table 8.2.2.3.5-2, with the addition of the parameters in Table 8.2.2.3.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of open-loop spatial multiplexing with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.2.3.5-1: Test Parameters for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  | Unit     | Test 1           |
|--|----------|------------------|
| Downlink power allocation  | $\rho_A$ | dB<br>0          |
|  | $\rho_B$ | dB<br>0 (NOTE 1) |
|  | $\sigma$ | dB<br>0          |
|  | PDSCH_RA | dB<br>-3         |
|  | PDSCH_RB | dB<br>-3         |
| $N_{oc}$ at antenna port   |          | dBm/15kHz<br>-98 |
| ACK/NACK feedback mode   |          | Bundling         |
| PDSCH transmission mode  |          | 3                |
| MUSTIdx (Note 2)   |          | 10               |
| p-a-must-r14 (Note 3)  |          | -3               |
| Note 1: $P_B = 1$ .<br>Note 2: MUSTIdx is described in subclause 6.3.3 of [4].<br>Note 3: p-a-must-r14 is described in subclause 6.3.2 of [7]. |          |                  |

**Table 8.2.2.3.5-2: Minimum Performance for Minimum Requirement 2 Tx Antenna Port - Superposed transmission (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.bb TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 19.3     | $\geq 2$    |

8.2.2.3.6 Minimum Requirement 2 Tx Antenna Port (network-based CRS interference mitigation)

The requirements are specified in Table 8.2.2.3.6-2, with the addition of parameters in Table 8.2.2.3.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performance with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by CRS of one dominant interfering cell with network-based CRS interference mitigation. In Table 8.2.2.3.6-1, Cell 1 is the serving cell, and Cell 2 is interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.



**Table 8.2.2.3.6-1: Test parameters for Larger Delay CDD (FRC) with network-based CRS interference mitigation**

| Parameter  |          | Unit      | Cell 1                               | Cell 2   |
|--|----------|-----------|--------------------------------------|--|
| Bandwidth  |          | MHz       | 10 MHz                               |  |
| Uplink downlink configuration  |          |           | 4                                    |  |
| Special subframe configuration   |          |           | 4                                    |  |
| Downlink power allocation  | $\rho_A$ | dB        | -3                                   | 0  |
|  | $\rho_B$ |           | -3 (Note 1)                          | 0  |
|  | $\sigma$ |           | 0                                    | 0  |
| Cell-specific reference signals  |          |           | Antenna ports 0,1                    | Antenna ports 0,1  |
| Cyclic Prefix  |          |           | Normal                               | Normal   |
| Cell ID  |          |           | 0                                    | 1  |
| Transmission mode  |          |           | 3                                    | NA (Note 4)  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                                  | N/A  |
| $\bar{E}_s/N_{oc}$ (Note 3)  |          | dB        | Reference Value in Table 8.2.2.3.6-2 | 10   |
| Correlation and antenna configuration  |          |           | Low (2x2)                            | Low (2x2)  |
| Max number of HARQ transmissions   |          |           | 4                                    | N/A  |
| Redundancy version coding sequence   |          |           | {0,1,2,3}                            | N/A  |
| nw-BasedCRS-InterferenceMitigation-r15   |          |           | Disabled                             | Enabled  |
| CRS transmission   |          |           | On                                   | CRS is configured with CRS muting pattern as '10UU11111110UU111000' where every 20 subframes consist of 11 subframes with full system BW CRS and 9 subframes with CRS only on the center 6 PRBs (Note 5) |
| Note 1: $P_B=1$<br>Note 2: Cell 1 is the serving cell. Cell 2 is the interfering cell.<br>Note 3: All cells are time-synchronous.<br>Note 4: Cell 2 has no PDSCH/PDCCH configured<br>Note 5: The muting pattern '10UU11111110UU111000' follows the Uplink downlink configuration 4 where U indicates uplink subframes, 1 indicates DL subframes with full system BW CRS configured and 0 indicates DL subframes including special subframes with CRS only on the center 6 PRBs configured. |          |           |                                      |  |

**Table 8.2.2.3.6-2: Minimum performance Large Delay CDD (FRC) with network-based CRS interference mitigation**

| Test Number   | Reference Channel | OCNG Pattern |        | Propagation Conditions (Note 1) |        | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|---------------------------------|--------|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 1                          | Cell 2 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1   | R.11-13 TDD       | OP.1 TDD     | NA     | EVA5                            | EVA5   | 70                                 | 15.0              | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: SNR corresponds to $\bar{E}_s/N_{oc}$ of Cell 1. |                   |              |        |                                 |        |                                    |                   |             |

## 8.2.2.4 Closed-loop spatial multiplexing performance

### 8.2.2.4.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.1-2, with the addition of the parameters in Table 8.2.2.4.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.2.4.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   |          | Unit      | Test 1          | Test 2          |
|---|----------|-----------|-----------------|-----------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3              | -3              |
|   | $\rho_B$ | dB        | -3 (Note 1)     | -3 (Note 1)     |
|   | $\sigma$ | dB        | 0               | 0               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98             | -98             |
| Precoding granularity   |          | PRB       | 6               | 50              |
| PMI delay (Note 2)  |          | ms        | 10 or 11        | 10 or 11        |
| Reporting interval  |          | ms        | 1 or 4 (Note 3) | 1 or 4 (Note 3) |
| Reporting mode  |          |           | PUSCH 1-2       | PUSCH 3-1       |
| CodeBookSubsetRestriction bitmap  |          |           | 001111          | 001111          |
| ACK/NACK feedback mode  |          |           | Multiplexing    | Multiplexing    |
| PDSCH transmission mode   |          |           | 4               | 4               |
| Note 1: $P_B = 1$ .   |          |           |                 |                 |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |                 |                 |
| Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.  |          |           |                 |                 |

**Table 8.2.2.4.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.10 TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | -3.1     | $\geq 1$    |
| 2           | 10 MHz    | R.10 TDD          | OP.1 TDD     | EPA5                  | 2x2 High                                     | 70                                 | -2.8     | $\geq 1$    |

### 8.2.2.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.1A-2, with the addition of the parameters in Table 8.2.2.4.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.2.4.1A-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter                 |          | Unit      | Test 1          | Test 2          |
|---------------------------|----------|-----------|-----------------|-----------------|
| Downlink power allocation | $\rho_A$ | dB        | -6              | -6              |
|                           | $\rho_B$ | dB        | -6 (Note 1)     | -6 (Note 1)     |
|                           | $\sigma$ | dB        | 3               | 3               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98             | -98             |
| Precoding granularity     |          | PRB       | 6               | 50              |
| PMI delay (Note 2)        |          | ms        | 10 or 11        | 10 or 11        |
| Reporting interval        |          | ms        | 1 or 4 (Note 3) | 1 or 4 (Note 3) |

| Reporting mode   |  | PUSCH 1-2  | PUSCH 3-1  |
|--|--|--|--|
| CodeBookSubsetRestriction on bitmap  |  | 0000000000000000<br>0000000000000000<br>0000000000000111<br>1111111111111111 | 0000000000000000<br>0000000000000000<br>0000000000000111<br>1111111111111111 |
| ACK/NACK feedback mode   |  | Multiplexing   | Multiplexing   |
| PDSCH transmission mode  |  | 4  | 4  |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |  |  |  |

**Table 8.2.2.4.1A-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth     | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL Category |
|-------------|---------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|             |               |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1           | 10 MHz        | R.13 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | -3.5     | ≥1          | ≥4             |
| 2           | 10MHz 1024QAM | R.101 TDD         | OP.1 TDD     | EPA5                  | 4x2 Low                                      | 70                                 | 25.0     | TBD         | 20, ≥ 22       |

#### 8.2.2.4.1B Enhanced Performance Requirement Type A – Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.2.4.1B-2, with the addition of the parameters in Table 8.2.2.4.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.2.2.4.1B-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.4.1B-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter                       | Unit     | Cell 1    | Cell 2            | Cell 3            |                   |
|---------------------------------|----------|-----------|-------------------|-------------------|-------------------|
| Downlink power allocation       | $\rho_A$ | dB        | -3                | -3                | -3                |
|                                 | $\rho_B$ | dB        | -3 (Note 1)       | -3                | -3                |
|                                 | $\sigma$ | dB        | 0                 | 0                 | 0                 |
| Cell-specific reference signals |          |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port        |          | dBm/15kHz | -98               | N/A               | N/A               |
| DIP (Note 2)                    |          | dB        | N/A               | -1.73             | -8.66             |
| BW <sub>Channel</sub>           |          | MHz       | 10                | 10                | 10                |
| Cyclic Prefix                   |          |           | Normal            | Normal            | Normal            |
| Cell Id                         |          |           | 0                 | 1                 | 2                 |
| Number of control OFDM symbols  |          |           | 2                 | 2                 | 2                 |
| PDSCH transmission mode         |          |           | 6                 | N/A               | N/A               |

|  |        |     |               |                              |                              |
|--|--------|-----|---------------|------------------------------|------------------------------|
| Interference model   |        |     | N/A           | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | %   | N/A           | 80                           | 80                           |
|  | Rank 2 | %   | N/A           | 20                           | 20                           |
| Precoding granularity  |        | PRB | 50            | 6                            | 6                            |
| PMI delay (Note 4)   |        | ms  | 10 or 11      | N/A                          | N/A                          |
| Reporting interval   |        | ms  | 5             | N/A                          | N/A                          |
| Reporting mode   |        |     | PUCCH 1-1     | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap   |        |     | 1111          | N/A                          | N/A                          |
| ACK/NACK feedback mode   |        |     | Multiplexing  | N/A                          | N/A                          |
| Physical channel for CQI reporting   |        |     | PUSCH(Note 6) | N/A                          | N/A                          |
| cqi-pmi-ConfigurationIndex   |        |     | 4             | N/A                          | N/A                          |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}'</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.</p> <p>Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 5: All cells are time-synchronous.</p> <p>Note 6: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |     |               |                              |                              |

**Table 8.2.2.4.1B-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|--------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1  | R.47 TDD          | OP. 1 TDD    | N/A    | N/A    | EV A5                  | EV A5  | EV A5  | 2x2 Low   | 70                                 | 1.1                | ≥1          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: SINR corresponds to <math>\widehat{E}_s/N_{oc}'</math> of Cell 1 as defined in clause 8.1.1.</p> <p>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.</p> |                   |              |        |        |                        |        |        |   |                                    |                    |             |

**8.2.2.4.1C Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

The requirements are specified in Table 8.2.2.4.1C-2, with the addition of parameters in Table 8.2.2.4.1C-1. The purpose is to verify the closed loop rank-one performance with wideband precoding if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.4.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.4.1C-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) – Non-MBSFN ABS**

| Parameter                      | Unit     | Cell 1 | Cell 2 | Cell 3 |
|--------------------------------|----------|--------|--------|--------|
| Uplink downlink configuration  |          | 1      | 1      | 1      |
| Special subframe configuration |          | 4      | 4      | 4      |
|                                | $\rho_A$ | dB     | -3     | -3     |

|  |                    |           |                                       |                        |                        |
|--|--------------------|-----------|---------------------------------------|------------------------|------------------------|
| Downlink power allocation  | $\rho_B$           | dB        | -3 (Note 1)                           | -3 (Note 1)            | -3 (Note 1)            |
|  | $\sigma$           | dB        | 0                                     | N/A                    | N/A                    |
| $N_{oc}$ at antenna port   | $N_{oc1}$          | dBm/15kHz | -98 (Note 2)                          | N/A                    | N/A                    |
|  | $N_{oc2}$          | dBm/15kHz | -98 (Note 3)                          | N/A                    | N/A                    |
|  | $N_{oc3}$          | dBm/15kHz | -93 (Note 4)                          | N/A                    | N/A                    |
| $\hat{E}_s / N_{oc2}$  |                    | dB        | Reference Value in Table 8.2.2.4.1C-2 | 12                     | 10                     |
| BW <sub>Channel</sub>  |                    | MHz       | 10                                    | 10                     | 10                     |
| Subframe Configuration   |                    |           | Non-MBSFN                             | Non-MBSFN              | Non-MBSFN              |
| Time Offset between Cells  |                    | μs        | N/A                                   | 3                      | -1                     |
| Frequency shift between Cells  |                    | Hz        | N/A                                   | 300                    | -100                   |
| Cell Id  |                    |           | 0                                     | 126                    | 1                      |
| ABS pattern (Note 5)   |                    |           | N/A                                   | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6)  |                    |           | 000000001<br>000000001                | N/A                    | N/A                    |
| CSI Subframe Sets (Note7)  | C <sub>CSI,0</sub> |           | 000000001<br>000000001                | N/A                    | N/A                    |
|  | C <sub>CSI,1</sub> |           | 1100111000<br>1100111000              | N/A                    | N/A                    |
| Number of control OFDM symbols   |                    |           | 2                                     | Note 8                 | Note 8                 |
| ACK/NACK feedback mode   |                    |           | Multiplexing                          | N/A                    | N/A                    |
| PDSCH transmission mode  |                    |           | 6                                     | Note 9                 | Note 9                 |
| Precoding granularity  |                    | PRB       | 50                                    | N/A                    | N/A                    |
| PMI delay (Note 10)  |                    | ms        | 10 or 11                              | N/A                    | N/A                    |
| Reporting interval   |                    | ms        | 1 or 4 (Note 11)                      | N/A                    | N/A                    |
| Peporting mode   |                    |           | PUSCH 3-1                             | N/A                    | N/A                    |
| CodeBookSubsetRestriction bitmap   |                    |           | 1111                                  | N/A                    | N/A                    |
| Cyclic prefix  |                    |           | Normal                                | Normal                 | Normal                 |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 5: ABS pattern as defined in [9].</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.</p> <p>Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 11: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.</p> <p>Note 12: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 13: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> |                    |           |                                       |                        |                        |

**Table 8.2.2.4.1C-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)– Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | Propagation Conditions (Note1) | Correlation Matrix and | Reference Value |  |
|-------------|-------------------|--------------|--------------------------------|------------------------|-----------------|--|
|-------------|-------------------|--------------|--------------------------------|------------------------|-----------------|--|

|   |                 | Cell 1   | Cell 2   | Cell 3   | Cell 1 | Cell 2 | Cell 3 | Antenna Configuration (Note 2) | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | UE Category |
|---|-----------------|----------|----------|----------|--------|--------|--------|--------------------------------|---|-------------------|-------------|
| 1   | R.11 TDD Note 4 | OP.1 TDD | OP.1 FDD | OP.1 TDD | EPA5   | EPA5   | EPA5   | 2x2 High                       | 70  | 6.4               | ≥2          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc2}</math> of cell 1.</p> <p>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.</p> |                 |          |          |          |        |        |        |                                |   |                   |             |

#### 8.2.2.4.1D Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.2.4.1D-2, with the addition of the parameters in Table 8.2.2.4.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 4 interference model defined in clause B.6.3. In Table 8.2.2.4.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.4.1D-1: Test Parameters for Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter   |          | Unit       | Cell 1                            | Cell 2                       |                              | Cell 3                       |                              |
|---|----------|------------|-----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| Uplink downlink Configuration                       |          |            | 1                                 | 1                            | 1                            | 1                            | 1                            |
| Special subframe configuration                      |          |            | 4                                 | 4                            | 4                            | 4                            | 4                            |
| Downlink power allocation                           | $\rho_A$ | dB         | -3                                | -3                           | -3                           | -3                           | -3                           |
|   | $\rho_B$ | dB         | -3 (Note 1)                       | -3                           | -3                           | -3                           | -3                           |
|   | $\sigma$ | dB         | 0                                 | 0                            | 0                            | 0                            | 0                            |
| Cell-specific reference signals                     |          |            | Antenna ports 0,1                 | Antenna ports 0,1            | Antenna ports 0,1            | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port                            |          | dBm/15 kHz | -98                               |                              |                              |                              |                              |
| Test number (Note 4)                                |          |            |                                   | Test 1                       | Test 2                       | Test 1                       | Test 2                       |
| $\hat{E}_s/N_{oc}$                                  |          | dB         | N/A                               | 13.91                        | 3.28                         | 3.34                         | 0.74                         |
| Cell Id   |          |            |                                   | 6                            | 1                            | 1                            | 6                            |
| CFI indicated in PCFICH in normal subframes         |          |            |                                   | 3                            | Random from set {1,2,3}      | 3                            | Random from set {1,2,3}      |
| CFI indicated in PCFICH in special subframes        |          |            |                                   | 2                            | Random from set {1,2}        | 2                            | Random from set {1,2}        |
| $BW_{Channel}$                                      |          | MHz        | 10                                | 10                           | 10                           | 10                           | 10                           |
| Cyclic Prefix                                       |          |            | Normal                            | Normal                       | Normal                       | Normal                       | Normal                       |
| Number of control OFDM symbols in normal subframes  |          |            | 3                                 | 3                            | 3                            | 3                            | 3                            |
| Number of control OFDM symbols in special subframes |          |            | 2                                 | 2                            | 2                            | 2                            | 2                            |
| PDSCH transmission mode                             |          |            | 4                                 | 4                            | 4                            | 4                            | 4                            |
| Interference model                                  |          |            | N/A                               | As specified in clause B.6.3 | As specified in clause B.6.3 | As specified in clause B.6.3 | As specified in clause B.6.3 |
| Precoding   |          |            | Random wideband precoding per TTI | As specified in clause B.6.3 | As specified in clause B.6.3 | As specified in clause B.6.3 | As specified in clause B.6.3 |

|  |                          |                |                   |                   |
|--|--------------------------|----------------|-------------------|-------------------|
| Time offset to cell 1  | us                       | N/A            | 2                 | 3                 |
| Frequency offset to cell 1   | Hz                       | N/A            | 200               | 300               |
| MBSFN  |                          | Not configured | Not configured    | Not configured    |
| NeighCellsInfo-r12<br>(Note 3)   | p-aList-r12              | N/A            | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
|  | transmissionModeList-r12 | N/A            | {2,3,4,8,9}       | {2,3,4,8,9}       |
| Note 1: $P_B = 1$  |                          |                |                   |                   |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |                |                   |                   |
| Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |                |                   |                   |
| Note 4: Test 1 and Test 2 are defined in Table 8.2.2.4.1D-2.             |                          |                |                   |                   |

**Table 8.2.2.4.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Num   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.11-12 TDD       | OP.1 TDD     | N/A    | N/A    | EVA 5                  | EVA 5  | EVA 5  | 2x2 Low   | 85                                 | 16.1              | ≥1          |
| 2  | R.11-11 TDD       | OP.1 TDD     | N/A    | N/A    | EPA 5                  | EPA 5  | EPA 5  | 2x2 Low   | 85                                 | 9.5               | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.              |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                          |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

#### 8.2.2.4.1E Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.2.2.4.1E-2, with the addition of parameters in Table 8.2.2.4.1E-1. The purpose is to verify the closed loop rank-one performance with wideband precoding when CRS assistance information [7] is configured. In Table 8.2.2.4.1E-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.4.1E-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter                       | Unit      | Cell 1                                | Cell 2      | Cell 3      |
|---------------------------------|-----------|---------------------------------------|-------------|-------------|
| Uplink downlink configuration   |           | 1                                     | 1           | 1           |
| Special subframe configuration  |           | 4                                     | 4           | 4           |
| Downlink power allocation       | $\rho_A$  | dB                                    | -3          | -3          |
|                                 | $\rho_B$  | dB                                    | -3 (Note 1) | -3 (Note 1) |
|                                 | $\sigma$  | dB                                    | 0           | 0           |
| $N_{oc}$ at antenna port        | dBm/15kHz | -98                                   | N/A         | N/A         |
| $\hat{E}_s/N_{oc}$              | dB        | Reference Value in Table 8.2.2.4.1E-2 | 10.45       | 4.6         |
| $BW_{channel}$                  | MHz       | 10                                    | 10          | 10          |
| Subframe Configuration          |           | Non-MBSFN                             | Non-MBSFN   | Non-MBSFN   |
| Time Offset to Cell 1           | μs        | N/A                                   | 3           | -1          |
| Frequency shift to Cell 1       | Hz        | N/A                                   | 300         | -100        |
| Cell Id                         |           | 0                                     | 1           | 128         |
| Cell-specific reference signals |           | Antenna ports 0,1                     |             |             |

|   |        |     |                 |                              |                              |
|---|--------|-----|-----------------|------------------------------|------------------------------|
| Number of control OFDM symbols  |        |     | 2               | 2                            | 2                            |
| Interference model  |        |     | N/A             | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells   |        | %   | N/A             | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %   | N/A             | 80                           | 80                           |
|   | Rank 2 | %   | N/A             | 20                           | 20                           |
| ACK/NACK feedback mode  |        |     | Multiplexing    | N/A                          | N/A                          |
| PDSCH transmission mode   |        |     | 4               | N/A                          | N/A                          |
| Precoding granularity   |        | PRB | 50              | N/A                          | N/A                          |
| PMI delay (Note 2)  |        | ms  | 10 or 11        | N/A                          | N/A                          |
| Reporting interval  |        | ms  | 1 or 4 (Note 3) | N/A                          | N/A                          |
| Reporting mode  |        |     | PUSCH 3-1       | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap  |        |     | 001111          | N/A                          | N/A                          |
| Cyclic prefix   |        |     | Normal          | Normal                       | Normal                       |
| Note 1: $P_B = 1$ .   |        |     |                 |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |        |     |                 |                              |                              |
| Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.  |        |     |                 |                              |                              |

Table 8.2.2.4.1E-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------|---------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                          | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.10-3 TDD        | OP.1 TDD     | N/A    | N/A    | EVA5                            | EVA5   | EVA5   | 2x2 Low   | 70                                 | 11.2              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |        |        |                                 |        |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |        |        |                                 |        |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.  |                   |              |        |        |                                 |        |        |   |                                    |                   |             |

#### 8.2.2.4.1F Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.2.2.4.1F-2, with the addition of parameters in Table 8.2.2.4.1F-1. In Table 8.2.2.4.1F-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

Table 8.2.2.4.1F-1: Test Parameters

| Parameter                      | Unit     | Cell 1 | Cell 2 | Cell 3 |
|--------------------------------|----------|--------|--------|--------|
| Uplink downlink configuration  |          | 1      | 1      | 1      |
| Special subframe configuration |          | 4      | 4      | 4      |
|                                | $\rho_A$ | dB     | -6     | -6     |



|  |          |           |                                       |                              |                              |
|--|----------|-----------|---------------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_B$ | dB        | -6 (Note 1)                           | -6 (Note 1)                  | -6 (Note 1)                  |
|  | $\sigma$ | dB        | 3                                     | 3                            | 3                            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                                   | N/A                          | N/A                          |
| $\widehat{E}_s/N_{oc}$   |          | dB        | Reference Value in Table 8.2.2.4.1F-2 | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>  |          | MHz       | 10                                    | 10                           | 10                           |
| Cyclic prefix  |          |           | Normal                                | Normal                       | Normal                       |
| Subframe Configuration   |          |           | Non-MBSFN                             | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID  |          |           | 0                                     | 1                            | 6                            |
| Cell-specific reference signals  |          |           | Antenna ports 0,1,2,3                 |                              |                              |
| Number of control OFDM symbols (CFI)   |          |           | 2                                     | 2                            | 2                            |
| PDSCH transmission mode  |          |           | 4                                     | N/A                          | N/A                          |
| Precoding granularity  |          | PRB       | 50                                    | N/A                          | N/A                          |
| PMI delay (Note 2)   |          | ms        | 8                                     | N/A                          | N/A                          |
| Reporting interval   |          | ms        | 1 or 4 (Note 3)                       | N/A                          | N/A                          |
| Reporting mode   |          |           | PUSCH 3-1                             | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap   |          |           | 000000000000<br>FFFF                  | N/A                          | N/A                          |
| ACK/NACK feedback mode   |          |           | Multiplexing                          | N/A                          | N/A                          |
| Time Offset relative to Cell 1   |          | μs        | N/A                                   | 3                            | -1                           |
| Frequency shift relative to Cell 1   |          | Hz        | N/A                                   | 300                          | -100                         |
| Interference model   |          |           | N/A                                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells  |          | %         | N/A                                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1   | %         | N/A                                   | 80                           | 80                           |
|  | Rank 2   | %         | N/A                                   | 20                           | 20                           |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |          |           |                                       |                              |                              |

**Table 8.2.2.4.1F-2: Minimum Performance for PDSCH**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.36 TDD          | OP.1 TDD     | N/A    | N/A    | EVA5                           | EVA5   | EVA5   | 4x2 low   | 70                                 | 14.1              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\widehat{E}_s/N_{oc}$ of cell 1. |                   |              |        |        |                                |        |        |   |                                    |                   |             |

**8.2.2.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port**

The requirements are specified in Table 8.2.2.4.2-2, with the addition of the parameters in Table 8.2.2.4.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.2.4.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | Unit | Test 1-2 | Test 3 |
|-----------|------|----------|--------|
|-----------|------|----------|--------|

|  |          |             |                 |                 |
|--|----------|-------------|-----------------|-----------------|
| Downlink power allocation  | $\rho_A$ | dB          | -3              | -3              |
|  | $\rho_B$ | dB          | -3 (Note 1)     | -3 (Note 1)     |
|  | $\sigma$ | dB          | 0               | 0               |
| $N_{oc}$ at antenna port   |          | dBm/15kHz   | -98             | -98             |
| Precoding granularity  |          | PRB         | 50              | 8               |
| PMI delay (Note 2)   |          | ms          | 10 or 11        | 10 or 11        |
| Reporting interval   |          | ms          | 1 or 4 (Note 3) | 1 or 4 (Note 3) |
| Reporting mode   |          |             | PUSCH 3-1       | PUSCH 1-2       |
| ACK/NACK feedback mode   |          |             | Bundling        | Bundling        |
| CodeBookSubsetRestriction bitmap   |          |             | 110000          | 110000          |
| PDSCH transmission mode  |          |             | 4               | 4               |
| Number of OFDM symbols for PDCCH per component carrier   |          | OFDM symbol | 2               | 1               |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |          |             |                 |                 |

Table 8.2.2.4.2-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)

| Test number | Bandwidth        | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL category |
|-------------|------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|             |                  |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1           | 10 MHz           | R.35 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 19.5     | $\geq 2$    | $\geq 6$       |
| 2           | 10 MHz           | R.11-1 TDD        | OP.1 TDD     | ETU70                 | 2x2 Low                                      | 70                                 | 13.9     | $\geq 2$    | $\geq 6$       |
| 3           | 20 MHz<br>256QAM | R. 65 TDD         | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 24.9     | 11-12       | $\geq 11$      |

#### 8.2.2.4.2A Enhanced Performance Requirement Type C Multi-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.2A-2, with the addition of the parameters in Table 8.2.2.4.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

Table 8.2.2.4.2A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)

| Parameter                        | Unit     | Test 1    |                 |
|----------------------------------|----------|-----------|-----------------|
| Downlink power allocation        | $\rho_A$ | dB        | -3              |
|                                  | $\rho_B$ | dB        | -3 (Note 1)     |
|                                  | $\sigma$ | dB        | 0               |
| $N_{oc}$ at antenna port         |          | dBm/15kHz | -98             |
| Precoding granularity            |          | PRB       | 50              |
| PMI delay (Note 2)               |          | ms        | 10 or 11        |
| Reporting interval               |          | ms        | 1 or 4 (Note 3) |
| Reporting mode                   |          |           | PUSCH 3-1       |
| ACK/NACK feedback mode           |          |           | Bundling        |
| CodeBookSubsetRestriction bitmap |          |           | 110000          |
| PDSCH transmission mode          |          |           | 4               |

|         |   |
|---------|---|
| Note 1: | .   |
| Note 2: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 3: | For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.  |

**Table 8.2.2.4.2A-2: Enhanced Performance Requirement Type C for Multi-Layer Spatial Multiplexing (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz     | R.11-1 TDD        | OP.1 TDD     | ETU70                 | 2x2 Medium                                   | 70                                 | 17.8     | ≥2          |

### 8.2.2.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.2.4.3-2, with the addition of the parameters in Table 8.2.2.4.3-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.4.3-4, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.4.3-7, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.2.4.3-8, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.2.4.3-9, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 6 DL CCs, the requirements are specified in Table 8.2.2.4.3-10, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 7 DL CCs, the requirements are specified in Table 8.2.2.4.3-11, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.2.4.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter                 | Unit      | Test 1          |             |
|---------------------------|-----------|-----------------|-------------|
| Downlink power allocation | $\rho_A$  | dB              | -6          |
|                           | $\rho_B$  | dB              | -6 (Note 1) |
|                           | $\sigma$  | dB              | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98             |             |
| Precoding granularity     | PRB       | 6               |             |
| PMI delay (Note 2)        | ms        | 10 or 11        |             |
| Reporting interval        | ms        | 1 or 4 (Note 3) |             |
| Reporting mode            |           | PUSCH 1-2       |             |
| ACK/NACK feedback mode    |           | Bundling        |             |

|  |  |   |
|--|--|---|
| CodeBookSubsetRestriction bitmap   |  | 00000000000000000000000000000000<br>00001111111111111111100000000<br>00000000 |
| PDSCH transmission mode  |  | 4   |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Void.<br>Note 5: Void.<br>Note 6: Void. |  |   |

**Table 8.2.2.4.3-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)**

| Test number  | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|--------------|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|              |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1            | 10 MHz     | R.36 TDD          | OP.1 TDD     | EPA5                  | 4x2 Low                                      | 70                                 | 15.7     | ≥2          |
| Note 1: Void |            |                   |              |                       |  |                                    |          |             |

**Table 8.2.2.4.3-3: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  | Unit      | Value  |             |
|--|-----------|--|-------------|
| Downlink power allocation  | $\rho_A$  | dB   | -6          |
|  | $\rho_B$  | dB   | -6 (Note 1) |
|  | $\sigma$  | dB   | 3           |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98  |             |
| Precoding granularity  | PRB       | 8  |             |
| PMI delay (Note 2)   | ms        | 10 or 11   |             |
| Reporting interval   | ms        | 1 or 4 (Note 3)  |             |
| Reporting mode   |           | PUSCH 1-2  |             |
| ACK/NACK feedback mode   |           | PUCCH format 1b with channel selection for Tests in Table 8.2.2.4.3-4; PUCCH format 3 for Tests in Table 8.2.2.4.3-7, Table 8.2.2.4.3-8 and Table 8.2.2.4.3-9. |             |
| CodeBookSubsetRestriction bitmap   |           | 00000000000000000000000000000000<br>00001111111111111111100000000<br>00000000  |             |
| CSI request field (Note 4)   |           | '10'   |             |
| PDSCH transmission mode  |           | 4  |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by high layers.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |           |  |             |

**Table 8.2.2.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA with 2DL CCs**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value     |          | UE Category |
|-------------|------------|-------------------|--------------|-----------------------|--|---------------------|----------|-------------|
|             |            |                   |              |                       |  | Fraction of Maximum | SNR (dB) |             |

|  |              |                         |                   |      |         | Throughput (%) |      |    |
|--|--------------|-------------------------|-------------------|------|---------|----------------|------|----|
| 1  | 2x20 MHz     | R.43 TDD                | OP.1 TDD (Note 1) | EVA5 | 4x2 Low | 70             | 11.1 | ≥5 |
| 2  | 20MHz +15MHz | R.43 TDD for 20MHz CC   | OP.1 TDD (Note 1) | EVA5 | 4x2 Low | 70             | 10.7 | ≥5 |
|  |              | R.43-5 TDD for 15MHz CC | OP.1 TDD (Note 1) |      |         |                | 10.6 |    |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. |              |                         |                   |      |         |                |      |    |

**Table 8.2.2.4.3-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.43-1 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 11.0     |
| 3MHz       | R.43-2 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 9.8      |
| 5MHz       | R.43-3 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.0     |
| 10 MHz     | R.43-4 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.5     |
| 15MHz      | R.43-5 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.6     |
| 20MHz      | R.43 TDD          | OP. 1 TDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.7     |

**Table 8.2.2.4.3-6: Void**

**Table 8.2.2.4.3-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 3x20MHz                   | As specified in Table 8.2.2.4.3-5 per CC | ≥5          |
| 2  | 20MHz+20MHz+15MHz         | As specified in Table 8.2.2.4.3-5 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.2.4.3-8: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 4x20MHz                   | As specified in Table 8.2.2.4.3-5 per CC | ≥8          |
| 2  | 20MHz+20MHz+20MHz+15MHz   | As specified in Table 8.2.2.4.3-5 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.2.4.3-9: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num. | CA Band-width combination | Requirement                              | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 5x20MHz                   | As specified in Table 8.2.2.4.3-5 per CC | 8, ≥11      |
| 2         | 15MHz+4x20MHz             | As specified in Table 8.2.2.4.3-5 per CC | 8, ≥11      |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3

**Table 8.2.2.4.3-10: Minimum performance (FRC) based on single carrier performance for CA with 6 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 6x20MHz                   | As specified in Table 8.2.2.4.3-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**Table 8.2.2.4.3-11: Minimum performance (FRC) based on single carrier performance for CA with 7 DL CCs**

| Test num.  | CA Band-width combination | Requirement                              | UE category |
|--|---------------------------|--|-------------|
| 1  | 7x20MHz                   | As specified in Table 8.2.2.4.3-5 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 |                           |  |             |

**8.2.2.4.3A Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity**

For dual connectivity the requirements are specified in Table 8.2.2.4.3A-3, for 2DL CCs, in Table 8.2.2.4.3A-4 for 3DL CCs, and Table 8.2.2.4.3A-5 for 4DL CCs, based on single carrier requirement specified in Table 8.2.2.4.3A-2, with the addition of the parameters in Table 8.2.2.4.3A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity.

**Table 8.2.2.4.3A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Parameter                             | Unit      | Value  |             |
|---------------------------------------|-----------|--|-------------|
| Downlink power allocation             | $\rho_A$  | dB   | -6          |
|                                       | $\rho_B$  | dB   | -6 (Note 1) |
|                                       | $\sigma$  | dB   | 3           |
| $N_{oc}$ at antenna port              | dBm/15kHz | -98  |             |
| Precoding granularity                 | PRB       | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs  |             |
| PMI delay (Note 2)                    | ms        | 10 or 11   |             |
| Reporting interval                    | ms        | 1 or 4 (Note 3)  |             |
| Reporting mode                        |           | PUSCH 1-2  |             |
| CodeBookSubsetRestriction bitmap      |           | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000   |             |
| PDSCH transmission mode               |           | 4  |             |
| ACK/NACK transmission                 |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |             |
| CSI feedback                          |           | Separate PUSCH feedbacks on the MCG and SCG  |             |
| Time offset between MCG CC and SCG CC | μs        | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 5) |             |

|         |  |
|---------|--|
| Note 1: | $P_B = 1$ .  |
| Note 2: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4) |
| Note 3: | For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.   |
| Note 4: | The same PDSCH transmission mode is applied to each component carrier.   |
| Note 5: | As defined in TS36.300 [11].   |
| Note 6: | If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.   |

**Table 8.2.2.4.3A-2: Single carrier performance for multiple dual connectivity configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.43-1 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 11.0     |
| 3MHz       | R.43-2 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 9.8      |
| 5MHz       | R.43-3 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.0     |
| 10 MHz     | R.43-4 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.5     |
| 15MHz      | R.43-5 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.6     |
| 20MHz      | R.43 TDD          | OP. 1 TDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.7     |

**Table 8.2.2.4.3A-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.  | Band-width combination | Requirement                               | UE category |
|--|------------------------|---|-------------|
| 1  | 2x20 MHz               | As specified in Table 8.2.2.4.3A-2 per CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A. |                        |   |             |

**Table 8.2.2.4.3A-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.  | Band-width combination | Requirement                               | UE category |
|--|------------------------|---|-------------|
| 1  | 3x20 MHz               | As specified in Table 8.2.2.4.3A-2 per CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A. |                        |   |             |

**Table 8.2.2.4.3A-5: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.  | Band-width combination | Requirement                               | UE category |
|--|------------------------|---|-------------|
| 1  | 4x20 MHz               | As specified in Table 8.2.2.4.3A-2 per CC | ≥8          |
| 2  | 15+20+20+20MHz         | As specified in Table 8.2.2.4.3A-2 per CC | ≥8          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A. |                        |   |             |

8.2.2.4.4 Void

8.2.2.4.5 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port (Superposed transmission)

The requirements are specified in Table 8.2.2.4.5-2, with the addition of the parameters in Table 8.2.2.4.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the minimum performance of closed-loop spatial multiplexing with 2 transmitter antennas superposed with simultaneous PDSCH interference.

**Table 8.2.2.4.5-1: Test Parameters for Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port - Superposed transmission (FRC)**

| Parameter  |          | Unit      | Test 1                            |
|--|----------|-----------|-----------------------------------|
| Downlink power allocation                                    | $\rho_A$ | dB        | 0                                 |
|  | $\rho_B$ | dB        | 0 (NOTE 1)                        |
|  | $\sigma$ | dB        | 0                                 |
|  | PDSCH_RA | dB        | -3                                |
|  | PDSCH_RB | dB        | -3                                |
| $N_{oc}$ at antenna port                                     |          | dBm/15kHz | -98                               |
| ACK/NACK feedback mode                                       |          |           | Multiplexing                      |
| PDSCH transmission mode                                      |          |           | 4                                 |
| Precoding  |          |           | Random wideband precoding per TTI |
| MUSTIdx for transport block 1 (Note 2)                       |          |           | 10                                |
| MUSTIdx for transport block 2 (Note 2)                       |          |           | 00                                |
| p-a-must-r14 (Note 3)  |          |           | -3                                |
| Note 1: $P_B = 1$ .  |          |           |                                   |
| Note 2: MUSTIdx is described in subclause 6.3.3 of [4].      |          |           |                                   |
| Note 3: p-a-must-r14 is described in subclause 6.3.2 of [7]. |          |           |                                   |

**Table 8.2.2.4.5-2: Minimum Performance for Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port - Superposed transmission (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.bb TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 17.2     | $\geq 2$    |

8.2.2.5 MU-MIMO

8.2.2.6 [Control channel performance: D-BCH and PCH]

8.2.2.7 Carrier aggregation with power imbalance

The requirements in this section verify the ability of an intraband adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only.



8.2.2.7.1 Minimum Requirement

For CA, the requirements are specified in Table 8.2.2.7.1-2, with the addition of the parameters in Table 8.2.2.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.7.1-1: Test Parameters for CA**

| Parameter   |          | Unit      | Test 1        | Test 2        |
|---|----------|-----------|---------------|---------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0             | 0             |
|   | $\rho_B$ | dB        | 0 (Note 1)    | 0 (Note 1)    |
|   | $\sigma$ | dB        | 0             | 0             |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | Off (Note 2)  | Off (Note 2)  |
| Symbols for unused PRBs   |          |           | OCNG (Note 3) | OCNG (Note 3) |
| Modulation  |          |           | 64 QAM        | 64 QAM        |
| Maximum number of HARQ transmission   |          |           | 1             | 1             |
| Redundancy version coding sequence  |          |           | {0}           | {0}           |
| PDSCH transmission mode of PCell  |          |           | 1             | 3             |
| PDSCH transmission mode of SCell  |          |           | 3             | 1             |
| OCNG Pattern  | PCell    |           | OP.1 TDD      | OP.5 TDD      |
|   | SCell    |           | OP.5 TDD      | OP.1 TDD      |
| Propagation Conditions  | PCell    |           | Clause B.1    | Clause B.1    |
|   | SCell    |           | Clause B.1    | Clause B.1    |
| Correlation Matrix and Antenna  | PCell    |           | 1x2           | 2x2           |
|   | SCell    |           | 2x2           | 1x2           |
| Note 1: $P_B = 0$ for 1x2 and $P_B = 1$ for 2x2 antenna configuration.<br>Note 2: No external noise sources are applied.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data.<br>Note 4: Void. |          |           |               |               |

**Table 8.2.2.7.1-2: Minimum performance (FRC) for CA**

| Test Number  | Bandwidth (MHz) |       | Reference channel |            | Power at antenna port (dBm/15KHz) |                                | Reference value Fraction of Maximum Throughput (%) |       | UE Category |
|--|-----------------|-------|-------------------|------------|-----------------------------------|--------------------------------|--|-------|-------------|
|  | PCell           | SCell | PCell             | SCell      | $\hat{E}_{s\_PCell}$ for PCell    | $\hat{E}_{s\_SCell}$ for SCell | PCell  | SCell |             |
| 1  | 20              | 20    | R.49 TDD          | NA         | -85                               | -79                            | 85   | NA    | $\geq 5$    |
| 2  | 20              | 15    | NA                | R.49-1 TDD | -79                               | -85.8                          | NA   | 85    | $\geq 5$    |
| Note 1: The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. |                 |       |                   |            |                                   |                                |  |       |             |

8.2.2.8 Intra-band contiguous carrier aggregation with minimum channel spacing

The requirements in this section verify the ability of an UE supporting intraband contiguous carrier aggregation with minimum channel spacing to demodulate the signal transmitted by the PCell and SCell(s). Throughput is measured on each cell. The minimum channel spacing of intra-band contiguous carrier aggregation refers to the possible minimum channel spacing as any multiple of 300 kHz less than the nominal channel spacing defined in 5.7.1A.

### 8.2.2.8.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.2.8.1-2, with the addition of the parameters in Table 8.2.2.8.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.8.1-1: Test Parameters for CA**

| Parameter   |          | Unit      | Test 1-2   |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | 0  |
|   | $\rho_B$ | dB        | 0 (Note 1)   |
|   | $\sigma$ | dB        | 0  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Symbols for unused PRBs   |          |           | OCNG (Note 2)  |
| Modulation  |          |           | 64QAM  |
| ACK/NACK feedback mode  |          |           | PUCCH format 1b with channel selection for Test 1; PUCCH format 3 for Test 2 |
| PDSCH transmission mode   |          |           | 1  |
| Note 1: $P_B = 0$   |          |           |  |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |           |  |
| Note 3: The same PDSCH transmission mode is applied to each component carrier.  |          |           |  |

**Table 8.2.2.8.1-2: Minimum performance (FRC) for intra-band CA with minimum channel spacing**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern      | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |                   |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 2x20MHz   | R.9 TDD           | OP.1 TDD (Note 1) | EVA5                  | 1x2 Low                                      | 70                                 | 17.16    | ≥5          |
|   |           | R.9 TDD           | OP.1 TDD (Note 1) |                       |  | 70                                 | 17.16    |             |
| 2   | 3x20MHz   | R.9 TDD           | OP.1 TDD (Note 1) | EVA5                  | 1x2 Low                                      | 70                                 | 17.16    | ≥5          |
|   |           | R.9 TDD           | OP.1 TDD (Note 1) |                       |  | 70                                 | 17.16    |             |
|   |           | R.9 TDD           | OP.1 TDD (Note 1) |                       |  | 70                                 | 17.16    |             |
| Note 1: The OCNG pattern applies for each CC.   |           |                   |                   |                       |  |                                    |          |             |
| Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3. |           |                   |                   |                       |  |                                    |          |             |

### 8.2.2.9 HST-SFN performance

#### 8.2.2.9.1 Minimum Requirement

The purpose of this test is to verify UE performance in the HST-SFN scenario defined in B.3A when *highSpeedEnhancedDemodulationFlag* [7] is received.

For single carrier, the requirements are specified in Table 8.2.2.9.1-2, with the addition of the parameters in Table 8.2.2.9.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.9.1-5, based on single carrier requirement specified in Table 8.2.2.9.1-4, with the addition of the parameters in Table 8.2.2.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.9.1-6, based on single carrier requirement specified in Table 8.2.2.9.1-4, with the addition of the parameters in Table 8.2.2.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.2.2.9.1-7, based on single carrier requirement specified in Table 8.2.2.9.1-4, with the addition of the parameters in Table 8.2.2.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.2.2.9.1-8, based on single carrier requirement specified in Table 8.2.2.9.1-4, with the addition of the parameters in Table 8.2.2.9.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.2.9.1-1: Test Parameters for UE performance in HST-SFN scenario (FRC)**

| Parameter                 |          | Unit      | Test 1       |
|---------------------------|----------|-----------|--------------|
| Downlink power allocation | $\rho_A$ | dB        | -3           |
|                           | $\rho_B$ | dB        | -3 (NOTE 1)  |
|                           | $\sigma$ | dB        | 0            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode    |          |           | Multiplexing |
| PDSCH transmission mode   |          |           | 3            |
| NOTE 1: $P_B = 1$ .       |          |           |              |

**Table 8.2.2.9.1-2: Minimum performance UE in HST-SFN scenario (FRC)**

| Test number   | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz     | R.87 TDD          | OP.1 TDD     | HST-SFN               | 2x2  | 70                                 | 13.2     | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.1.  |            |                   |              |                       |  |                                    |          |             |
| NOTE 2: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |            |                   |              |                       |  |                                    |          |             |

**Table 8.2.2.9.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter  |          | Unit      | Value  |
|--|----------|-----------|--|
| Downlink power allocation  | $\rho_A$ | dB        | -3   |
|  | $\rho_B$ | dB        | -3 (Note 1)  |
|  | $\sigma$ | dB        | 0  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98  |
| ACK/NACK feedback mode   |          |           | PUCCH format 1b with channel selection for Tests in Table 8.2.2.3.1-4; PUCCH format 3 for Tests in Table 8.2.2.3.1-7 |
| PDSCH transmission mode  |          |           | 3  |
| NOTE 1: $P_B = 1$  |          |           |  |
| NOTE 2: Void   |          |           |  |
| NOTE 3: The same PDSCH transmission mode is applied to each component carrier. |          |           |  |

**Table 8.2.2.9.1-4: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|------------------------|--|------------------------------------|----------|
|            |                   |              |                        |  | Fraction of maximum throughput (%) | SNR (dB) |
| 5 MHz      | R.87-2 TDD        | OP.1 TDD     | HST-SFN                | 2x2 Low                                | 70                                 | [13.1]   |
| 10 MHz     | R.87 TDD          | OP.1 TDD     | HST-SFN                | 2x2 Low                                | 70                                 | [13.2]   |
| 15 MHz     | R.87-3 TDD        | OP.1 TDD     | HST-SFN                | 2x2 Low                                | 70                                 | [13.4]   |
| 20 MHz     | R.87-4 TDD        | OP. 1 TDD    | HST-SFN                | 2x2 Low                                | 70                                 | [13.6]   |

**Table 8.2.2.9.1-5: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x20 MHz                  | As specified in Table 8.2.2.9.1-4 per CC | ≥5          |
| 2   | 20 MHz + 15 MHz           | As specified in Table 8.2.2.9.1-4 per CC | ≥5          |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3 |                           |  |             |

**Table 8.2.2.9.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 3x20 MHz                  | As specified in Table 8.2.2.9.1-4 per CC | ≥5          |
| 2   | 20 MHz + 20 MHz + 15 MHz  | As specified in Table 8.2.2.9.1-4 per CC | ≥5          |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3 |                           |  |             |

**Table 8.2.2.9.1-7: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num.   | CA Band-width combination         | Requirement                              | UE category |
|---|-----------------------------------|--|-------------|
| 1   | 4x20 MHz                          | As specified in Table 8.2.2.9.1-4 per CC | ≥8          |
| 2   | 20 MHz + 20 MHz + 20 MHz + 15 MHz | As specified in Table 8.2.2.9.1-4 per CC | ≥8          |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3 |                                   |  |             |

**Table 8.2.2.9.1-8: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.   | CA Band-width combination | Requirement                              | UE category |
|---|---------------------------|--|-------------|
| 1   | 5x20 MHz                  | As specified in Table 8.2.2.9.1-4 per CC | 8, ≥11      |
| 2   | 15 MHz + 4x20 MHz         | As specified in Table 8.2.2.9.1-4 per CC | 8, ≥11      |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3 |                           |  |             |

### 8.2.2.9.2 Minimum Requirement for Rel-16 further enhanced HST

The requirements are specified in Table 8.2.2.9.2-2, with the addition of the parameters in Table 8.2.2.9.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify UE performance in the HST-SFN-500 and HST-500 scenario. The test for HST-SFN-500 scenario defined in B.3B is applied when *highSpeedEnhDemodFlag2-r16* [7] is received. The test for HST-500 scenario defined in B.3C is applied when

*highSpeedEnhDemodFlag2-r16* [7] is not received. HST-500 test is not applicable to UE that has passed HST-SFN-500 test.

**Table 8.2.2.9.2-1: Test Parameters for UE performance in HST-SFN-500 and HST-500 scenario (FRC)**

| Parameter                 |          | Unit      | Test 1       |
|---------------------------|----------|-----------|--------------|
| Downlink power allocation | $\rho_A$ | dB        | -3           |
|                           | $\rho_B$ | dB        | -3 (NOTE 1)  |
|                           | $\sigma$ | dB        | 0            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode    |          |           | Multiplexing |
| PDSCH transmission mode   |          |           | 3            |
| NOTE 1: $P_B = 1$ .       |          |           |              |

**Table 8.2.2.9.2-2: Minimum performance UE in HST-SFN scenario (FRC)**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1 <sup>NOTE 2</sup>   | 10 MHz    | R.87-1 TDD        | OP.1 TDD     | HST-SFN-500           | 2x2  | 70                                 | 9.6      | $\geq 1$    |
| 2   | 10 MHz    | R.87 TDD          | OP.1 TDD     | HST-500               | 2x2  | 70                                 | 11.4     | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.1 and 8.1.2.6.  |           |                   |              |                       |  |                                    |          |             |
| NOTE 2: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |           |                   |              |                       |  |                                    |          |             |

## 8.2.3 TDD FDD CA (Fixed Reference Channel)

The parameters specified in Table 8.2.3-1 are valid for all the TDD FDD CA tests unless otherwise stated.

**Table 8.2.3-1: Common Test Parameters**

| Parameter   |           | Unit         | Value  |
|---|-----------|--------------|--|
| Uplink downlink configuration (Note 1) for TDD CC only  |           |              | 1  |
| Special subframe configuration (Note 2) for TDD CC only |           |              | 4  |
| Inter-TTI Distance                                      |           |              | 1  |
| Maximum number of HARQ processes per component carrier  | FDD PCell | Processes    | 8 for FDD and TDD CCs  |
|   | TDD PCell | Processes    | 11 for FDD CC; 7 for TDD CC  |
| Maximum number of HARQ transmission                     |           |              | 4  |
| Redundancy version coding sequence                      |           |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM  |
| Number of OFDM symbols for PDCCH per component carrier  |           | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix   |           |              | Normal   |
| Cell_ID   |           |              | 0  |

|   |           |  |
|---|-----------|--|
| Cross carrier scheduling                              |           | Not configured                               |
| ACK/NACK feedback mode                                |           | PUCCH format 3                               |
| Downlink HARQ-ACK timing                              | FDD PCell | As specified in Clause 7.3.3 in TS36.213 [6] |
|   | TDD PCell | As specified in Clause 7.3.4 in TS36.213 [6] |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. |           |  |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. |           |  |

The applicability of their requirements are specified in Clause 8.1.2.3. The single carrier performance with different bandwidths for multiple CA configurations specified in Clause 8.2.3 cannot be applied for UE single carrier test.

### 8.2.3.1 Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.3 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS.

#### 8.2.3.1.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.1.1-4 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.1.1-5 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.1.1-6 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.1.1-7 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 6DL CCs, the requirements are specified in Table 8.2.3.1.1-8 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 7DL CCs, the requirements are specified in Table 8.2.3.1.1-9 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.1.1-1: Test Parameters for CA**

| Parameter   | Unit      | Value         |            |
|---|-----------|---------------|------------|
| Downlink power allocation   | $\rho_A$  | dB            | 0          |
|   | $\rho_B$  | dB            | 0 (Note 1) |
|   | $\sigma$  | dB            | 0          |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98           |            |
| Symbols for unused PRBs   |           | OCNG (Note 2) |            |
| Modulation  |           | QPSK          |            |
| PDSCH transmission mode   |           | 1             |            |
| Note 1: $P_B = 0$ .   |           |               |            |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |               |            |
| Note 3: The same PDSCH transmission mode is applied to each component carrier.  |           |               |            |

**Table 8.2.3.1.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.4 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.3     |
| 3 MHz     | R.42-1 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.1     |
| 5MHz      | R.42-2 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.0     |
| 10MHz     | R.2 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.7     |
| 15MHz     | R.42-3 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.6     |
| 20MHz     | R.42 FDD          | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.7     |

**Table 8.2.3.1.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.4 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -0.6     |
| 3 MHz     | R.42-1 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -0.8     |
| 5MHz      | R.42-2 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.2     |
| 10MHz     | R.2 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.6     |
| 15MHz     | R.42-3 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.4     |
| 20MHz     | R.42 TDD          | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.4     |

**Table 8.2.3.1.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz)  |        |        | Minimum performance requirement                              | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.          |        |        |  |             |
| Note 2:     | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any FDD CC. |        |        |  |             |

**Table 8.2.3.1.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 3x20                           | 20     | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |
| 2           | 20+20+15                       | 15     | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |

|   |              |       |       |  |    |
|---|--------------|-------|-------|--|----|
| 3   | 20+20+1<br>0 | 10    | 2x20  | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 4   | 3x20         | 2x20  | 20    | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 5   | 20+20+1<br>5 | 20+15 | 20    | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 6   | 20+20+1<br>0 | 20+10 | 20    | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 7   | 20+10+1<br>0 | 2x10  | 20    | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 8   | 10+15+2<br>0 | 10    | 15+20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 9   | 10+15+2<br>0 | 10+15 | 20    | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.          |              |       |       |  |    |
| Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any FDD CC. |              |       |       |  |    |

**Table 8.2.3.1.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number   | CA Bandwidth combination (MHz) |          |        | Minimum performance requirement                              | UE Category |
|---|--------------------------------|----------|--------|--|-------------|
|   | Total                          | FDD CC   | TDD CC |  |             |
| 1   | 4x20                           | 20       | 3x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 2   | 4x20                           | 2x20     | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 3   | 3x20+15                        | 20+15    | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 4   | 2x15+2x<br>20                  | 2x15     | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 5   | 3x20+15                        | 2x20+15  | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 6   | 2x15+2x<br>20                  | 2x15+20  | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 7   | 3x20+10                        | 2x20+10  | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 8   | 4x20                           | 3x20     | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 9   | 10+3x20                        | 10       | 3x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 10  | 2x10+2x<br>20                  | 2x10     | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 11  | 2x10+20<br>+15                 | 2x10     | 20+15  | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 12  | 10+3x20                        | 10+20    | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 13  | 10+15+2<br>x20                 | 10+15    | 2x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| 14  | 10+15+2<br>x20                 | 10+15+20 | 20     | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.      |                                |          |        |  |             |
| Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. |                                |          |        |  |             |

**Table 8.2.3.1.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement | UE Category |
|-------------|--------------------------------|--------|--------|---------------------------------|-------------|
|             | Total                          | FDD CC | TDD CC |                                 |             |



|         |   |          |      |  |        |
|---------|---|----------|------|--|--------|
| 1       | 15+4x20   | 15+2x20  | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 2       | 2x15+3x20   | 2x15+20  | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 3       | 4x20+20   | 4x20     | 20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 4       | 3x20+2x20   | 3x20     | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 5       | 2x20+3x20   | 2x20     | 3x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 6       | 20+4x20   | 20       | 4x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 7       | 10+4x20   | 10       | 4x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 8       | 10+20+3x20  | 10+20    | 3x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 9       | 2x10+3x20   | 2x10     | 3x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 10      | 10+2x20+2x20  | 10+2x20  | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| 11      | 10+15+20+2x20   | 10+15+20 | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.      |          |      |  |        |
| Note 2: | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. |          |      |  |        |

**Table 8.2.3.1.1-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+5x20                      | 1x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |
| 2           | 2x20+4x20                      | 2x20   | 4x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

**Table 8.2.3.1.1-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+6x20                      | 1x20   | 6x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |
| 2           | 2x20+5x20                      | 2x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

### 8.2.3.1.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.1.2-4 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 3DL CCs, the requirements are specified in Table 8.2.3.1.2-5 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 4DL CCs, the requirements are specified in Table 8.2.3.1.2-6 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 5DL CCs, the requirements are specified in Table 8.2.3.1.2-7 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 6DL CCs, the requirements are specified in Table 8.2.3.1.2-8 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 7DL CCs, the requirements are specified in Table 8.2.3.1.2-9 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.1.2-1: Test Parameters for CA**

| Parameter   | Unit      | Value         |
|---|-----------|---------------|
| Downlink power allocation   | $\rho_A$  | dB            |
|   | $\rho_B$  | dB            |
|   | $\sigma$  | dB            |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98           |
| Symbols for unused PRBs   |           | OCNG (Note 2) |
| Modulation  |           | QPSK          |
| PDSCH transmission mode   |           | 1             |
| Note 1: $P_B = 0$ .   |           |               |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |               |
| Note 3: The same PDSCH transmission mode is applied to each component carrier.  |           |               |

**Table 8.2.3.1.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.4 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.3     |
| 3 MHz     | R.42-1 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.1     |
| 5MHz      | R.42-2 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.0     |
| 10MHz     | R.2 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.7     |
| 15MHz     | R.42-3 FDD        | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.6     |
| 20MHz     | R.42 FDD          | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.7     |

**Table 8.2.3.1.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.4 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -0.6     |
| 3 MHz     | R.42-1 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -0.8     |
| 5MHz      | R.42-2 TDD        | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.2     |

|       |            |          |      |         |    |      |
|-------|------------|----------|------|---------|----|------|
| 10MHz | R.2 TDD    | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 15MHz | R.42-3 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |
| 20MHz | R.42 TDD   | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |

**Table 8.2.3.1.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                              | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B           |        |        |  |             |
| Note 2:     | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any TDD CC. |        |        |  |             |

**Table 8.2.3.1.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                              | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 3x20  | 20     | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 2           | 20+20+15  | 15     | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 3           | 20+20+10  | 10     | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 4           | 3x20  | 2x20   | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 5           | 20+20+15  | 20+15  | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 6           | 20+20+10  | 20+10  | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 7           | 20+10+10  | 2x10   | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 8           | 10+15+20  | 10     | 15+20  | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| 9           | 10+15+20  | 10+15  | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.          |        |        |  |             |
| Note 2:     | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any TDD CC. |        |        |  |             |

**Table 8.2.3.1.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 4x20                           | 20     | 3x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8          |
| 2           | 4x20                           | 2x20   | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8          |
| 3           | 3x20+15                        | 20+15  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8          |
| 4           | 2x15+2x20                      | 2x15   | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8          |

|         |   |          |       |  |    |
|---------|---|----------|-------|--|----|
| 5       | 3x20+15   | 2x20+15  | 20    | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 6       | 2x15+2x20   | 2x15+20  | 20    | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 7       | 3x20+10   | 2x20+10  | 20    | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 8       | 4x20  | 3x20     | 20    | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 9       | 10+3x20   | 10       | 3x20  | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 10      | 2x10+2x20   | 2x10     | 2x20  | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 11      | 2x10+20+15  | 2x10     | 20+15 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 12      | 10+3x20   | 10+20    | 2x20  | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 13      | 10+15+2x20  | 10+15    | 2x20  | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| 14      | 10+15+2x20  | 10+15+20 | 20    | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥8 |
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.      |          |       |  |    |
| Note 2: | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. |          |       |  |    |

**Table 8.2.3.1.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |          |        | Minimum performance requirement                              | UE Category |
|-------------|---|----------|--------|--|-------------|
|             | Total   | FDD CC   | TDD CC |  |             |
| 1           | 15+4x20   | 15+2x20  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 2           | 2x15+3x20   | 2x15+20  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 3           | 4x20+20   | 4x20     | 20     | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 4           | 3x20+2x20   | 3x20     | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 5           | 2x20+3x20   | 2x20     | 3x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 6           | 20+4x20   | 20       | 4x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 7           | 10+4x20   | 10       | 4x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 8           | 10+20+3x20  | 10+20    | 3x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 9           | 2x10+3x20   | 2x10     | 3x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 10          | 10+2x20+2x20  | 10+2x20  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 11          | 10+15+20+2x20   | 10+15+20 | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.      |          |        |  |             |
| Note 2:     | 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. |          |        |  |             |

**Table 8.2.3.1.2-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement | UE Category |
|-------------|--------------------------------|--------|--------|---------------------------------|-------------|
|             | Total                          | FDD CC | TDD CC |                                 |             |

|   |               |      |      |   |        |
|---|---------------|------|------|---|--------|
| 1 | 1x20+5x2<br>0 | 1x20 | 5x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per<br>CC | 8, ≥11 |
| 2 | 2x20+4x2<br>0 | 2x20 | 4x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per<br>CC | 8, ≥11 |

**Table 8.2.3.1.2-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                                 | UE Category |
|-------------|--------------------------------|--------|--------|---|-------------|
|             | Total                          | FDD CC | TDD CC |   |             |
| 1           | 1x20+6x2<br>0                  | 1x20   | 6x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per<br>CC | 8, ≥11      |
| 2           | 2x20+5x2<br>0                  | 2x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per<br>CC | 8, ≥11      |

## 8.2.3.2 Open-loop spatial multiplexing performance 2Tx Antenna port

### 8.2.3.2.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.2.1-4 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.2.1-5 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.2.1-6 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.2.1-7 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 6DL CCs, the requirements are specified in Table 8.2.3.2.1-8 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 7DL CCs, the requirements are specified in Table 8.2.3.2.1-9 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.2.1-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter                 | Unit      | Value |
|---------------------------|-----------|-------|
| Downlink power allocation | $\rho_A$  | dB    |
|                           | $\rho_B$  | dB    |
|                           | $\sigma$  | dB    |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |
| PDSCH transmission mode   |           | 3     |

|  |
|--|
| Note 1: $P_B = 1$ .  |
| Note 2: The same PDSCH transmission mode is applied to each component carrier. |

**Table 8.2.3.2.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.11-5 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.6     |
| 3 MHz     | R.11-6 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.3     |
| 5MHz      | R.11-2 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.3     |
| 10MHz     | R.11 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.9     |
| 15MHz     | R.11-7 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.8     |
| 20MHz     | R.30 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.9     |

**Table 8.2.3.2.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.11-5 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.2     |
| 3 MHz     | R.11-6 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.8     |
| 5MHz      | R.11-7 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.6     |
| 10MHz     | R.11-8 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.8     |
| 15MHz     | R.11-9 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.9     |
| 20MHz     | R.30-1 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.0     |

**Table 8.2.3.2.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                              | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B |        |        |  |             |

**Table 8.2.3.2.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5          |
| 9           | 10+15+20                   | 10+15  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.1.1-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.

**Table 8.2.3.2.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|----------|--------|--|-------------|
|             | Total                      | FDD CC   | TDD CC |  |             |
| 1           | 4x20                       | 20       | 3x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15    | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 4           | 2x15+2x20                  | 2x15     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 5           | 3x20+15                    | 2x20+15  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 6           | 2x15+2x20                  | 2x15+20  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 7           | 3x20+10                    | 2x20+10  | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 8           | 4x20                       | 3x20     | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 9           | 10+3x20                    | 10       | 3x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 10          | 2x10+2x20                  | 2x10     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 11          | 2x10+20+15                 | 2x10     | 20+15  | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 12          | 10+3x20                    | 10+20    | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 13          | 10+15+2x20                 | 10+15    | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |
| 14          | 10+15+2x20                 | 10+15+20 | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥8          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.

**Table 8.2.3.2.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|----------|--------|--|-------------|
|             | Total                      | FDD CC   | TDD CC |  |             |
| 1           | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 2           | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | 8, ≥11      |
| 3           | 4x20+20                    | 4x20     | 20     | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 4           | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 5           | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 6           | 20+4x20                    | 20       | 4x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 7           | 10+4x20                    | 10       | 4x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 8           | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 9           | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 10          | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 11          | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.

**Table 8.2.3.2.1-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+5x20                      | 1x20   | 5x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 2           | 2x20+4x20                      | 2x20   | 4x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |

**Table 8.2.3.2.1-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+6x20                      | 1x20   | 6x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |
| 2           | 2x20+5x20                      | 2x20   | 5x20   | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | 8, ≥11      |

### 8.2.3.2.1A Soft buffer management test for FDD PCell

For TDD-FDD CA, the requirements are specified in Table 8.2.3.2.1A-2, with the addition of the parameters in Table 8.2.3.2.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation for FDD as PCell.

**Table 8.2.3.2.1A-1: Test Parameters for CA**

| Parameter | Unit | Value       |             |
|-----------|------|-------------|-------------|
|           |      | FDD Carrier | TDD Carrier |



|  |          |           |             |             |
|--|----------|-----------|-------------|-------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3          | -3          |
|  | $\rho_B$ | dB        | -3 (Note 1) | -3 (Note 1) |
|  | $\sigma$ | dB        | 0           | 0           |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98         | -98         |
| PDSCH transmission mode  |          |           | 3           | 3           |
| Note 1: $P_B = 1$ .  |          |           |             |             |
| Note 2: The same PDSCH transmission mode is applied to each component carrier. |          |           |             |             |

Table 8.2.3.2.1A-2: Minimum performance (FRC) for CA

| Test num.  | Band-width |       | Reference channel | OCNG pattern      | Propagation condition | Correlation matrix and antenna config | Reference value                    |          | UE category |
|--|------------|-------|-------------------|-------------------|-----------------------|---------------------------------------|------------------------------------|----------|-------------|
|  |            |       |                   |                   |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1  | PCell      | 20MHz | R.30 FDD          | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 13.2     | 3           |
|  | SCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 13.2     |             |
| 2  | PCell      | 20MHz | R.35-1 FDD        | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.3     | 4           |
|  | SCell      | 20MHz | R.35-1 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 16.3     |             |
| 3  | PCell      | 10MHz | R.35-3 FDD        | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.0     | 3           |
|  | SCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 13.2     |             |
| 4  | PCell      | 10MHz | R.35-3 FDD        | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.0     | 4           |
|  | SCell      | 20MHz | R.35-1 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 16.3     |             |
| 5  | PCell      | 15MHz | R.35-2 FDD        | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.0     | 3           |
|  | SCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 13.2     |             |
| 6  | PCell      | 15MHz | R.35-2 FDD        | OP.1 FDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.0     | 4           |
|  | SCell      | 20MHz | R.35-1 TDD        | OP.1 TDD (Note 1) |                       |                                       | 70                                 | 16.3     |             |
| Note 1: The OCNG pattern applies for each CC.  |            |       |                   |                   |                       |                                       |                                    |          |             |
| Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3B. |            |       |                   |                   |                       |                                       |                                    |          |             |

### 8.2.3.2.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.2.2-4 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.2.2-5 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.2.2-6 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table

8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.2.2-7 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 6DL CCs, the requirements are specified in Table 8.2.3.2.2-8 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 7DL CCs, the requirements are specified in Table 8.2.3.2.2-9 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.2.2-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter  | Unit      | Value |
|--|-----------|-------|
| Downlink power allocation  | $\rho_A$  | dB    |
|  | $\rho_B$  | dB    |
|  | $\sigma$  | dB    |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98   |
| PDSCH transmission mode  |           | 3     |
| Note 1: $P_B = 1$ .  |           |       |
| Note 2: The same PDSCH transmission mode is applied to each component carrier. |           |       |

**Table 8.2.3.2.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz    | R.11-5 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.6     |
| 3 MHz      | R.11-6 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.3     |
| 5MHz       | R.11-2 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.3     |
| 10MHz      | R.11 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.9     |
| 15MHz      | R.11-7 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.8     |
| 20MHz      | R.30 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                      | 70                                 | 12.9     |

**Table 8.2.3.2.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |

|         |               |             |       |         |    |      |
|---------|---------------|-------------|-------|---------|----|------|
| 1.4 MHz | R.11-5<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 13.2 |
| 3 MHz   | R.11-6<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 5MHz    | R.11-7<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 12.6 |
| 10MHz   | R.11-8<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 15MHz   | R.11-9<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 20MHz   | R.30-1<br>TDD | OP.1<br>TDD | EVA70 | 2x2 Low | 70 | 13.0 |

Table 8.2.3.2.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B

Table 8.2.3.2.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |
| 9           | 10+15+20                   | 10+15  | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.

Table 8.2.3.2.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 4x20                       | 20     | 3x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20   | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15  | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8          |

|  |            |          |       |  |    |
|--|------------|----------|-------|--|----|
| 4  | 2x15+2x20  | 2x15     | 2x20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 5  | 3x20+15    | 2x20+15  | 20    | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 6  | 2x15+2x20  | 2x15+20  | 20    | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 7  | 3x20+10    | 2x20+10  | 20    | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 8  | 4x20       | 3x20     | 20    | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 9  | 10+3x20    | 10       | 3x20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 10   | 2x10+2x20  | 2x10     | 2x20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 11   | 2x10+20+15 | 2x10     | 20+15 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 12   | 10+3x20    | 10+20    | 2x20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 13   | 10+15+2x20 | 10+15    | 2x20  | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| 14   | 10+15+2x20 | 10+15+20 | 20    | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥8 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |            |          |       |  |    |

Table 8.2.3.2.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)

| Test number  | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|--|----------------------------|----------|--------|--|-------------|
|  | Total                      | FDD CC   | TDD CC |  |             |
| 1  | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 2  | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 3  | 4x20+20                    | 4x20     | 20     | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 4  | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 5  | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 6  | 20+4x20                    | 20       | 4x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 7  | 10+4x20                    | 10       | 4x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 8  | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 9  | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 10   | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| 11   | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |                            |          |        |  |             |

Table 8.2.3.2.2-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+5x20                      | 1x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

|   |           |      |      |  |        |
|---|-----------|------|------|--|--------|
| 2 | 2x20+4x20 | 2x20 | 4x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11 |
|---|-----------|------|------|--|--------|

**Table 8.2.3.2.2-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+6x20                      | 1x20   | 6x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |
| 2           | 2x20+5x20                      | 2x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

**8.2.3.2.2A Soft buffer management test for TDD PCell**

For TDD-FDD CA, the requirements are specified in Table 8.2.3.2.2A-2, with the addition of the parameters in Table 8.2.3.2.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation for TDD as PCell.

**Table 8.2.3.2.2A-1: Test Parameters for CA**

| Parameter                 |          | Unit      | Value       |             |
|---------------------------|----------|-----------|-------------|-------------|
|                           |          |           | FDD Carrier | TDD Carrier |
| Downlink power allocation | $\rho_A$ | dB        | -3          | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) | -3 (Note 1) |
|                           | $\sigma$ | dB        | 0           | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         | -98         |
| PDSCH transmission mode   |          |           | 3           | 3           |

Note 1:  $P_B = 1$ .

Note 2: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.3.2.2A-2: Minimum performance (FRC) for CA**

| Test num. | Band-width |       | Reference channel | OCNG pattern      | Propagation condition | Correlation matrix and antenna config | Reference value                    |          | UE category |
|-----------|------------|-------|-------------------|-------------------|-----------------------|---------------------------------------|------------------------------------|----------|-------------|
|           |            |       |                   |                   |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |             |
| 1         | PCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 13.2     | 3           |
|           | SCell      | 20MHz | R.30 FDD          | OP.1 FDD (Note 1) |                       |                                       | 70                                 | 13.2     |             |
| 2         | PCell      | 20MHz | R.35-1 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.2     | 4           |
|           | SCell      | 20MHz | R.35-1 FDD        | OP.1 FDD (Note 1) |                       |                                       | 70                                 | 16.2     |             |
| 3         | PCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 13.2     | 3           |
|           | SCell      | 10MHz | R.35-3 FDD        | OP.1 FDD (Note 1) |                       |                                       | 70                                 | 16.0     |             |
| 4         | PCell      | 20MHz | R.35-1 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 16.2     | 4           |
|           | SCell      | 10MHz | R.35-3 FDD        | OP.1 FDD (Note 1) |                       |                                       | 70                                 | 15.8     |             |
| 5         | PCell      | 20MHz | R.30-2 TDD        | OP.1 TDD (Note 1) | EVA70                 | 2x2 Low                               | 70                                 | 13.2     | 3           |

|   |              |       |            |                      |       |            |    |      |   |
|---|--------------|-------|------------|----------------------|-------|------------|----|------|---|
|   | <b>SCell</b> | 15MHz | R.35-2 FDD | OP.1 FDD<br>(Note 1) |       |            | 70 | 15.8 |   |
| 6   | <b>PCell</b> | 20MHz | R.35-1 TDD | OP.1 TDD<br>(Note 1) | EVA70 | 2x2<br>Low | 70 | 16.2 | 4 |
|   | <b>SCell</b> | 15MHz | R.35-2 FDD | OP.1 FDD<br>(Note 1) |       |            | 70 | 15.8 |   |
| Note 1: The OCNB pattern applies for each CC.<br>Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3B. |              |       |            |                      |       |            |    |      |   |

### 8.2.3.3 Closed-loop spatial multiplexing performance 4Tx Antenna Port

#### 8.2.3.3.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.3.1-4 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.3.1-5 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.3.1-6 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.3.1-7 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 6DL CCs, the requirements are specified in Table 8.2.3.3.1-8 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 7DL CCs, the requirements are specified in Table 8.2.3.3.1-9 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.3.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                 |          | Unit      | Value  |
|---------------------------|----------|-----------|--|
| Downlink power allocation | $\rho_A$ | dB        | -6   |
|                           | $\rho_B$ | dB        | -6 (Note 1)  |
|                           | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity     |          | PRB       | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)        | FDD CC   | ms        | 8  |
|                           | TDD CC   | ms        | 10 or 11   |
| Reporting interval        | FDD CC   | ms        | 1  |
|                           | TDD CC   | ms        | 1 or 4 (Note 3)  |
| Reporting mode            |          |           | PUSCH 1-2  |

|   |  |  |
|---|--|--|
| CodeBookSubsetRestriction bitmap  |  | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000 |
| CSI request field (Note 3)  |  | '10'   |
| PDSCH transmission mode   |  | 4  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> |  |  |

**Table 8.2.3.3.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz    | R.14-4 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.4     |
| 3 MHz      | R.14-5 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.5      |
| 5MHz       | R.14-6 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.5      |
| 10MHz      | R.14 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.1     |
| 15MHz      | R.14-7 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.1     |
| 20MHz      | R.14-3 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.3     |

**Table 8.2.3.3.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|            |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz    | R.43-1 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 11.0     |
| 3 MHz      | R.43-2 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.8      |
| 5MHz       | R.43-3 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.0     |
| 10MHz      | R.43-4 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.5     |
| 15MHz      | R.43-5 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.6     |
| 20MHz      | R.43 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.7     |

**Table 8.2.3.3.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |

|   |       |    |    |  |    |
|---|-------|----|----|--|----|
| 2   | 20+10 | 10 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| 3   | 20+15 | 15 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B |       |    |    |  |    |

**Table 8.2.3.3.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number  | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|--|----------------------------|--------|--------|--|-------------|
|  | Total                      | FDD CC | TDD CC |  |             |
| 1  | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 2  | 20+20+15                   | 15     | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 3  | 20+20+10                   | 10     | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 4  | 3x20                       | 2x20   | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 5  | 20+20+15                   | 20+15  | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 6  | 20+20+10                   | 20+10  | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 7  | 20+10+10                   | 2x10   | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 8  | 10+15+20                   | 10     | 15+20  | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| 9  | 10+15+20                   | 10+15  | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |                            |        |        |  |             |

**Table 8.2.3.3.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 4x20                       | 20      | 3x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20    | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15   | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 4           | 2x15+2x20                  | 2x15    | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 5           | 3x20+15                    | 2x20+15 | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 6           | 2x15+2x20                  | 2x15+20 | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 7           | 3x20+10                    | 2x20+10 | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 8           | 4x20                       | 3x20    | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 9           | 10+3x20                    | 10      | 3x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 10          | 2x10+2x20                  | 2x10    | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 11          | 2x10+20+15                 | 2x10    | 20+15  | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 12          | 10+3x20                    | 10+20   | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |
| 13          | 10+15+2x20                 | 10+15   | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥8          |



|  |                |              |    |   |    |
|--|----------------|--------------|----|---|----|
| 14   | 10+15+2x<br>20 | 10+15+2<br>0 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | ≥8 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |                |              |    |   |    |

**Table 8.2.3.3.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                 | UE Category |
|---|----------------------------|----------|--------|---|-------------|
|   | Total                      | FDD CC   | TDD CC |   |             |
| 1   | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 2   | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 3   | 4x20+20                    | 4x20     | 20     | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 4   | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 5   | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 6   | 20+4x20                    | 20       | 4x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 7   | 10+4x20                    | 10       | 4x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 8   | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 9   | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 10  | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 11  | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B |                            |          |        |   |             |

**Table 8.2.3.3.1-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                                 | UE Category |
|-------------|--------------------------------|--------|--------|---|-------------|
|             | Total                          | FDD CC | TDD CC |   |             |
| 1           | 1x20+5x20                      | 1x20   | 5x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 2           | 2x20+4x20                      | 2x20   | 4x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |

**Table 8.2.3.3.1-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                                 | UE Category |
|-------------|--------------------------------|--------|--------|---|-------------|
|             | Total                          | FDD CC | TDD CC |   |             |
| 1           | 1x20+6x20                      | 1x20   | 6x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |
| 2           | 2x20+5x20                      | 2x20   | 5x20   | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per<br>CC | 8, ≥11      |

### 8.2.3.3.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.3.2-4 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table

8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.3.2-5 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.3.2-6 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.3.2-7 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 6DL CCs, the requirements are specified in Table 8.2.3.3.2-8 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 7DL CCs, the requirements are specified in Table 8.2.3.3.2-9 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.3.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit      | Value   |
|---|----------|-----------|---|
| Downlink power allocation   | $\rho_A$ | dB        | -6  |
|   | $\rho_B$ | dB        | -6 (Note 1)   |
|   | $\sigma$ | dB        | 3   |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   |
| Precoding granularity   |          | PRB       | Wideband pre-coding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)  | FDD CC   | ms        | 8   |
|   | TDD CC   | ms        | 10 or 11  |
| Reporting interval  | FDD CC   | ms        | 1   |
|   | TDD CC   | ms        | 1 or 4 (Note 3)   |
| Reporting mode  |          |           | PUSCH 1-2   |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>000011111111111111111111111100000000<br>00000000                |
| CSI request field (Note 3)  |          |           | '10'  |
| PDSCH transmission mode   |          |           | TM4   |
| Note 1: $P_B = 1$ .   |          |           |   |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |   |
| Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.   |          |           |   |
| Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.  |          |           |   |
| Note 5: The same PDSCH transmission mode is applied to each component carrier.  |          |           |   |

**Table 8.2.3.3.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.14-4 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.4     |
| 3 MHz     | R.14-5 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.5      |
| 5MHz      | R.14-6 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.5      |
| 10MHz     | R.14 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.1     |
| 15MHz     | R.14-7 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.1     |
| 20MHz     | R.14-3 FDD        | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.3     |

**Table 8.2.3.3.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz   | R.43-1 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 11.0     |
| 3 MHz     | R.43-2 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 9.8      |
| 5MHz      | R.43-3 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.0     |
| 10MHz     | R.43-4 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.5     |
| 15MHz     | R.43-5 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.6     |
| 20MHz     | R.43 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.7     |

**Table 8.2.3.3.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B

**Table 8.2.3.3.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5          |

|  |          |       |       |  |    |
|--|----------|-------|-------|--|----|
| 2  | 20+20+15 | 15    | 2x20  | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 3  | 20+20+10 | 10    | 2x20  | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 4  | 3x20     | 2x20  | 20    | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 5  | 20+20+15 | 20+15 | 20    | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 6  | 20+20+10 | 20+10 | 20    | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 7  | 20+10+10 | 2x10  | 20    | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 8  | 10+15+20 | 10    | 15+20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 9  | 10+15+20 | 10+15 | 20    | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |          |       |       |  |    |

Table 8.2.3.3.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)

| Test number  | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|--|----------------------------|----------|--------|--|-------------|
|  | Total                      | FDD CC   | TDD CC |  |             |
| 1  | 4x20                       | 20       | 3x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 2  | 4x20                       | 2x20     | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 3  | 3x20+15                    | 20+15    | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 4  | 2x15+2x20                  | 2x15     | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 5  | 3x20+15                    | 2x20+15  | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 6  | 2x15+2x20                  | 2x15+20  | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 7  | 3x20+10                    | 2x20+10  | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 8  | 4x20                       | 3x20     | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 9  | 10+3x20                    | 10       | 3x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 10   | 2x10+2x20                  | 2x10     | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 11   | 2x10+20+15                 | 2x10     | 20+15  | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 12   | 10+3x20                    | 10+20    | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 13   | 10+15+2x20                 | 10+15    | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| 14   | 10+15+2x20                 | 10+15+20 | 20     | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |                            |          |        |  |             |

Table 8.2.3.3.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 15+4x20                    | 15+2x20 | 2x20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11      |

|  |               |          |      |  |        |
|--|---------------|----------|------|--|--------|
| 2  | 2x15+3x20     | 2x15+20  | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 3  | 4x20+20       | 4x20     | 20   | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 4  | 3x20+2x20     | 3x20     | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 5  | 2x20+3x20     | 2x20     | 3x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 6  | 20+4x20       | 20       | 4x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 7  | 10+4x20       | 10       | 4x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 8  | 10+20+3x20    | 10+20    | 3x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 9  | 2x10+3x20     | 2x10     | 3x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 10   | 10+2x20+2x20  | 10+2x20  | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| 11   | 10+15+20+2x20 | 10+15+20 | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | 8, ≥11 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. |               |          |      |  |        |

**Table 8.2.3.3.2-8: Minimum performance for multiple CA configurations with 6DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+5x20                      | 1x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |
| 2           | 2x20+4x20                      | 2x20   | 4x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

**Table 8.2.3.3.2-9: Minimum performance for multiple CA configurations with 7DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|--------------------------------|--------|--------|--|-------------|
|             | Total                          | FDD CC | TDD CC |  |             |
| 1           | 1x20+6x20                      | 1x20   | 6x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |
| 2           | 2x20+5x20                      | 2x20   | 5x20   | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | 8, ≥11      |

#### 8.2.3.4 Minimum Requirement for Closed-loop spatial multiplexing performance 4Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.2.3.4-4, based on single carrier requirement specified in Table 8.2.3.4-2 and Table 8.2.3.4-3, with the addition of the parameters in Table 8.2.3.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity transmission.

**Table 8.2.3.4-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for TDD-FDD dual connectivity**

| Parameter                 | Unit     | Values |             |
|---------------------------|----------|--------|-------------|
| Downlink power allocation | $\rho_A$ | dB     | -6          |
|                           | $\rho_B$ | dB     | -6 (Note 1) |
|                           | $\sigma$ | dB     | -3          |

|   |           |  |
|---|-----------|--|
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  |
| Precoding granularity   | PRB       | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs  |
| PMI delay (Note 2)  | ms        | 8 for FDD CC<br>10 or 11 for TDD CC  |
| Reporting interval  | ms        | 1 for FDD CC<br>1 or 4 for TDD CC (Note 3)   |
| Reporting mode  |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |           | 00000000000000000000000000000000<br>0000111111111111111100000000<br>00000000   |
| PDSCH transmission mode   |           | 4  |
| ACK/NACK transmission   |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |
| CSI feedback  |           | Separate PUSCH feedbacks on the MCG and SCG  |
| Time offset between MCG CC and SCG CC   | $\mu$ s   | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 5) |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.</p> <p>Note 4: The same PDSCH transmission mode is applied to each component carrier.</p> <p>Note 5: As defined in TS36.300 [11].</p> <p>Note 6: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.</p> |           |  |

**Table 8.2.3.4-2: FDD single carrier performance for multiple dual connectivity configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz    | R.14-4 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.36    |
| 3MHz      | R.14-5 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 5MHz      | R.14-6 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 9.5      |
| 10 MHz    | R.14 FDD          | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 15MHz     | R.14-7 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.1     |
| 20MHz     | R.14-3 FDD        | OP. 1 FDD    | EVA5                  | 4x2 Low                                | 70                                 | 10.3     |

**Table 8.2.3.4-3: TDD single carrier performance for multiple dual connectivity configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |

|        |               |              |      |         |    |      |
|--------|---------------|--------------|------|---------|----|------|
| 1.4MHz | R.43-1<br>TDD | OP.1<br>TDD  | EVA5 | 4x2 Low | 70 | 11.0 |
| 3MHz   | R.43-2<br>TDD | OP.1<br>TDD  | EVA5 | 4x2 Low | 70 | 9.8  |
| 5MHz   | R.43-3<br>TDD | OP.1<br>TDD  | EVA5 | 4x2 Low | 70 | 10.0 |
| 10 MHz | R.43-4<br>TDD | OP.1<br>TDD  | EVA5 | 4x2 Low | 70 | 10.5 |
| 15MHz  | R.43-5<br>TDD | OP.1<br>TDD  | EVA5 | 4x2 Low | 70 | 10.6 |
| 20MHz  | R.43 TDD      | OP. 1<br>TDD | EVA5 | 4x2 Low | 70 | 10.7 |

**Table 8.2.3.4-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.   | Bandwidth combination | Requirement  | UE category |
|---|-----------------------|--|-------------|
| 1   | 2x20 MHz              | As specified in Table 8.2.3.4-2 and Table 8.2.3.4-3 per CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.   |                       |  |             |
| Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A. |                       |  |             |

### 8.2.3.5 HST-SFN performance

#### 8.2.3.5.0 General

The purpose of this test is to verify UE performance in the HST-SFN scenario defined in B.3A when *highSpeedEnhancedDemodulationFlag* [7] is received.

#### 8.2.3.5.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.5.1-4 based on single carrier requirement specified in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3, with the addition of the parameters in Table 8.2.3.5.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.5.1-5 based on single carrier requirement specified in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3, with the addition of the parameters in Table 8.2.3.5.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.5.1-6 based on single carrier requirement specified in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3, with the addition of the parameters in Table 8.2.3.5.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.5.1-7 based on single carrier requirement specified in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3, with the addition of the parameters in Table 8.2.3.5.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.5.1-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter                 | Unit     | Value       |
|---------------------------|----------|-------------|
| Downlink power allocation | $\rho_A$ | dB          |
|                           | $\rho_B$ | dB          |
|                           | $\sigma$ | dB          |
|                           |          | -3          |
|                           |          | -3 (Note 1) |
|                           |          | 0           |

|  |           |     |
|--|-----------|-----|
| $N_{oc}$ at antenna port   | dBm/15kHz | -98 |
| PDSCH transmission mode  |           | 3   |
| NOTE 1: $P_B = 1$ .  |           |     |
| NOTE 2: The same PDSCH transmission mode is applied to each component carrier. |           |     |

**Table 8.2.3.5.1-2: Single carrier performance for multiple CA configurations for FDD PCell and SCell (FRC)**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 5 MHz     | R.87-2 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.9]   |
| 10 MHz    | R.87 FDD          | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.3]   |
| 15 MHz    | R.87-3 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.9]   |
| 20 MHz    | R.87-4 FDD        | OP. 1 FDD    | HST-SFN               | 2x2 Low                                | 70                                 | [14.1]   |

**Table 8.2.3.5.1-3: Single carrier performance for multiple CA configurations for TDD SCell (FRC)**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |
| 5 MHz     | R.87-2 TDD        | OP.1 TDD     | HST-SFN               | 2x2 Low                                | 70                                 | [13.1]   |
| 10 MHz    | R.87 TDD          | OP.1 TDD     | HST-SFN               | 2x2 Low                                | 70                                 | [13.2]   |
| 15 MHz    | R.87-3 TDD        | OP.1 TDD     | HST-SFN               | 2x2 Low                                | 70                                 | [13.4]   |
| 20 MHz    | R.87-4 TDD        | OP. 1 TDD    | HST-SFN               | 2x2 Low                                | 70                                 | [13.6]   |

**Table 8.2.3.5.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number  | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|--|----------------------------|--------|--------|--|-------------|
|  | Total                      | FDD CC | TDD CC |  |             |
| 1  | 2x20                       | 20     | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |
| 2  | 20+10                      | 10     | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |
| 3  | 20+15                      | 15     | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B |                            |        |        |  |             |

**Table 8.2.3.5.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5          |



|   |          |       |       |  |    |
|---|----------|-------|-------|--|----|
| 4   | 3x20     | 2x20  | 20    | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| 5   | 20+20+15 | 20+15 | 20    | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| 6   | 20+20+10 | 20+10 | 20    | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| 7   | 20+10+10 | 2x10  | 20    | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| 8   | 10+15+20 | 10    | 15+20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| 9   | 10+15+20 | 10+15 | 20    | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥5 |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B. |          |       |       |  |    |

Table 8.2.3.5.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 4x20                       | 20       | 3x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 2   | 4x20                       | 2x20     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 3   | 3x20+15                    | 20+15    | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 4   | 2x15+2x20                  | 2x15     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 5   | 3x20+15                    | 2x20+15  | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 6   | 2x15+2x20                  | 2x15+20  | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 7   | 3x20+10                    | 2x20+10  | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 8   | 4x20                       | 3x20     | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 9   | 10+3x20                    | 10       | 3x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 10  | 2x10+2x20                  | 2x10     | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 11  | 2x10+20+15                 | 2x10     | 20+15  | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 12  | 10+3x20                    | 10+20    | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 13  | 10+15+2x20                 | 10+15    | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| 14  | 10+15+2x20                 | 10+15+20 | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | ≥8          |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B. |                            |          |        |  |             |

Table 8.2.3.5.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 15+4x20                    | 15+2x20 | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11      |
| 2           | 2x15+3x20                  | 2x15+20 | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11      |
| 3           | 4x20+20                    | 4x20    | 20     | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11      |
| 4           | 3x20+2x20                  | 3x20    | 2x20   | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11      |

|   |               |          |      |  |        |
|---|---------------|----------|------|--|--------|
| 5   | 2x20+3x20     | 2x20     | 3x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 6   | 20+4x20       | 20       | 4x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 7   | 10+4x20       | 10       | 4x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 8   | 10+20+3x20    | 10+20    | 3x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 9   | 2x10+3x20     | 2x10     | 3x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 10  | 10+2x20+2x20  | 10+2x20  | 2x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| 11  | 10+15+20+2x20 | 10+15+20 | 2x20 | As defined in Table 8.2.3.5.1-2 and Table 8.2.3.5.1-3 per CC | 8, ≥11 |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B. |               |          |      |  |        |

### 8.2.3.5.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.5.2-4 based on single carrier requirement specified in Table 8.2.5.2.2-2 and Table 8.2.3.5.2-3, with the addition of the parameters in Table 8.2.3.5.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.5.2-5 based on single carrier requirement specified in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3, with the addition of the parameters in Table 8.2.3.5.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 4DL CCs, the requirements are specified in Table 8.2.3.5.2-6 based on single carrier requirement specified in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3, with the addition of the parameters in Table 8.2.3.5.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 5DL CCs, the requirements are specified in Table 8.2.3.5.2-7 based on single carrier requirement specified in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3, with the addition of the parameters in Table 8.2.3.5.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.3.5.2-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter  | Unit      | Value |
|--|-----------|-------|
| Downlink power allocation  | $\rho_A$  | dB    |
|  | $\rho_B$  | dB    |
|  | $\sigma$  | dB    |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98   |
| PDSCH transmission mode  |           | 3     |
| NOTE 1: $P_B = 1$ .  |           |       |
| NOTE 2: The same PDSCH transmission mode is applied to each component carrier. |           |       |

**Table 8.2.3.5.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
|           |                   |              |                       |  |                                    |          |

|        |               |             |         |         |    |        |
|--------|---------------|-------------|---------|---------|----|--------|
| 5 MHz  | R.87-2<br>FDD | OP.1<br>FDD | HST-SFN | 2x2 Low | 70 | [13,9] |
| 10 MHz | R.87 FDD      | OP.1<br>FDD | HST-SFN | 2x2 Low | 70 | [13.3] |
| 15 MHz | R.87-3<br>FDD | OP.1<br>FDD | HST-SFN | 2x2 Low | 70 | [13.9] |
| 20 MHz | R.87-4<br>FDD | OP.1<br>FDD | HST-SFN | 2x2 Low | 70 | [14.1] |

**Table 8.2.3.5.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 5 MHz     | R.87-2<br>TDD     | OP.1<br>TDD  | HST-SFN               | 2x2 Low                                      | 70                                 | [13.1]   |
| 10 MHz    | R.87 TDD          | OP.1<br>TDD  | HST-SFN               | 2x2 Low                                      | 70                                 | [13.2]   |
| 15 MHz    | R.87-3<br>TDD     | OP.1<br>TDD  | HST-SFN               | 2x2 Low                                      | 70                                 | [13.4]   |
| 20 MHz    | R.87-4<br>TDD     | OP.1<br>TDD  | HST-SFN               | 2x2 Low                                      | 70                                 | [13.6]   |

**Table 8.2.3.5.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B

**Table 8.2.3.5.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |
| 9           | 10+15+20                   | 10+15  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥5          |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B.

**Table 8.2.3.5.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|----------|--------|--|-------------|
|             | Total                      | FDD CC   | TDD CC |  |             |
| 1           | 4x20                       | 20       | 3x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15    | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 4           | 2x15+2x20                  | 2x15     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 5           | 3x20+15                    | 2x20+15  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 6           | 2x15+2x20                  | 2x15+20  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 7           | 3x20+10                    | 2x20+10  | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 8           | 4x20                       | 3x20     | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 9           | 10+3x20                    | 10       | 3x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 10          | 2x10+2x20                  | 2x10     | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 11          | 2x10+20+15                 | 2x10     | 20+15  | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 12          | 10+3x20                    | 10+20    | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 13          | 10+15+2x20                 | 10+15    | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |
| 14          | 10+15+2x20                 | 10+15+20 | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | ≥8          |

NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B.

**Table 8.2.3.5.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                              | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 15+4x20                    | 15+2x20 | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 2           | 2x15+3x20                  | 2x15+20 | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 3           | 4x20+20                    | 4x20    | 20     | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 4           | 3x20+2x20                  | 3x20    | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 5           | 2x20+3x20                  | 2x20    | 3x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 6           | 20+4x20                    | 20      | 4x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 7           | 10+4x20                    | 10      | 4x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 8           | 10+20+3x20                 | 10+20   | 3x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 9           | 2x10+3x20                  | 2x10    | 3x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |
| 10          | 10+2x20+2x20               | 10+2x20 | 2x20   | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per CC | 8, ≥11      |

|   |                   |              |      |   |              |
|---|-------------------|--------------|------|---|--------------|
| 11  | 10+15+20+<br>2x20 | 10+15+2<br>0 | 2x20 | As defined in Table 8.2.3.5.2-2 and Table 8.2.3.5.2-3 per<br>CC | 8, $\geq 11$ |
| NOTE: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in clause 8.1.2.3B. |                   |              |      |   |              |

## 8.2.4 LAA

### 8.2.4.1 Closed-loop spatial multiplexing performance 4Tx Antenna Port

#### 8.2.4.1.1 FDD PCell (FDD single carrier)

The parameters specified in Table 8.2.4.1.1-1 are valid for FDD CC and LAA SCell(s) unless otherwise stated. And the additional parameters specified in Table 8.2.4.1.1-2 are valid for LAA SCell(s).

**Table 8.2.4.1.1-1: Common Test Parameters**

| Parameter  | Unit      | Value  |
|--|-----------|--|
| Inter-TTI Distance   |           | 1  |
| Number of HARQ processes per component carrier   | Processes | 8  |
| Maximum number of HARQ transmission (Note 1)   |           | 4  |
| Redundancy version coding sequence   |           | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM |
| Cyclic Prefix  |           | Normal   |
| Cell_ID  |           | 0  |
| Cross carrier scheduling   |           | Not configured   |
| Note 1: For retransmission in partial subframes, the TB size should be kept the same as the initial transmission regardless of the initial transmission is performed in full subframes or partial subframes. |           |  |

**Table 8.2.4.1.1-2: Additional Test Parameters for LAA SCell(s)**

| Parameter                            | Unit     | Value   |
|--------------------------------------|----------|---|
| DMTC Periodicity                     | ms       | 80  |
| dmtc-PeriodOffset-r12<br>ms80-r12    |          | 0   |
| Discovery signal occasion duration   | subframe | 1   |
| Power allocation of discovery signal |          | Same as power allocation of CRS within a transmission burst in the test |

For CA with LAA SCell(s), the requirements are specified in Table 8.2.4.1.1-4, with the addition of the parameters in Table 8.2.4.1.1-1, Table 8.2.4.1.1-2, Table 8.2.4.1.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with frequency selective precoding for CA with LAA SCell(s).

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.4.1.1-3: Test Parameters for Dual-Layer Spatial Multiplexing (FRC)**

| Parameter                 | Unit     | Value       |
|---------------------------|----------|-------------|
| Downlink power allocation | $\rho_A$ | dB          |
|                           | $\rho_B$ | dB          |
|                           | $\sigma$ | dB          |
|                           |          | -6          |
|                           |          | -6 (Note 1) |
|                           |          | 3           |

|   |           |  |
|---|-----------|--|
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  |
| Precoding granularity   | PRB       | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs            |
| PMI delay (Note 2)  | ms        | 8  |
| Reporting interval  | ms        | 1  |
| Reporting mode  |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |           | 00000000000000000000000000000000<br>0011111111111111111111000000000000<br>0000 |
| CSI request field (Note 3)  |           | '10'   |
| PDSCH transmission mode   |           | TM4  |
| DL Burst transmission pattern for LAA SCell   |           | As specified in B.8  |
| The number of subframes set ( $S_i$ ) in a burst  |           | {1,3,5,8}  |
| Occupied OFDM symbols set in the last subframe  |           | {6,9,12,14}  |
| Random variable $p$ defined in B.8  |           | 0.5  |
| timing error relative of LAA SCell to PCell   | $\mu$ s   | 0  |
| Frequency offset of the $i$ -th LAA SCell relative to PCell   | Hz        | 200  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> |           |  |

**Table 8.2.4.1.1-4: Single carrier performance for PCell for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|------------------------|--|------------------------------------|----------|
|            |                   |              |                        |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.14-4 FDD        | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 10.4     |
| 3MHz       | R.14-5 FDD        | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 9.5      |
| 5MHz       | R.14-6 FDD        | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 9.5      |
| 10MHz      | R.14 FDD          | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 10.1     |
| 15MHz      | R.14-7 FDD        | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 10.1     |
| 20MHz      | R.14-3 FDD        | OP.1 FDD     | EVA5                   | 4x2 Low                                | 70                                 | 10.3     |

**Table 8.2.4.1.1-5: Single carrier performance for LAA SCell(s) for multiple CA configurations**

| Band-width  | Sub-test (Note 2) | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                                     |          |
|---|-------------------|-------------------|--------------|------------------------|--|---|----------|
|   |                   |                   |              |                        |  | Fraction of nominal maximum throughput (%) (Note 1) | SNR (dB) |
| 20MHz   | 1                 | R.1 FS3           | OP.1 FS3     | EVA5                   | 4x2 Low                                | 70  | 18.7     |
|   | 2                 | R.1 FS3           | OP.1 FS3     | EVA5                   | 4x2 Low                                | 70  | 18.6     |
|   | 3                 | R.1 FS3           | OP.1 FS3     | EVA5                   | 4x2 Low                                | 70  | 18.9     |
|   | 4                 | R.1 FS3           | OP.1 FS3     | EVA5                   | 4x2 Low                                | 70  | 19       |
| <p>Note 1: Fraction of nominal maximum throughput is calculated based on random transmission occasions of PDSCH.</p> <p>Note 2: An UE is required to fulfill only one test of Sub-test 1-4 depending on UE capabilities of endingDwPTS and secondSlotStartingPosition. For an UE not supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 1; For an UE not supporting endingDwPTS but</p> |                   |                   |              |                        |  |   |          |

supporting secondSlotStartingPosition, it is required to fulfill Sub-test 2; For an UE supporting endingDwPTS but not supporting secondSlotStartingPosition, it is required to fulfill Sub-test 3; and For an UE supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 4.

**Table 8.2.4.1.1-6: Minimum performance (FRC) based on single carrier performance for CA with one LAA SCell**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 2x20   | 20    | 20        | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+20  | 15    | 20        | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+20  | 10    | 20        | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.         |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.1-7: Minimum performance (FRC) based on single carrier performance for CA with two LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 3x20   | 20    | 2x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+2x20  | 15    | 2x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+2x20  | 10    | 2x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in Table 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.1-8: Minimum performance (FRC) based on single carrier performance for CA with three LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 4x20   | 20    | 3x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+3x20  | 15    | 3x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+3x20  | 10    | 3x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in Table 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.1-9: Minimum performance (FRC) based on single carrier performance for CA with four LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 5x20   | 20    | 4x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+4x20  | 15    | 4x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+4x20  | 10    | 4x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in Table 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.1-10: Minimum performance (FRC) based on single carrier performance for CA with five LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 6x20   | 20    | 5x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+5x20  | 15    | 5x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+5x20  | 10    | 5x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in Table 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.1-11: Minimum performance (FRC) based on single carrier performance for CA with six LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 7x20   | 20    | 6x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 2           | 15+6x20  | 15    | 6x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| 3           | 10+6x20  | 10    | 6x20      | As defined in Table 8.2.4.1.1-4 and Table 8.2.4.1.1-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.2.4.1.1-4 for PCell and apply a per-CC requirement defined in Table 8.2.4.1.1-5 for LAA SCell. |       |           |   |             |

### 8.2.4.1.2 TDD PCell (TDD single carrier)

The parameters specified in Table 8.2.4.1.2-1 are valid for TDD CC and LAA SCell(s) unless otherwise stated. And the additional parameters specified in Table 8.2.4.1.2-2 are valid for LAA SCell(s).

**Table 8.2.4.1.2-1: Common Test Parameters (TDD)**

| Parameter                                      | Unit   | Value  |
|--|--|--|
| Uplink downlink configuration (Note 1)         |  | 1  |
| Special subframe configuration (Note 2)        |  | 4  |
| Cyclic prefix                                  |  | Normal   |
| Cell ID  |  | 0  |
| Inter-TTI Distance                             |  | 1  |
| Number of HARQ processes per component carrier | Processes  | 7  |
| Maximum number of HARQ transmission (Note 3)   |  | 4  |
| Redundancy version coding sequence             |  | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM |
| Cross carrier scheduling                       |  | Not configured   |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4].  |  |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4].  |  |
| Note 3:  | For retransmission in partial subframes, the TB size should be kept the same as the initial transmission regardless of the initial transmission is performed in full subframes or partial subframes. |  |



**Table 8.2.4.1.2-2: Additional Test Parameters for LAA SCell(s)**

| Parameter                               | Unit     | Value  |
|---|----------|--|
| DMTC Periodicity                        | ms       | 80   |
| dmtc-PeriodOffset-r12<br>ms80-r12       |          | 0  |
| Discovery signal<br>occasion duration   | subframe | 1  |
| Power allocation of<br>discovery signal |          | Same as power allocation of CRS within a<br>transmission burst in the test |

For CA with LAA SCell(s), the requirements are specified in Table 8.2.4.1.2-4, with the addition of the parameters in Table 8.2.4.1.2-1, Table 8.2.4.1.2-2, Table 8.2.4.1.2-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with frequency selective precoding for CA with LAA SCell(s).

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.4.1.2-3: Test Parameters for Dual-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Value  |             |
|---|-----------|--|-------------|
| Downlink power<br>allocation  | $\rho_A$  | dB   | -6          |
|   | $\rho_B$  | dB   | -6 (Note 1) |
|   | $\sigma$  | dB   | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  |             |
| Precoding granularity   | PRB       | 4 for 3MHz and 5MHz CCs, 6 for<br>10MHz CCs, 8 for 15MHz and 20MHz<br>CCs      |             |
| PMI delay (Note 2)  | ms        | 10 or 11   |             |
| Reporting interval  | ms        | 1 or 4 (Note 3)  |             |
| Reporting mode  |           | PUSCH 1-2  |             |
| CodeBookSubsetRestriction<br>bitmap   |           | 00000000000000000000000000000000<br>0011111111111111111111000000000000<br>0000 |             |
| CSI request field (Note 4)  |           | '10'   |             |
| PDSCH transmission mode   |           | TM4  |             |
| DL Burst transmission pattern<br>for LAA SCell  |           | As specified in B.8  |             |
| The number of subframes set<br>( $S_T$ ) in a burst   |           | {1,3,5,8}  |             |
| Occupied OFDM symbols set<br>in the last subframe   |           | {6,9,12,14}  |             |
| Random variable $p$ defined in<br>B.8   |           | 0.5  |             |
| timing error relative of LAA<br>SCell to PCell  | $\mu$ s   | 0  |             |
| Frequency offset of the $i$ -th LAA<br>SCell relative to PCell  | Hz        | 200  |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.<br>Note 5: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.<br>Note 6: The same PDSCH transmission mode is applied to each component carrier. |           |  |             |

**Table 8.2.4.1.2-4: Single carrier performance for PCell for multiple CA configurations**

|  |  |  |  |  |                 |
|--|--|--|--|--|-----------------|
|  |  |  |  |  | Reference value |
|--|--|--|--|--|-----------------|

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Fraction of maximum throughput (%) | SNR (dB) |
|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
| 1.4MHz    | R.43-1 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 11.0     |
| 3MHz      | R.43-2 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 9.8      |
| 5MHz      | R.43-3 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.0     |
| 10MHz     | R.43-4 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.5     |
| 15MHz     | R.43-5 TDD        | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.6     |
| 20MHz     | R.43 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                | 70                                 | 10.7     |

**Table 8.2.4.1.2-5: Single carrier performance for LAA SCell for multiple CA configurations**

| Bandwidth   | Sub-test (Note 2) | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                             |          |
|---|-------------------|-------------------|--------------|-----------------------|--|---|----------|
|   |                   |                   |              |                       |  | Fraction of maximum throughput (%) (Note 1) | SNR (dB) |
| 20MHz   | 1                 | R.1 FS3           | OP.1 FS3     | EVA5                  | 4x2 Low                                | 70  | 18.7     |
|   | 2                 | R.1 FS3           | OP.1 FS3     | EVA5                  | 4x2 Low                                | 70  | 18.6     |
|   | 3                 | R.1 FS3           | OP.1 FS3     | EVA5                  | 4x2 Low                                | 70  | 18.9     |
|   | 4                 | R.1 FS3           | OP.1 FS3     | EVA5                  | 4x2 Low                                | 70  | 19       |
| Note 1: Fraction of nominal maximum throughput is calculated based on random transmission occasions of PDSCH.<br>Note 2: An UE is required to fulfill only one test of Sub-test 1-4 depending on UE capabilities of endingDwPTS and secondSlotStartingPosition. For an UE not supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 1; For an UE not supporting endingDwPTS but supporting secondSlotStartingPosition, it is required to fulfill Sub-test 2; For an UE supporting endingDwPTS but not supporting secondSlotStartingPosition, it is required to fulfill Sub-test 3; and For an UE supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 4. |                   |                   |              |                       |  |   |          |

**Table 8.2.4.1.2-6: Minimum performance (FRC) based on single carrier performance for CA with one LAA SCell**

| Test number  | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|--|----------------------------|-------|-----------|---|-------------|
|  | Total                      | PCell | LAA SCell |   |             |
| 1  | 2x20                       | 20    | 20        | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.<br>Note 2: Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |                            |       |           |   |             |

**Table 8.2.4.1.2-7: Minimum performance (FRC) based on single carrier performance for CA with two LAA SCells**

| Test number  | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|--|----------------------------|-------|-----------|---|-------------|
|  | Total                      | PCell | LAA SCell |   |             |
| 1  | 3x20                       | 20    | 2x20      | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.<br>Note 2: Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |                            |       |           |   |             |

**Table 8.2.4.1.2-8: Minimum performance (FRC) based on single carrier performance for CA with three LAA SCells**

| Test number | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2) | UE Category |
|-------------|----------------------------|-------|-----------|--|-------------|
|             | Total                      | PCell | LAA SCell |  |             |

|         |  |    |      |   |    |
|---------|--|----|------|---|----|
| 1       | 4x20   | 20 | 3x20 | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5 |
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.         |    |      |   |    |
| Note 2: | Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |    |      |   |    |

**Table 8.2.4.1.2-9: Minimum performance (FRC) based on single carrier performance for CA with four LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 5x20   | 20    | 4x20      | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.         |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.2-10: Minimum performance (FRC) based on single carrier performance for CA with five LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 6x20   | 20    | 5x20      | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.         |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |       |           |   |             |

**Table 8.2.4.1.2-11: Minimum performance (FRC) based on single carrier performance for CA with six LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 7x20   | 20    | 6x20      | As defined in Table 8.2.4.1.2-4 and Table 8.2.4.1.2-5 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.         |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in 8.2.4.1.2-4 for PCell and apply a per-CC requirement defined in 8.2.4.1.2-5 for LAA SCell. |       |           |   |             |

## 8.3 Demodulation of PDSCH (User-Specific Reference Symbols)

### 8.3.1 FDD

The parameters specified in Table 8.3.1-1 are valid for FDD unless otherwise stated.

**Table 8.3.1-1: Common Test Parameters for User-specific Reference Symbols**

| Parameter | Unit               | Value  |
|-----------|--------------------|--------|
|           | Cyclic prefix      | Normal |
|           | Cell ID            | 0      |
|           | Inter-TTI Distance | 1      |

|                                     |              |  |
|-------------------------------------|--------------|--|
| Number of HARQ processes            | Processes    | 8  |
| Maximum number of HARQ transmission |              | 4  |
| Redundancy version coding sequence  |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM      |
| Number of OFDM symbols for PDCCH    | OFDM symbols | 2  |
| Precoder update granularity         |              | Frequency domain: 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms |
| Note 1:                             | Void.        |  |
| Note 2:                             | Void.        |  |

### 8.3.1.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.1.1-1 and 8.3.1.1-2, with the addition of the parameters in Table 8.3.1.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.3.1.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| parameter  | Unit               | Test 1, Test 1a         | Test 2                  | Test 3                    | Test 4   | Test 5                    |
|--|--------------------|-------------------------|-------------------------|---------------------------|--|---------------------------|
| Downlink power allocation  | $\rho_A$           | dB                      | 0                       | 0                         | 0  | 0                         |
|  | $\rho_B$           | dB                      | 0 (Note 1)              | 0 (Note 1)                | 0 (Note 1)   | 0 (Note 1)                |
|  | $\sigma$           | dB                      | -3                      | -3                        | -3   | -3                        |
| Beamforming model  |                    | Annex B.4.1             | Annex B.4.1             | Annex B.4.1               | Annex B.4.1  | Annex B.4.1               |
| Cell-specific reference signals  |                    | Antenna ports 0,1       |                         |                           |  |                           |
| CSI reference signals  |                    | Antenna ports 15,...,18 | Antenna ports 15,...,18 | Antenna ports 15, ..., 18 | Antenna ports 15,...,18                                | Antenna ports 15, ..., 18 |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | Subframes          | 5 / 2                   | 5 / 2                   | 5 / 2                     | 5 / 2  | 5 / 2                     |
| CSI reference signal configuration   |                    | 0                       | 3                       | 0                         | 0  | 0                         |
| csi-RS-ConfigZP-<br>ApList   |                    | N/A                     | N/A                     | N/A                       | {0,1}  | N/A                       |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap | Subframes / bitmap | 3 /<br>0001000000000000 | 3 /<br>0001000000000000 | 3 /<br>0001000000000000   | 0100000000000000<br>or<br>0001000000000000<br>(Note 7) | N/A                       |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                     | -98                     | -98                       | -98  | -98                       |
| Symbols for unused PRBs  |                    | OCNG (Note 4)           | OCNG (Note 4)           | OCNG (Note 4)             | OCNG (Note 4)  | OCNG (Note 4)             |
| Number of allocated resource blocks (Note 2)   | PRB                | 50                      | 50                      | 50                        | 50   | 50                        |
| Simultaneous transmission  |                    | No                      | Yes (Note 3, 5)         | No                        | No   | No                        |

|                           |           |            |    |    |            |    |
|---------------------------|-----------|------------|----|----|------------|----|
| PDSCH transmission mode   |           | 9          | 9  | 9  | 9          | 9  |
| Number of MBSFN subframes | Subframes | 6 (Note 6) | NA | NA | 6 (Note 6) | NA |

Note 1:  $P_b = 1$ .

Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.

Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.

Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

Note 5: The two UEs' scrambling identities  $n_{SCID}$  are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.

Note 6: For FDD mode, 6 subframes (#1/2/3/6/7/8) are allocated as MBSFN subframes.

Note 7: Through DCI signalling, indicating aperiodic ZP-CSI-RS in sub-frames #3 and #8 per frame, the indicated aperiodic ZP-CSI-RS is random selected from RRC-configured AP ZP CSIRS list.

**Table 8.3.1.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1           | 10 MHz QPSK 1/3   | R.43-1 FDD        | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -1.2     | $\geq 1$    | $\geq 6$       |
| 1a          | 10 MHz QPSK 1/3   | R.43-2 FDD        | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -1.3     | $\geq 1$    | $\geq 6$       |
| 3           | 10MHz 256QAM      | R. 66 FDD         | OP.1 FDD     | EPA5                  | 2x2 Low                                      | 70                                 | 24.3     | 11-12       | $\geq 11$      |
| 4           | 10 MHz QPSK 1/3   | R.43-1 FDD        | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -1.2     | $\geq 1$    | $\geq 6$       |
| 5           | 10MHz 1024QAM     | R.101 FDD         | OP.1 FDD     | EPA5                  | 4x2 Low                                      | 70                                 | 30.1     | TBD         | 20, $\geq 22$  |

Note 1: For UE that does not support aperiodic ZP-CSI-RS, test 1a will be run and test 1 will be skipped if the UE indicates support of *pdsch-CollisionHandling-r13*. Otherwise, test 1 will be run and test 1a will be skipped. For UE that does not support aperiodic ZP-CSI-RS, test 4 and test 4a will be skipped.

**Table 8.3.1.1-3: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 2           | 10 MHz 64QAM 1/2  | R.50 FDD          | OP.1 FDD     | EPA5                  | 2x2 Low                                      | 70                                 | 21.9     | $\geq 2$    |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

### 8.3.1.1A Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.1.1A-2, with the addition of the parameters in Table 8.3.1.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.3.1.1A-1, Cell 1 is the serving cell, and

Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.3.1.1A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model**

| parameter   |          | Unit      | Cell 1  | Cell 2                       |
|---|----------|-----------|---|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0   | 0                            |
|   | $\rho_B$ | dB        | 0 (Note 1)  | 0                            |
|   | $\sigma$ | dB        | -3  | -3                           |
| Cell-specific reference signals   |          |           | Antenna ports 0,1   | Antenna ports 0,1            |
| CSI reference signals   |          |           | Antenna ports 15,...,18   | N/A                          |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes | 5 / 2   | N/A                          |
| CSI reference signal configuration  |          |           | 0   | N/A                          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   | N/A                          |
| DIP (Note 2)  |          | dB        | N/A   | -1.73                        |
| $BW_{\text{Channel}}$   |          | MHz       | 10  | 10                           |
| Cyclic Prefix   |          |           | Normal  | Normal                       |
| Cell Id   |          |           | 0   | 126                          |
| Number of control OFDM symbols  |          |           | 2   | 2                            |
| PDSCH transmission mode   |          |           | 9   | N/A                          |
| Beamforming model   |          |           | As specified in clause B.4.3 (Note 4, 5)  | N/A                          |
| Interference model  |          |           | N/A   | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells                 | Rank 1   |           | N/A   | 70                           |
|   | Rank 2   |           | N/A   | 30                           |
| Precoder update granularity   |          | PRB       | 50  | 6                            |
| PMI delay (Note 5)  |          | Ms        | 8   | N/A                          |
| Reporting interval  |          | Ms        | 5   | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1   | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111                                | N/A                          |
| Symbols for unused PRBs   |          |           | OCNG (Note 6)   | N/A                          |
| Simultaneous transmission   |          |           | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A                          |
| Physical channel for CQI reporting  |          |           | PUSCH(Note 8)   | N/A                          |
| cqi-pmi-ConfigurationIndex  |          |           | 5   | N/A                          |
| Note 1: $P_B = 1$   |          |           |   |                              |

|         |  |
|---------|--|
| Note 2: | The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |
| Note 3: | The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.   |
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI.   |
| Note 5: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.  |
| Note 7: | All cells are time-synchronous.  |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |

**Table 8.3.1.1A-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model**

| Test Number  | Reference Channel | OCNB Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|--|-------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1  | R.48 FDD          | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 4x2 Low   | 70                                 | -1.1               | ≥1          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                   |              |        |                        |        |   |                                    |                    |             |
| Note 2: SINR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.               |                   |              |        |                        |        |   |                                    |                    |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                   |              |        |                        |        |   |                                    |                    |             |

### 8.3.1.1B Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.3.1.1B-2, with the addition of parameters in Table 8.3.1.1B-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.3.1.1B-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.1.1B-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Parameter                 | Unit      | Cell 1                              | Cell 2       | Cell 3      |
|---------------------------|-----------|-------------------------------------|--------------|-------------|
| Downlink power allocation | $\rho_A$  | dB                                  | 0            | -3          |
|                           | $\rho_B$  | dB                                  | 0 (Note 1)   | -3 (Note 1) |
|                           | $\sigma$  | dB                                  | -3           | N/A         |
| $N_{oc}$ at antenna port  | $N_{oc1}$ | dBm/15kHz                           | -98 (Note 2) | N/A         |
|                           | $N_{oc2}$ | dBm/15kHz                           | -98 (Note 3) | N/A         |
|                           | $N_{oc3}$ | dBm/15kHz                           | -93 (Note 4) | N/A         |
| $\hat{E}_s / N_{oc2}$     | dB        | Reference Value in Table 8.3.1.1B-2 | 12           | 10          |
| BW <sub>Channel</sub>     | MHz       | 10                                  | 10           | 10          |
| Subframe Configuration    |           | Non-MBSFN                           | Non-MBSFN    | Non-MBSFN   |

|   |                    |                       |  |  |  |
|---|--------------------|-----------------------|--|--|--|
| Time Offset between Cells   |                    | $\mu\text{s}$         | N/A  | 3  | -1   |
| Frequency shift between Cells   |                    | Hz                    | N/A  | 300  | -100   |
| Cell Id   |                    |                       | 0  | 1  | 126  |
| Cell-specific reference signals   |                    |                       | Antenna ports 0,1  |  |  |
| CSI reference signals   |                    |                       | Antenna ports<br>15,16                                   | N/A  | N/A  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$    |                    | Subframes             | 5 / 2  | N/A  | N/A  |
| CSI reference signal configuration  |                    |                       | 8  | N/A  | N/A  |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$<br>bitmap |                    | Subframes /<br>bitmap | 3 /<br>00100000000000<br>00                              | N/A  | N/A  |
| ABS pattern (Note 5)  |                    |                       | N/A  | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6)   |                    |                       | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A  | N/A  |
| CSI Subframe Sets (Note7)   | $C_{\text{CSI},0}$ |                       | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | N/A  | N/A  |
|   | $C_{\text{CSI},1}$ |                       | 00111111<br>00111111<br>00111111<br>00111111<br>00111111 | N/A  | N/A  |
| Number of control OFDM symbols  |                    |                       | 2  | Note 8   | Note 8   |
| PDSCH transmission mode   |                    |                       | TM9-1layer   | Note 9   | Note 9   |
| Precoding granularity   |                    |                       | Frequency domain: 1 PRG<br>Time domain: 1 ms             | N/A  | N/A  |
| Beamforming model   |                    |                       | Annex B.4.1  | N/A  | N/A  |
| Cyclic prefix   |                    |                       | Normal   | Normal   | Normal   |



|          |  |
|----------|--|
| Note 1:  | $P_B = 1$ .  |
| Note 2:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.  |
| Note 3:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.  |
| Note 4:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS   |
| Note 5:  | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 6:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |
| Note 7:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].   |
| Note 8:  | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.   |
| Note 9:  | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.   |
| Note 10: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 11: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.  |
| Note 12: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.   |
| Note 13: | The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.   |

**Table 8.3.1.1B-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Test Number | Reference Channel   | OCNG Pattern |          |          | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|---|--------------|----------|----------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |   | Cell 1       | Cell 2   | Cell 3   | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.51 FDD  | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EVA5                           |        |        | 2x2 Low   | 70                                 | 7.8               | ≥2          |
| Note 1:     | The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |              |          |          |                                |        |        |   |                                    |                   |             |
| Note 2:     | The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |              |          |          |                                |        |        |   |                                    |                   |             |
| Note 3:     | SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.                                     |              |          |          |                                |        |        |   |                                    |                   |             |

### 8.3.1.1C Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.1.1C-2, with the addition of the parameters in Table 8.3.1.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7, 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In 8.3.1.1C-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1C-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM9 interference model**

| Parameter                 |          | Unit | Cell 1     | Cell 2 | Cell 3 |
|---------------------------|----------|------|------------|--------|--------|
| Downlink power allocation | $\rho_A$ | dB   | 0          | 0      | 0      |
|                           | $\rho_B$ | dB   | 0 (Note 1) | 0      | 0      |
|                           | $\sigma$ | dB   | -3         | -3     | -3     |

|  |                          |                       |  |                                 |                                 |
|--|--------------------------|-----------------------|--|---------------------------------|---------------------------------|
| Cell-specific reference signals  |                          |                       | Antenna ports<br>0,1                       | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                          | dBm/15kHz             | -98  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                          | dB                    | N/A  | 13.91                           | 3.34                            |
| $BW_{Channel}$   |                          | MHz                   | 10   | 10                              | 10                              |
| Cyclic Prefix  |                          |                       | Normal                                     | Normal                          | Normal                          |
| Cell Id  |                          |                       | 0  | 1                               | 6                               |
| Number of control OFDM symbols   |                          |                       | 3  | 3                               | 3                               |
| CFI indicated in PCFICH  |                          |                       | 3  | 3                               | 3                               |
| PDSCH transmission mode  |                          |                       | 9  | 9                               | 9                               |
| Interference model   |                          |                       | N/A  | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| Precoding  |                          |                       | Random<br>wideband<br>precoding per<br>TTI | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| CSI reference signals  |                          |                       | Antenna ports<br>15, 16, 17, 18            | Antenna ports<br>15, 16         | Antenna ports<br>15, 16         |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |                          | Subframes             | 10 / 1                                     | 10 / 1                          | 10 / 1                          |
| CSI reference signal configuration                                       |                          |                       | 5  | 6                               | 7                               |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                          | Subframes /<br>bitmap | 6 /<br>10000000000<br>00000                | 6 /<br>010000000000<br>0000     | 6 /<br>001000000000<br>00000    |
| Time offset to cell 1  |                          | us                    | N/A  | 2                               | 3                               |
| Frequency offset to cell 1   |                          | Hz                    | N/A  | 200                             | 300                             |
| MBSFN  |                          |                       | Not configured                             | Not configured                  | Not configured                  |
| NeighCellsInfo-r12<br>(Note 4)   | p-aList-r12              |                       | N/A  | {dB-6, dB-3,<br>dB0}            | {dB-6, dB-3,<br>dB0}            |
|  | transmissionModeList-r12 |                       | N/A  | {2,3,4,8,9}                     | {2,3,4,8,9}                     |
| Note 1: $P_B = 1$  |                          |                       |  |                                 |                                 |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |                       |  |                                 |                                 |
| Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.   |                          |                       |  |                                 |                                 |
| Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |                       |  |                                 |                                 |

**Table 8.3.1.1C-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration |         |         | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|--|---------|---------|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 | Cell 1                                       | Cell 2  | Cell 3  | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1           | R.69 FDD          | OP. 1 FDD    | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 4x2 Low                                      | 2x2 Low | 2x2 Low | 85                                 | 18.5              | ≥1          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

### 8.3.1.1D Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model

The requirements are specified in Table 8.3.1.1D-2, with the addition of the parameters in Table 8.3.1.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by the CRS of the interfering cell, applying the CRS interference model defined in clause B.6.5. In 8.3.1.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are

interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1D-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with CRS interference model**

| Parameter  |                          | Unit      | Cell 1                            | Cell 2                       | Cell 3                       |
|--|--------------------------|-----------|-----------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_A$                 | dB        | 0                                 | 0                            | 0                            |
|  | $\rho_B$                 | dB        | 0 (Note 1)                        | 0                            | 0                            |
|  | $\sigma$                 | dB        | -3                                | -3                           | -3                           |
| Cell-specific reference signals  |                          |           | Antenna ports 0,1                 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port   |                          | dBm/15kHz | -98                               |                              |                              |
| $\widehat{E}_s/N_{oc}$   |                          | dB        | N/A                               | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                          | MHz       | 10                                | 10                           | 10                           |
| Cyclic Prefix  |                          |           | Normal                            | Normal                       | Normal                       |
| Cell Id  |                          |           | 0                                 | 1                            | 6                            |
| Number of control OFDM symbols   |                          |           | 3                                 | 3                            | 3                            |
| CFI indicated in PCFICH  |                          |           | 3                                 | 3                            | 3                            |
| PDSCH transmission mode  |                          |           | 8                                 | N/A                          | N/A                          |
| Interference model   |                          |           | N/A                               | As specified in clause B.6.5 | As specified in clause B.6.5 |
| Precoding  |                          |           | Random wideband precoding per TTI | N/A                          | N/A                          |
| Time offset to cell 1  |                          | us        | N/A                               | 2                            | 3                            |
| Frequency offset to cell 1   |                          | Hz        | N/A                               | 200                          | 300                          |
| MBSFN  |                          |           | Not configured                    | Not configured               | Not configured               |
| NeighCellsInfo-r12 (Note 3)  | p-aList-r12              |           | N/A                               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|  | transmissionModeList-r12 |           | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$  |                          |           |                                   |                              |                              |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |           |                                   |                              |                              |
| Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |           |                                   |                              |                              |

**Table 8.3.1.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with CRS interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.71 FDD          | OP. 1 FDD    | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 14.3              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.              |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 2: SNR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                      |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

### 8.3.1.1E Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference model

The requirements are specified in Table 8.3.1.1E-2, with the addition of the parameters in Table 8.3.1.1E-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 3 interference model defined in clause B.6.2. In 8.3.1.1E-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1E-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM3 interference model**

| Parameter  |                           | Unit      | Cell 1                            | Cell 2                       | Cell 3                       |
|--|---------------------------|-----------|-----------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_A$                  | dB        | 0                                 | -3                           | -3                           |
|  | $\rho_B$                  | dB        | 0 (Note 1)                        | -3                           | -3                           |
|  | $\sigma$                  | dB        | -3                                | 0                            | 0                            |
| Cell-specific reference signals  |                           |           | Antenna ports 0,1                 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port   |                           | dBm/15kHz | -98                               |                              |                              |
| $\widehat{E}_s/N_{oc}$   |                           | dB        | N/A                               | 3.28                         | 0.74                         |
| $BW_{Channel}$   |                           | MHz       | 10                                | 10                           | 10                           |
| Cyclic Prefix  |                           |           | Normal                            | Normal                       | Normal                       |
| Cell Id  |                           |           | 0                                 | 1                            | 6                            |
| Number of control OFDM symbols   |                           |           | 3                                 | 3                            | 3                            |
| CFI indicated in PCFICH  |                           |           | 3                                 | Random from {1,2,3}          | Random from {1,2,3}          |
| PDSCH transmission mode  |                           |           | 8                                 | 3                            | 3                            |
| Interference model   |                           |           | N/A                               | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Precoding  |                           |           | Random wideband precoding per TTI | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Time offset to cell 1  |                           | us        | N/A                               | 2                            | 3                            |
| Frequency offset to cell 1   |                           | Hz        | N/A                               | 200                          | 300                          |
| MBSFN  |                           |           | Not configured                    | Not configured               | Not configured               |
| NeighCellsInfo-r12 (Note 4)  | p-aList-r12               |           | N/A                               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|  | transmissionModelList-r12 |           | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$  |                           |           |                                   |                              |                              |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                           |           |                                   |                              |                              |
| Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.   |                           |           |                                   |                              |                              |
| Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                           |           |                                   |                              |                              |

**Table 8.3.1.1E-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1           | R.70 FDD          | OP. 1 FD D   | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 11.5              | $\geq 1$    |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SNR corresponds to  $\widehat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.3.1.1F Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model

The requirements are specified in Table 8.3.1.1F-2, with the addition of the parameters in Table 8.3.1.1F-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission configured with TM10 in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.6.3. The NAICS network assistance is provided when the serving cell TM10 is configured with QCL-type A and PCID based DM-RS scrambling. The neighbouring cell has transmission mode TM9 and NeighCellsInfo-r12 for interfering cell indicates presence of TM9. In 8.3.1.1F-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1F-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM10 serving cell configuration and TM9 interference model**

| Parameter   |                           | Unit                  | Cell 1                                     | Cell 2                          | Cell 3                          |
|---|---------------------------|-----------------------|--|---------------------------------|---------------------------------|
| Downlink power allocation   | $\rho_A$                  | dB                    | 0  | 0                               | 0                               |
|   | $\rho_B$                  | dB                    | 0 (Note 1)                                 | 0                               | 0                               |
|   | $\sigma$                  | dB                    | -3   | -3                              | -3                              |
| Cell-specific reference signals   |                           |                       | Antenna ports<br>0,1                       | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port  |                           | dBm/15kHz             | -98  |                                 |                                 |
| $\widehat{E}_s/N_{oc}$  |                           | dB                    | N/A  | 13.91                           | 3.34                            |
| BW <sub>Channel</sub>   |                           | MHz                   | 10   | 10                              | 10                              |
| Cyclic Prefix   |                           |                       | Normal                                     | Normal                          | Normal                          |
| Cell Id   |                           |                       | 0  | 1                               | 6                               |
| Number of control OFDM symbols  |                           |                       | 3  | 3                               | 3                               |
| CFI indicated in PCFICH   |                           |                       | 3  | 3                               | 3                               |
| PDSCH transmission mode   |                           |                       | 10   | 9                               | 9                               |
| Interference model  |                           |                       | N/A  | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| Precoding   |                           |                       | Random<br>wideband<br>precoding per<br>TTI | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| CSI reference signals   |                           |                       | Antenna ports<br>15, 16, 17, 18            | Antenna ports<br>15, 16         | Antenna ports<br>15, 16         |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$        |                           | Subframes             | 10 / 1                                     | 10 / 1                          | 10 / 1                          |
| CSI reference signal configuration  |                           |                       | 5  | 6                               | 7                               |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / \text{ZeroPowerCSI-RS}$ bitmap |                           | Subframes /<br>bitmap | 6 /<br>1000000000<br>00000                 | 6 /<br>01000000000<br>0000      | 6 /<br>00100000000<br>00000     |
| Time offset to cell 1   |                           | us                    | N/A  | 2                               | 3                               |
| Frequency offset to cell 1  |                           | Hz                    | N/A  | 200                             | 300                             |
| MBSFN   |                           |                       | Not configured                             | Not configured                  | Not configured                  |
| NeighCellsInfo-r12<br>(Note 4)  | p-aList-r12               |                       | N/A  | {dB-6, dB-3,<br>dB0}            | {dB-6, dB-3,<br>dB0}            |
|   | transmissionModelList-r12 |                       | N/A  | {2,3,4,8,9}                     | {2,3,4,8,9}                     |

- Note 1:  $P_B = 1$   
 Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.  
 Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.  
 Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 8.3.1.1F-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM10 serving cell configuration and TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration |         |         | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|------------------------|--------|--------|--|---------|---------|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 | Cell 1                                       | Cell 2  | Cell 3  | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1           | R.69 FDD          | OP. 1 FD D   | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 4x2 Low                                      | 2x2 Low | 2x2 Low | 85                                 | 18.2              | ≥1          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

### 8.3.1.1G Single-layer Spatial Multiplexing (CRS assistance information is configured)

The requirements are specified in Table 8.3.1.1G-2, with the addition of parameters in Table 8.3.1.1G-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell with CRS assistance information. In Table 8.3.1.1G-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1, Cell2 and Cell 3 is according to Annex C.3.2. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.1.1G-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports)**

| Parameter  |          | Unit      | Cell 1                              | Cell 2     | Cell 3     |
|--|----------|-----------|-------------------------------------|------------|------------|
| Downlink power allocation  | $\rho_A$ | dB        | 0                                   | 0          | 0          |
|  | $\rho_B$ | dB        | 0 (Note 1)                          | 0 (Note 1) | 0 (Note 1) |
|  | $\sigma$ | dB        | -3                                  | -3         | -3         |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                                 | N/A        | N/A        |
| $\hat{E}_s/N_{oc}$   |          | dB        | Reference Value in Table 8.3.1.1G-2 | 10.45      | 4.6        |
| BW <sub>Channel</sub>  |          | MHz       | 10                                  | 10         | 10         |
| Subframe Configuration   |          |           | Non-MBSFN                           | Non-MBSFN  | Non-MBSFN  |
| Time Offset to Cell 1  |          | μs        | N/A                                 | 3          | -1         |
| Frequency shift to Cell 1  |          | Hz        | N/A                                 | 300        | -100       |
| Cell Id  |          |           | 0                                   | 1          | 128        |
| Cell-specific reference signals  |          |           | Antenna ports 0,1                   |            |            |
| CSI reference signals  |          |           | Antenna ports 15,16                 | N/A        | N/A        |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |          | Subframes | 5 / 2                               | N/A        | N/A        |
| CSI reference signal configuration                                       |          |           | 8                                   | N/A        | N/A        |

|  |        |                       |  |                                 |                                 |
|--|--------|-----------------------|--|---------------------------------|---------------------------------|
| Zero-power CSI-RS configuration<br><i>l<sub>CSI-RS</sub></i> / <i>ZeroPowerCSI-RS</i><br>bitmap  |        | Subframes /<br>bitmap | 3 /<br>00100000000000<br>000                       | N/A                             | N/A                             |
| Number of control OFDM<br>symbols  |        |                       | 2  | 2                               | 2                               |
| PDSCH transmission mode  |        |                       | TM9-1layer   | N/A                             | N/A                             |
| Precoding granularity  |        |                       | Frequency<br>domain: 1 PRG<br>Time domain: 1<br>ms | N/A                             | N/A                             |
| Beamforming model  |        |                       | Annex B.4.1  | N/A                             | N/A                             |
| Interference model   |        |                       | N/A  | As specified in<br>clause B.5.4 | As specified in<br>clause B.5.4 |
| Probability of occurrence of<br>transmission in interference cells   |        | %                     | N/A  | 20                              | 20                              |
| Probability of<br>occurrence of<br>transmission rank in<br>interfering cells   | Rank 1 | %                     | N/A  | 80                              | 80                              |
|  | Rank 2 | %                     | N/A  | 20                              | 20                              |
| Cyclic prefix  |        |                       | Normal   | Normal                          | Normal                          |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 4: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> <p>Note 5: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.</p> |        |                       |  |                                 |                                 |

**Table 8.3.1.1G-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports)**

| Test<br>Number   | Reference<br>Channel | OCNG Pattern |        |        | Propagation<br>Conditions (Note1) |        |        | Correlation<br>Matrix and<br>Antenna<br>Configurati<br>on (Note 2) | Reference Value                             |                            | UE<br>Cate<br>gory |
|--|----------------------|--------------|--------|--------|-----------------------------------|--------|--------|--|---|----------------------------|--------------------|
|  |                      | Cell 1       | Cell 2 | Cell 3 | Cell 1                            | Cell 2 | Cell 3 |  | Fraction of<br>Maximum<br>Throughput<br>(%) | SNR<br>(dB)<br>(Note<br>3) |                    |
| 1  | R.51-1<br>FDD        | OP.1<br>FDD  | N/A    | N/A    | EVA5                              |        |        | 2x2 Low  | 70  | 11.6                       | ≥2                 |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc}</math> of cell 1.</p> |                      |              |        |        |                                   |        |        |  |   |                            |                    |

### 8.3.1.1H Single-layer Spatial Multiplexing (With Enhanced DMRS table configured)

For single-layer transmission on antenna port 7, 8, 11 or 13 upon detection of a PDCCH with DCI format 2C, the requirement is specified in Table 8.3.1.1H-2, with the addition of the parameters in Table 8.3.1.1H-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of the test is to verify rank-1 performance on antenna port 11 with a simultaneous transmission on the antenna port 7, 8 or 13 with DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.3.1.1H-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| parameter                       | Unit     | Test 1            |            |
|---------------------------------|----------|-------------------|------------|
| Downlink power<br>allocation    | $\rho_A$ | dB                | 0          |
|                                 | $\rho_B$ | dB                | 0 (Note 1) |
|                                 | $\sigma$ | dB                | -3         |
| Beamforming model               |          | Annex B.4.1A      |            |
| Cell-specific reference signals |          | Antenna ports 0,1 |            |

|   |                       |                         |
|---|-----------------------|-------------------------|
| CSI reference signals   |                       | Antenna ports 15,...,18 |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes             | 5 / 2                   |
| CSI reference signal configuration  |                       | 3                       |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br><i>ZeroPowerCSI-RS</i> bitmap  | Subframes /<br>bitmap | 3 /<br>0001000000000000 |
| $N_{oc}$ at antenna port  | dBm/15kHz             | -98                     |
| Symbols for unused PRBs   |                       | OCNG (Note 4)           |
| Number of allocated resource blocks (Note 2)  | PRB                   | 50                      |
| Simultaneous transmission   |                       | Yes (Note 3, 5)         |
| dmrs-Enhancements-r13   |                       | Enable                  |
| PDSCH transmission mode   |                       | 9                       |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 11.</p> <p>Note 3: Modulation symbols of an interference signal are random mapped onto one antenna port among antenna port 7, 8 and 13. The update granularity for randomized mapping antenna port is 1 PRG in frequency domain and 1ms in time domain.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 5: The two UEs' scrambling identities <math>n_{SCID}</math> are set to 0 with OCC =4.</p> |                       |                         |

**Table 8.3.1.1H-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM 1/2 | R.50 FDD          | OP.1 FDD     | EPA5                  | 2x2 Low                                      | 70                                 | 21.9     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

**8.3.1.11 Single-layer Spatial Multiplexing (with assistance information for simultaneous transmission interfering PDSCH)**

For single-layer transmission on a DMRS antenna port upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.1.1I-1, with the addition of the parameters in Table 8.3.1.1I-2 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one DMRS antenna port with a simultaneous transmission on one of the other DMRS antenna port with or without DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.3.1.1I-1: Test Parameters for Minimum Performance Requirement - Single-layer Spatial Multiplexing with assistance information for simultaneous transmission interfering PDSCH (FRC)**

| parameter                 | Unit     | Test 1 | Test 2     | Test 3 |
|---------------------------|----------|--------|------------|--------|
| Downlink power allocation | $\rho_A$ |        | 0          |        |
|                           | $\rho_B$ |        | 0 (Note 1) |        |



|  |                       |          |                         |        |  |
|--|-----------------------|----------|-------------------------|--------|--|
|  | $\sigma$              | dB       | -3                      |        |  |
| Beamforming model  |                       |          | Annex B.4.1             |        |  |
| Cell-specific reference signals  |                       |          | Antenna ports 0,1       |        |  |
| CSI reference signals  |                       |          | Antenna ports 15,...,18 |        |  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   | Subframes             |          | 5 / 2                   |        |  |
| CSI reference signal configuration   |                       |          | 3                       |        |  |
| Zero-power CSI-RS configuration<br>$l_{\text{CSI-RS}} /$<br>ZeroPowerCSI-RS bitmap   | Subframes /<br>bitmap |          | 3 /<br>0001000000000000 |        |  |
| $N_{oc}$ at antenna port   | dBm/15kHz             |          | -98                     |        |  |
| Symbols for unused PRBs  |                       |          | OCNG (Note 2)           |        |  |
| Number of allocated resource blocks  | PRB                   |          | 50                      |        |  |
| Simultaneous transmission  |                       |          | Yes                     |        |  |
| PDSCH transmission mode  |                       |          | 9                       |        |  |
| Number of MBSFN subframes  | Subframes             |          | NA                      |        |  |
| dmrs-Enhancements-r13  |                       | Disabled | Enable                  | Enable |  |
| k-max-r14 (Note 5)   |                       | 1        | 1                       | 3      |  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 3: In Test 1, the modulation symbols of the signal under test are mapped randomly onto antenna port 7 or 8. Modulation symbols of an interference signal are mapped randomly onto one of the remaining DMRS antenna port. The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =2.</p> <p>Note 4: In Test 2 and Test 3, the modulation symbols of the signal under test are mapped randomly onto antenna port 7, 8, 11 or 13. Modulation symbols of an interference signal are mapped randomly onto one of the remaining DMRS antenna port. The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =4.</p> <p>Note 5: k-max-r14 is described in subclause 6.3.2 of [7].</p> <p>Note 6: The update granularity for randomized mapping antenna port is 50 PRGs in frequency domain and 1ms in time domain.</p> |                       |          |                         |        |  |

**Table 8.3.1.1I-2: Minimum performance for Minimum Performance Requirement - Single-layer Spatial Multiplexing with assistance information for simultaneous transmission interfering PDSCH (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.cc FDD          | OP.1 FDD     | EPA5                  | 4x2 Low                                      | 70                                 | 15.2     | ≥2          |
| 2           |           |                   |              |                       |  |                                    |          |             |
| 3           |           |                   |              |                       |  |                                    |          |             |

### 8.3.1.2 Dual-Layer Spatial Multiplexing

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.1.2-2, with the addition of the parameters in Table 8.3.1.2-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.3.1.2-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| Parameter  |          | Unit               | Test 1                             |                       |
|--|----------|--------------------|------------------------------------|-----------------------|
|  |          |                    | Cell 1                             | Cell 2                |
| Downlink power allocation  | $\rho_A$ | dB                 | 0                                  | 0                     |
|  | $\rho_B$ | dB                 | 0 (Note 1)                         | 0                     |
|  | $\sigma$ | dB                 | -3                                 | -3                    |
|  | PDSCH_RA | dB                 | 4                                  | NA                    |
|  | PDSCH_RB | dB                 | 4                                  | NA                    |
| Cell-specific reference signals  |          |                    | Antenna ports 0 and 1              | Antenna ports 0 and 1 |
| Cell ID  |          |                    | 0                                  | 126                   |
| CSI reference signals  |          |                    | Antenna ports 15,16                | NA                    |
| Beamforming model  |          |                    | Annex B.4.2                        | NA                    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   |          | Subframes          | 5 / 2                              | NA                    |
| CSI reference signal configuration   |          |                    | 8                                  | NA                    |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap   |          | Subframes / bitmap | 3 / 0010000000000000               | NA                    |
| $N_{oc}$ at antenna port   |          | dBm/15kHz          | -98                                | -98                   |
| $\widehat{E}_s / N_{oc}$   |          |                    | Reference Value in Table 8.3.1.2-2 | 7.25dB                |
| Symbols for unused PRBs  |          |                    | OCNG (Note 2)                      | NA                    |
| Number of allocated resource blocks (Note 2)   |          | PRB                | 50                                 | NA                    |
| Simultaneous transmission  |          |                    | No                                 | NA                    |
| PDSCH transmission mode  |          |                    | 9                                  | Blanked               |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                    |                                    |                       |

**Table 8.3.1.2-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern |        | Propagation Condition |        | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|--------|-----------------------|--------|--|------------------------------------|----------|-------------|
|             |                     |                   | Cell1        | Cell 2 | Cell 1                | Cell 2 |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.51 FDD          | OP.1 FDD     | N/A    | ETU5                  | ETU5   | 2x2 Low                                      | 70                                 | 14.2     | $\geq 2$    |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.  
 Note 3: SNR corresponds to  $\widehat{E}_s / N_{oc}$  of Cell 1.

### 8.3.1.2A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing

The requirements are specified in Table 8.3.1.2A-2, with the addition of the parameters in Table 8.3.1.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify rank two performance for full RB allocation upon antenna ports 7 and 8.

**Table 8.3.1.2A-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter   |          | Unit               | Test 1                |
|---|----------|--------------------|-----------------------|
| Downlink power allocation   | $\rho_A$ | dB                 | 0                     |
|   | $\rho_B$ | dB                 | 0 (Note 1)            |
|   | $\sigma$ | dB                 | -3                    |
| Cell-specific reference signals   |          |                    | Antenna ports 0 and 1 |
| CSI reference signals   |          |                    | Antenna ports 15,16   |
| Beamforming model   |          |                    | Annex B.4.2           |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          | Subframes          | 5 / 2                 |
| CSI reference signal configuration  |          |                    | 8                     |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap  |          | Subframes / bitmap | 3 / 0010000000000000  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz          | -98                   |
| Symbols for unused PRBs   |          |                    | OCNG (Note 2)         |
| Number of allocated resource blocks (Note 2)  |          | PRB                | 50                    |
| Simultaneous transmission   |          |                    | No                    |
| PDSCH transmission mode   |          |                    | 9                     |
| Note 1: $P_B = 1$   |          |                    |                       |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                    |                       |

**Table 8.3.1.2A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.51 FDD          | OP.1 FDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 17.4     | ≥2          |

### 8.3.1.3 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

#### 8.3.1.3.1 Minimum requirement with Same Cell ID (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.1.3.1-3, with the additional parameters in Table 8.3.1.3.1-1 and Table 8.3.1.3.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6], configured according to Table 8.3.1.3.1-2. In Tables 8.3.1.3.1-1 and 8.3.1.3.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter   |          | Unit           | TP 1                                 | TP 2                                 |
|---|----------|----------------|--------------------------------------|--------------------------------------|
| Downlink power allocation   | $\rho_A$ | dB             | 0                                    | 0                                    |
|   | $\rho_B$ | dB             | 0 (Note 1)                           | 0                                    |
|   | $\sigma$ | dB             | -3                                   | -3                                   |
| Cell-specific reference signals   |          |                | Antenna ports 0,1                    | (Note 2)                             |
| CSI-RS 0 antenna ports  |          |                | NA                                   | Port {15,16}                         |
| <i>qcl-CSI-RS-ConfigNZPId-r11</i> , CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes      | NA                                   | 5/2                                  |
| <i>qcl-CSI-RS-ConfigNZPId-r11</i> , CSI-RS 0 configuration  |          |                | NA                                   | 8                                    |
| <i>csi-RS-ConfigZPId-r11</i> , Zero-power CSI-RS 0 configuration $l_{\text{CSI-RS}} / \text{ZeroPower CSI-RS bitmap}$     |          |                | NA                                   | 2/<br>0000010000000000               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>z | -98                                  | -98                                  |
| $\hat{E}_s / N_{oc}$  |          | dB             | Reference point in Table 8.3.1.3.1-3 | Reference point in Table 8.3.1.3.1-3 |
| BW <sub>Channel</sub>   |          | MHz            | 10                                   | 10                                   |
| Cyclic Prefix   |          |                | Normal                               | Normal                               |
| Cell Id   |          |                | 0                                    | 0                                    |
| Number of control OFDM symbols  |          |                | 2                                    | 2                                    |
| PDSCH transmission mode   |          |                | Blanked                              | 10                                   |
| Number of allocated PRB   |          | PRB            | NA                                   | 50                                   |
| <i>qcl-Operation</i> , ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’   |          |                | Type B, ‘00’                         |                                      |
| Time offset between TPs   |          | μs             | NA                                   | Reference point in Table 8.3.1.3.1-3 |
| Frequency error between TPs   |          | Hz             | NA                                   | 0                                    |
| Beamforming model   |          |                | NA                                   | Port 7 as specified in clause B.4.1  |
| Symbols for unused PRBs   |          |                | NA                                   | OCNG (Note 3)                        |
| Note 1: $P_B = 1$   |          |                |                                      |                                      |
| Noet 2: REs for antenna ports 0 and 1 have zero transmission power.   |          |                |                                      |                                      |

Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.1.3.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | Blanked                                     | PDSCH |

**Table 8.3.1.3.1-3: Minimum performance for quasi co-location type B: same Cell ID**

| Test Number | Reference Channel | OCN pattern |          | Time offset between TPs ( $\mu$ s) | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|-------------|----------|------------------------------------|--------------------------------|------|---|------------------------------------|-------------------|-------------|
|             |                   | TP 1        | TP 2     |                                    | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.52 FDD          | NA          | OP.1 FDD | 2                                  | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 12.1              | $\geq 2$    |
| 2           | R.52 FDD          | NA          | OP.1 FDD | -0.5                               | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 12.6              | $\geq 2$    |

Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.  
Note 2: The correlation matrix and antenna configuration apply for TP 1 and TP 2.  
Note 3: SNR corresponds to  $\hat{E}_s / N_{oc}$  of TP 2 as defined in clause 8.1.1.

### 8.3.1.3.2 Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources)

The requirements are specified in Table 8.3.1.3.2-3, with the additional parameters in Tables 8.3.1.3.2-1 and 8.3.1.3.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6]. In Tables 8.3.1.3.2-1 and 8.3.1.3.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.1.3.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter                       | Unit     | TP 1                         | TP 2                         |
|---------------------------------|----------|------------------------------|------------------------------|
| Downlink power allocation       | $\rho_A$ | dB                           | 0                            |
|                                 | $\rho_B$ | dB                           | 0 (Note 1)                   |
|                                 | $\sigma$ | dB                           | -3                           |
| Beamforming model               |          | As specified in clause B.4.1 | As specified in clause B.4.1 |
| Cell-specific reference signals |          | Antenna ports 0,1            | (Note 2)                     |

|  |                   |                                      |                                      |
|--|-------------------|--------------------------------------|--------------------------------------|
| CSI reference signals 0  |                   | Antenna ports {15,16}                | N/A                                  |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes         | 5 / 2                                | N/A                                  |
| CSI reference signal 0 configuration   |                   | 0                                    | N/A                                  |
| CSI reference signals 1  |                   | N/A                                  | Antenna ports {15,16}                |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes         | N/A                                  | 5 / 2                                |
| CSI reference signal 1 configuration   |                   | N/A                                  | 8                                    |
| Zero-power CSI-RS 0 configuration $l_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$   | Subframes /bitmap | 2/<br>0010000000000000               | N/A                                  |
| Zero-power CSI-RS1 configuration $l_{CSI-RS} / ZeroPower\ CSI-RS\ bitmaps$   | Subframes /bitmap | N/A                                  | 2/<br>0000010000000000               |
| $\hat{E}_s / N_{oc}$   | dB                | Reference Value in Table 8.3.1.3.2-3 | Reference Value in Table 8.3.1.3.2-3 |
| $N_{oc}$ at antenna port   | dBm/15kHz         | -98                                  | -98                                  |
| $BW_{Channel}$   | MHz               | 10                                   | 10                                   |
| Cyclic Prefix  |                   | Normal                               | Normal                               |
| Cell Id  |                   | 0                                    | 0                                    |
| Number of control OFDM symbols   |                   | 2                                    | 2                                    |
| Timing offset between TPs  |                   | N/A                                  | Reference Value in Table 8.3.1.3.2-3 |
| Frequency offset between TPs   | Hz                | N/A                                  | 0                                    |
| Number of allocated resource blocks  | PRB               | 50                                   | 50                                   |
| PDSCH transmission mode  |                   | 10                                   | 10                                   |
| Probability of occurrence of PDSCH transmission(Note 3)  | %                 | 30                                   | 70                                   |
| Symbols for unused PRBs  |                   | OCNG (Note 4)                        | OCNG (Note 4)                        |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: REs for antenna ports 0 and 1 have zero transmission power.</p> <p>Note 3: PDSCH transmission from TPs shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> |                   |                                      |                                      |

**Table 8.3.1.3.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |         |
|---------------|--|-------------------------|---|---------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2    |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blanked |
| PQI set 3     | CSI-RS 1                                 | ZP CSI-RS 1             | Blanked                                     | PDSCH   |

**Table 8.3.1.3.2-3: Performance Requirements for timing offset compensation with DPS transmission**

| Test Number | Timing offset(us) | Reference Channel | OCNG Pattern |          | Propagation Conditions |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|-------------------|--------------|----------|------------------------|------|---|------------------------------------|-------------------|-------------|
|             |                   |                   | TP 1         | TP 2     | TP 1                   | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | 2                 | R.53 FDD          | OP.1 FDD     | OP.1 FDD | EPA5                   | EPA5 | 2x2 Low   | 70                                 | 12.2              | ≥2          |
| 2           | -0.5              | R.53 FDD          | OP.1 FDD     | OP.1 FDD | EPA5                   | EPA5 | 2x2 Low   | 70                                 | 12.5              | ≥2          |

Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.  
 Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.  
 Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of both TP 1 and TP 2 as defined in clause 8.1.1.

**8.3.1.3.3 Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)**

The requirements are specified in Table 8.3.1.3.3-2, with the additional parameters in Table 8.3.1.3.3-1. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission points have different Cell ID and colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference between two transmission points, channel parameters estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.3.1.3.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.3-1: Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter  | Unit              | TP 1                                       | TP 2                                 |
|--|-------------------|--|--------------------------------------|
| Downlink power allocation  | $\rho_A$          | dB   | 0                                    |
|  | $\rho_B$          | dB   | 0 (Note 1)                           |
|  | $\sigma$          | dB   | -3                                   |
| Beamforming model  |                   | N/A  | As specified in clause B.4.2         |
| Cell-specific reference signals  |                   | Antenna ports 0,1                          | Antenna ports 0,1                    |
| CSI reference signals 0  |                   | N/A  | Antenna ports {15,16}                |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes         | N/A  | 5 / 2                                |
| CSI reference signal 0 configuration                                       |                   | N/A  | 0                                    |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ | Subframes /bitmap | N/A  | 2/<br>0010000000000000               |
| $\hat{E}_s/N_{oc}$   | dB                | Reference point in Table 8.3.1.3.3-2 + 4dB | Reference Value in Table 8.3.1.3.3-2 |
| $N_{oc}$ at antenna port z   | dBm/15kHz         | -98  | -98                                  |
| $BW_{Channel}$   | MHz               | 10   | 10                                   |
| Cyclic Prefix  |                   | Normal                                     | Normal                               |
| Cell Id  |                   | 0  | 126                                  |

|   |    |              |             |
|---|----|--------------|-------------|
| Number of control OFDM symbols  |    | 1            | 2           |
| Timing offset between TPs   | us | N/A          | 0           |
| Frequency offset between TPs  | Hz | N/A          | 200         |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'   |    | Type B, '00' |             |
| PDSCH transmission mode   |    | Blank        | 10          |
| Number of allocated resource block  |    | N/A          | 50          |
| Symbols for unused PRBs   |    | N/A          | OCNG(Note2) |
| Note 1: $P_B = 1$   |    |              |             |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |    |              |             |

**Table 8.3.1.3.3-2: Performance Requirements for quasi co-location type B with different Cell ID and Colliding CRS**

| Test Number  | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|----------|--------------------------------|------|---|------------------------------------|-------------------|-------------|
|  |                   | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.54 FDD          | N/A          | OP.1 FDD | EPA5                           | ETU5 | 2x2 Low   | 70                                 | 14.4              | ≥2          |
| Note 1: The propagation conditions for TP.1 and TP.2 are statistically independent.              |                   |              |          |                                |      |   |                                    |                   |             |
| Note 2: Correlation matrix and antenna configuration parameters apply for each of TP.1 and TP.2. |                   |              |          |                                |      |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of TP.2 as defined in clause 8.1.1.                |                   |              |          |                                |      |   |                                    |                   |             |

#### 8.3.1.3.4 Minimum requirement with Different Cell ID and non-colliding CRS (with single NZP CSI-RS resource and CRS assistance information is configured)

The requirements are specified in Table 8.3.1.3.4-3, with the additional parameters in Table 8.3.1.3.4-1 and Table 8.3.1.3.4-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where three transmission points have different Cell ID and non-colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference and time difference between two transmission points, channel parameters estimation and rate matching behaviour according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' signalling defined in [6]. Further, the test verifies that the UE, configured with the CRS assistance information [7], can mitigate interference from CRS for demodulation. The CRS assistance information [7] includes TP 3. In Table 8.3.1.3.4-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, transmission point 2 (TP 2) transmits PDSCH with different Cell ID, and Transmission point 3 (TP 3) is the aggressor transmission point. The downlink physical channel setup for TP 1 is according to Table C.3.4-1, for TP 2 is according to Table C.3.4-2, and for TP 3 is according to Annex C.3.2.

**Table 8.3.1.3.4-1: Test Parameters for quasi co-location type B with different Cell ID and non-Colliding CRS when CRS assistance information is configured**

| parameter                 | Unit     | TP 1 | TP 2       | TP 3 |
|---------------------------|----------|------|------------|------|
| Downlink power allocation | $\rho_A$ | dB   | 0          | 0    |
|                           | $\rho_B$ | dB   | 0 (Note 1) | 0    |
|                           | $\sigma$ | dB   | -3         | -3   |



|  |                   |                   |                                      |                              |
|--|-------------------|-------------------|--------------------------------------|------------------------------|
| Beamforming model  |                   | N/A               | Port 7 as specified in clause B.4.1  | N/A                          |
| Cell-specific reference signals  |                   | Antenna ports 0,1 | Antenna ports 0,1                    | Antenna ports 0,1            |
| CSI reference signals 0  |                   | N/A               | Antenna ports {15,16}                | N/A                          |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes         | N/A               | 5 / 2                                | N/A                          |
| CSI reference signal 0 configuration   |                   | N/A               | 0                                    | N/A                          |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$   | Subframes /bitmap | N/A               | 2/<br>0010000000000000               | N/A                          |
| $\widehat{E}_s / N_{oc}$   | dB                | 10.45             | Reference Value in Table 8.3.1.3.4-3 | 8.45                         |
| $N_{oc}$ at antenna port   | dBm/15kHz         | -98               | -98                                  | N/A                          |
| $BW_{Channel}$   | MHz               | 10                | 10                                   | 10                           |
| Cyclic Prefix  |                   | Normal            | Normal                               | Normal                       |
| Cell Id  |                   | 0                 | 1                                    | 128                          |
| Number of control OFDM symbols   |                   | 1                 | 2                                    | 2                            |
| Timing offset to TP 1  | us                | N/A               | -0.5                                 | 3                            |
| Frequency offset to TP 1   | Hz                | N/A               | 200                                  | -100                         |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'  |                   | Type B, '00'      |                                      | N/A                          |
| PDSCH transmission mode  |                   | Blank             | 10                                   | 9                            |
| Number of allocated resource block   |                   | N/A               | 50                                   | N/A                          |
| Symbols for unused PRBs  |                   | N/A               | OCNG(Note2)                          | N/A                          |
| Interference model   |                   | N/A               | N/A                                  | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells  | %                 | N/A               | N/A                                  | 20                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1            | %                 | N/A                                  | 80                           |
|  | Rank 2            | %                 | N/A                                  | 20                           |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                   |                   |                                      |                              |

**Table 8.3.1.3.4-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | Blanked                                     | PDSCH |

**Table 8.3.1.3.4-3: Performance Requirements for quasi co-location type B with different Cell ID and non-Colliding CRS when CRS assistance information is configured**

| Test Number  | Reference Channel | OCNG Pattern |          |     | Propagation Conditions (Note1) |      |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|----------|-----|--------------------------------|------|------|---|------------------------------------|-------------------|-------------|
|  |                   | TP 1         | TP 2     | TP3 | TP 1                           | TP 2 | TP3  |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.52-1 FDD        | N/A          | OP.1 FDD | N/A | EVA5                           | EVA5 | EVA5 | 2x2 Low   | 70                                 | 10.8              | ≥2          |
| Note 1: The propagation conditions for TP.1, TP.2 and TP.3 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP.1, TP.2 and TP.3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP.2 as defined in clause 8.1.1. |                   |              |          |     |                                |      |      |   |                                    |                   |             |

### 8.3.1.3.5 Minimum requirements with different Cell ID and non-colliding CRS (with multiple NZP CSI-RS resources and CRS assistance information is configured)

The requirements are specified in Table 8.3.1.3.5-3, with the additional parameters in Tables 8.3.1.3.5-1 and 8.3.1.3.5-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where three transmission points have different Cell ID and non-colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference and timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6]. Further, the test verifies that the UE, configured with the CRS assistance information [7], can mitigate interference from CRS for demodulation. The CRS assistance information [7] includes TP 3. In Tables 8.3.1.3.5-1 and 8.3.1.3.5-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, Transmission point 2 (TP 2) has different Cell ID as TP 1, and Transmission point 3 (TP 3) is the aggressor transmission point. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between TP 1 and TP 2 with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.1.3.5-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1, for TP 2 is according to Table C.3.4-2, and for TP 3 is according to Annex C.3.2.

**Table 8.3.1.3.5-1: Test Parameters DPS transmission with CRS assistance information**

| parameter  | Unit              | TP 1                         | TP 2                         | TP 3              |
|--|-------------------|------------------------------|------------------------------|-------------------|
| Downlink power allocation  | $\rho_A$          | dB                           | 0                            | 0                 |
|  | $\rho_B$          | dB                           | 0 (Note 1)                   | 0                 |
|  | $\sigma$          | dB                           | -3                           | -3                |
| Beamforming model  |                   | As specified in clause B.4.1 | As specified in clause B.4.1 | N/A               |
| Cell-specific reference signals  |                   | Antenna ports 0,1            | Antenna ports 0,1            | Antenna ports 0,1 |
| CSI reference signals 0  |                   | Antenna ports {15,16}        | N/A                          | N/A               |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes         | 5 / 2                        | N/A                          | N/A               |
| CSI reference signal 0 configuration                                       |                   | 0                            | N/A                          | N/A               |
| CSI reference signals 1  |                   | N/A                          | Antenna ports {15,16}        | N/A               |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes         | N/A                          | 5 / 2                        | N/A               |
| CSI reference signal 1 configuration                                       |                   | N/A                          | 8                            | N/A               |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ | Subframes /bitmap | 2/<br>0010000000000000       | N/A                          | N/A               |
| Zero-power CSI-RS1 configuration   | Subframes /bitmap | N/A                          | 2/<br>0000010000000000       | N/A               |

|   |        |           |                                      |                                      |                              |
|---|--------|-----------|--------------------------------------|--------------------------------------|------------------------------|
| $I_{CSI-RS} /$<br>ZeroPower CSI-RS bitmaps  |        |           |                                      |                                      |                              |
| $\widehat{E}_s / N_{oc}$ (Note 2)   |        | dB        | Reference Value in Table 8.3.1.3.5-3 | Reference Value in Table 8.3.1.3.5-3 | 8.45                         |
| $N_{oc}$ at antenna port  |        | dBm/15kHz | -98                                  | -98                                  | N/A                          |
| BW <sub>Channel</sub>   |        | MHz       | 10                                   | 10                                   | 10                           |
| Cyclic Prefix   |        |           | Normal                               | Normal                               | Normal                       |
| Cell Id   |        |           | 0                                    | 1                                    | 128                          |
| Number of control OFDM symbols  |        |           | 2                                    | 2                                    | 2                            |
| Timing offset to TP 1   |        |           | N/A                                  | -0.5                                 | 3                            |
| Frequency offset to TP 1  |        | Hz        | N/A                                  | 200                                  | -100                         |
| Number of allocated resource blocks   |        | PRB       | 50                                   | 50                                   | N/A                          |
| PDSCH transmission mode   |        |           | 10                                   | 10                                   | 9                            |
| Probability of occurrence of PDSCH transmission(Note 3)   |        | %         | 30                                   | 70                                   | N/A                          |
| Symbols for unused PRBs   |        |           | OCNG (Note 4)                        | OCNG (Note 4)                        | N/A                          |
| Interference model  |        |           | N/A                                  | N/A                                  | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells   |        | %         | N/A                                  | N/A                                  | 20                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %         | N/A                                  | N/A                                  | 80                           |
|   | Rank 2 | %         | N/A                                  | N/A                                  | 20                           |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: <math>\widehat{E}_s / N_{oc}</math> of TP1 is set the same as that of TP2.</p> <p>Note 3: PDSCH transmission from TP 1 and TP 2 shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> |        |           |                                      |                                      |                              |

**Table 8.3.1.3.5-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         |  | DL transmission hypothesis for each PQI Set |         |
|---------------|--|-------------------------|--|---|---------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration |  | TP 1  | TP 2    |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             |  | PDSCH                                       | Blanked |
| PQI set 1     | CSI-RS 1                                 | ZP CSI-RS 1             |  | Blanked                                     | PDSCH   |

**Table 8.3.1.3.5-3: Performance Requirements DPS transmission with CRS assistance information**

| Test Number | Reference Channel | OCNG Pattern |      |     | Propagation Conditions (Note1) |      |     | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value     |          | UE Category |
|-------------|-------------------|--------------|------|-----|--------------------------------|------|-----|---|---------------------|----------|-------------|
|             |                   | TP 1         | TP 2 | TP3 | TP 1                           | TP 2 | TP3 |   | Fraction of Maximum | SNR (dB) |             |

|         |  |          |          |     |      |      |      |         | Throughput (%) | (Note 3) |    |
|---------|--|----------|----------|-----|------|------|------|---------|----------------|----------|----|
| 1       | R.52-1 FDD   | OP.1 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | EVA5 | 2x2 Low | 70             | 10.7     | ≥2 |
| Note 1: | The propagation conditions for TP.1, TP.2 and TP.3 are statistically independent.              |          |          |     |      |      |      |         |                |          |    |
| Note 2: | Correlation matrix and antenna configuration parameters apply for each of TP.1, TP.2 and TP.3. |          |          |     |      |      |      |         |                |          |    |
| Note 3: | SNR corresponds to $\hat{E}_s/N_{oc}$ of both TP.1 and TP.2 as defined in clause 8.1.1.        |          |          |     |      |      |      |         |                |          |    |

### 8.3.1.3.6 Minimum requirements for QCL Type C and 2 Layers Spatial Multiplexing

The requirements are specified in Table 8.3.1.3.6-3, with the additional parameters in Table 8.3.1.3.6-1 and Table 8.3.1.3.6-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.3.1.3.6-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP1 and TP2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

**Table 8.3.1.3.6-1: Test Parameters**

| Parameter  |          | Unit             | TP 1                        | TP 2                        |
|--|----------|------------------|-----------------------------|-----------------------------|
| Downlink power allocation  | $\rho_A$ | dB               | 0                           | 0                           |
|  | $\rho_B$ | dB               | 0 (Note 1)                  | 0                           |
|  | $\sigma$ | dB               | -3                          | -3                          |
| Beamforming model  |          |                  | Random beamforming (rank 1) | Random beamforming (rank 1) |
| Cell-specific reference signals  |          |                  | Antenna ports 0,1           | Antenna ports 0,1           |
| CSI reference signals 0  |          |                  | Antenna ports {15,16}       | N/A                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    |          | Subframes        | 5 / 2                       |                             |
| CSI reference signal 0 configuration                                       |          |                  | 0                           |                             |
| CSI reference signals 1  |          |                  | N/A                         | Antenna ports {15,16}       |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    |          | Subframes        |                             | 5 / 2                       |
| CSI reference signal 1 configuration                                       |          |                  |                             | 8                           |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ |          | Subframes/bitmap | 2/<br>0010000000000000      | N/A                         |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$  |          | Subframes/bitmap | N/A                         | 2/<br>0010000000000000      |
| $\hat{E}_s / N_{oc}$   |          | dB               | SNR1                        | SNR2 = SNR1                 |
| $N_{oc}$ at antenna port   |          | dBm/15kHz        | -98                         | -98                         |
| BW <sub>Channel</sub>  |          | MHz              | 10                          | 10                          |
| Cyclic Prefix  |          |                  | Normal                      | Normal                      |
| Cell ID  |          |                  | 0                           | 126                         |
| Number of control OFDM symbols / PDSCH start                               |          |                  | 2                           | 2                           |
| Timing offset relative to TP 1   |          | us               | N/A                         | 2                           |
| Frequency offset relative to TP 1  |          | Hz               | N/A                         | 200                         |

|   |  |              |    |
|---|--|--------------|----|
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator' |  | Type C, '00' |    |
| PDSCH transmission mode (Note 2)  |  | 10           | 10 |
| Number of allocated resource block  |  | 50           | 50 |
| Note 1:   | $P_B = 1$  |              |    |
| Note 2:   | PDSCH transmission is done from both TPs (CW1 is transmitted from TP 1 and CW2 is transmitted from TP 2) |              |    |

**Table 8.3.1.3.6-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     | ZP CSI-RS 0             | PDSCH                                       | PDSCH |

**Table 8.3.1.3.6-3: Performance Requirements**

| Test Number   | Reference Channel |          | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|---|-------------------|----------|--------------|----------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|   | TP 1              | TP 2     | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1   | R.97 FDD          | R.97 FDD | OP.1F DD     | OP.1F DD | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 11.1               | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 1 and TP 2 as defined in clause 8.1.1. |                   |          |              |          |                                |      |   |                                    |                    |             |

**8.3.1.4 Performance Requirements for semiOpenLoop transmission**

The requirements are specified in Table 8.3.1.4-2, with the addition of the parameters in Table 8.3.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank one and rank two performances for full RB allocation upon antenna ports 7 and 8 with higher layer parameter *semiOpenLoop* is configured.

**Table 8.3.1.4-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) when high layer parameter *semiOpenLoop* is configured**

| parameter   | Unit      | Test 1                | Test 2                    |
|---|-----------|-----------------------|---------------------------|
| Downlink power allocation   | $\rho_A$  | dB                    | 0                         |
|   | $\rho_B$  | dB                    | 0 (Note 1)                |
|   | $\sigma$  | dB                    | -3                        |
| Cell-specific reference signals                                       |           | Antenna ports 0 and 1 | Antenna ports 0 and 1     |
| CSI reference signals   |           | Antenna ports 15,16   | Antenna ports 15,16,17,18 |
| Beamforming model   |           | B.4.3 (Note 3)        | B.4.3 (Note 3)            |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes | 5 / 2                 | 5 / 2                     |
| CSI reference signal configuration                                    |           | 0                     | 0                         |

|  |                       |                         |                         |
|--|-----------------------|-------------------------|-------------------------|
| Zero-power CSI-RS configuration<br><i>l</i> <sub>CSI-RS</sub> /<br><i>ZeroPowerCSI-RS</i><br>bitmap  | Subframes /<br>bitmap | 3 /<br>0010000000000000 | 3 /<br>0010000000000000 |
| <i>N</i> <sub>oc</sub> at antenna port   | dBm/15kHz             | -98                     | -98                     |
| Symbols for unused PRBs  |                       | OCNG (Note 2)           | OCNG (Note 2)           |
| Number of allocated resource blocks (Note 2)   | PRB                   | 50                      | 50                      |
| Simultaneous transmission  |                       | No                      | No                      |
| PDSCH transmission mode  |                       | 9                       | 9                       |
| Rank Number of PDSCH   |                       | 1                       | 2                       |
| <i>semiOpenLoop</i>  |                       | True                    | True                    |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 3: For 2 antenna ports {15, 16}, the precoding matrix corresponding to codebook index 0 from Table 6.3.4.2.3-1 in [4] with <math>\nu = 2</math>;<br/>For 4 antenna ports { 15,16,17,18 }, the precoding matrix random selected from Table 6.3.4.2.3-2 in [4] with <math>\nu = 2</math>.</p> |                       |                         |                         |

**Table 8.3.1.4-2: Minimum Performance Requirements for CDM-multiplexed DM RS (FRC) when high layer parameter *semiOpenLoop* is configured**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz QPSK 1/3   | R.86A FDD         | OP.1 FDD     | EVA 70Hz              | 2x2 Medium                                   | 70                                 | 0.6      | ≥1          |
| 2           | 10 MHz 16QAM 1/2  | R.45A-1 FDD       | OP.1 FDD     | EVA 70Hz              | 4x2 Low                                      | 70                                 | 14.9     | ≥2          |

### 8.3.2 TDD

The parameters specified in Table 8.3.2-1 are valid for TDD unless otherwise stated.

**Table 8.3.2-1: Common Test Parameters for User-specific Reference Symbols**

| Parameter                               | Unit      | Value  |
|---|-----------|--------|
| Uplink downlink configuration (Note 1)  |           | 1      |
| Special subframe configuration (Note 2) |           | 4      |
| Cyclic prefix                           |           | Normal |
| Cell ID                                 |           | 0      |
| Inter-TTI Distance                      |           | 1      |
| Number of HARQ processes                | Processes | 7      |
| Maximum number of HARQ transmission     |           | 4      |

|  |              |   |
|--|--------------|---|
| Redundancy version coding sequence                   |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM                                     |
| Number of OFDM symbols for PDCCH                     | OFDM symbols | 2   |
| Precoder update granularity                          |              | Frequency domain: 1 PRB for Transmission mode 8, 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms |
| ACK/NACK feedback mode                               |              | Multiplexing  |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4] |              |   |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4] |              |   |

### 8.3.2.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna port 5, the requirements are specified in Table 8.3.2.1-2, with the addition of the parameters in Table 8.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the demodulation performance using user-specific reference signals with full RB or single RB allocation.

**Table 8.3.2.1-1: Test Parameters for Testing DRS**

| Parameter   |          | Unit     | Test 1         | Test 2        | Test 3        | Test 4        |
|---|----------|----------|----------------|---------------|---------------|---------------|
| Downlink power allocation   | $\rho_A$ | dB       | 0              | 0             | 0             | 0             |
|   | $\rho_B$ | dB       | 0 (Note 1)     | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)    |
|   | $\sigma$ | dB       | 0              | 0             | 0             | 0             |
| Cell-specific reference signals   |          |          | Antenna port 0 |               |               |               |
| Beamforming model   |          |          | Annex B.4.1    |               |               |               |
| $N_{oc}$ at antenna port  |          | dB/15kHz | -98            | -98           | -98           | -98           |
| Symbols for unused PRBs   |          |          | OCNG (Note 2)  | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| PDSCH transmission mode   |          |          | 7              | 7             | 7             | 7             |
| Note 1: $P_B = 0$ .   |          |          |                |               |               |               |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |          |                |               |               |               |

**Table 8.3.2.1-2: Minimum performance DRS (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz QPSK 1/3   | R.25 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | -0.8     | $\geq 1$    |
| 2           | 10 MHz 16QAM 1/2  | R.26 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 7.0      | $\geq 2$    |
|             | 5MHz 16QAM 1/2    | R.26-1 TDD        | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 7.0      | 1           |
| 3           | 10 MHz 64QAM 3/4  | R.27 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 17.0     | $\geq 2$    |
|             | 10 MHz 64QAM 3/4  | R.27-1 TDD        | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 17.0     | 1           |
| 4           | 10 MHz 16QAM 1/2  | R.28 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 30                                 | 1.7      | $\geq 1$    |

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2B, the requirements are specified in Table 8.3.2.1-4 and 8.3.2.1-5, with the addition of the parameters in Table 8.3.2.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port.

**Table 8.3.2.1-3: Test Parameters for Testing CDM-multiplexed DM RS (single layer)**

| Parameter   |          | Unit      | Test 1                            | Test 2        | Test 3        | Test 4          | Test 5          |
|---|----------|-----------|-----------------------------------|---------------|---------------|-----------------|-----------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0                                 | 0             | 0             | 0               | 0               |
|   | $\rho_B$ | dB        | 0 (Note 1)                        | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)      | 0 (Note 1)      |
|   | $\sigma$ | dB        | -3                                | -3            | -3            | -3              | -3              |
| Cell-specific reference signals   |          |           | Antenna port 0 and antenna port 1 |               |               |                 |                 |
| Beamforming model   |          |           | Annex B.4.1                       |               |               |                 |                 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                               | -98           | -98           | -98             | -98             |
| Symbols for unused PRBs   |          |           | OCNG (Note 4)                     | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4)   | OCNG (Note 4)   |
| Simultaneous transmission   |          |           | No                                | No            | No            | Yes (Note 3, 5) | Yes (Note 3, 5) |
| PDSCH transmission mode   |          |           | 8                                 | 8             | 8             | 8               | 8               |
| Note 1: $P_B = 1$ .<br>Note 2: The modulation symbols of the signal under test is mapped onto antenna port 7 or 8.<br>Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.<br>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 5: The two UEs' scrambling identities $n_{SCID}$ are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases. |          |           |                                   |               |               |                 |                 |

**Table 8.3.2.1-4: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz QPSK 1/3   | R.31 TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | -1.0     | $\geq 1$    |
| 2           | 10 MHz 16QAM 1/2  | R.32 TDD          | OP.1 TDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 7.7      | $\geq 2$    |
|             | 5MHz 16QAM 1/2    | R.32-1 TDD        | OP.1 TDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 7.7      | 1           |
| 3           | 10 MHz 64QAM 3/4  | R.33 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 17.7     | $\geq 2$    |
|             | 10 MHz 64QAM 3/4  | R.33-1 TDD        | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 17.7     | 1           |

**Table 8.3.2.1-5: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 4           | 10 MHz 16QAM 1/2  | R.32 TDD (Note 1) | OP.1 TDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 21.9     | $\geq 2$    |



|   |                     |                      |          |      |         |    |      |    |
|---|---------------------|----------------------|----------|------|---------|----|------|----|
| 5   | 10 MHz<br>64QAM 1/2 | R.34 TDD<br>(Note 1) | OP.1 TDD | EPA5 | 2x2 Low | 70 | 22.0 | ≥2 |
| Note 1: The reference channel applies to both the input signal under test and the interfering signal. |                     |                      |          |      |         |    |      |    |

### 8.3.2.1A Single-layer Spatial Multiplexing (with multiple CSI-RS configurations)

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.1A-2 and 8.3.2.1A-3, with the addition of the parameters in Table 8.3.2.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.3.2.1A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter  |                    | Unit | Test 1, Test 1a         | Test 2                  | Test 3                  | Test 4 a   | Test 5                  |
|--|--------------------|------|-------------------------|-------------------------|-------------------------|--|-------------------------|
| Downlink power allocation  | $\rho_A$           | dB   | 0                       | 0                       | 0                       | 0  | 0                       |
|  | $\rho_B$           | dB   | 0 (Note 1)              | 0 (Note 1)              | 0 (Note 1)              | 0 (Note 1)   | 0 (Note 1)              |
|  | $\sigma$           | dB   | -3                      | -3                      | -3                      | -3   | -3                      |
| Cell-specific reference signals  |                    |      | Antenna ports 0,1       |                         |                         |  |                         |
| CSI reference signals  |                    |      | Antenna ports 15,...,22 | Antenna ports 15,...,18 | Antenna ports 15,...,18 | Antenna ports 15,...,22                                | Antenna ports 15,...,18 |
| Beamforming model  |                    |      | Annex B.4.1             | Annex B.4.1             | Annex B.4.1             | Annex B.4.1  | Annex B.4.1             |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | Subframes          |      | 5 / 4                   | 5 / 4                   | 5 / 4                   | 5 / 4  | 5 / 4                   |
| CSI reference signal configuration   |                    |      | 1                       | 3                       | 3                       | 1  | 3                       |
| csi-RS-ConfigZP-ApList   |                    |      | N/A                     | NA                      | NA                      | {0,1}  | NA                      |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap | Subframes / bitmap |      | 4 /<br>0010000100000000 | 4 /<br>0010000000000000 | 4 /<br>0010000000000000 | 0010000100000000<br>or<br>0001000100000000<br>(Note 7) | N/A                     |
| $N_{oc}$ at antenna port   | dBm/15kHz          |      | -98                     | -98                     | -98                     | -98  | -98                     |
| Symbols for unused PRBs  |                    |      | OCNG (Note 4)           | OCNG (Note 4)           | OCNG (Note 4)           | OCNG (Note 4)  | OCNG (Note 4)           |
| Number of allocated resource blocks (Note 2)   | PRB                |      | 50                      | 50                      | 100                     | 50   | 50                      |
| Simultaneous transmission  |                    |      | No                      | Yes (Note 3, 5)         | No                      | No   | No                      |
| PDSCH transmission mode  |                    |      | 9                       | 9                       | 9                       | 9  | 9                       |
| Number of MBSFN subframes  | Subframes          |      | 2 (Note 6)              | NA                      | NA                      | 2 (Note 7)   | NA                      |

Note 1:  $P_B = 1$ .

Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.

Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.

Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

- Note 5: The two UEs' scrambling identities  $n_{\text{SCID}}$  are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.
- Note 6: For TDD mode, 2 subframes (#4/9) are allocated as MBSFN subframes.
- Note 7: Through DCI signalling, indicating aperiodic ZP-CSI-RS in sub-frames #4 and #9 per frame, the indicated aperiodic ZP-CSI-RS is random selected from RRC-configured AP ZP CSIRS list.

**Table 8.3.2.1A-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | UE DL Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1           | 10 MHz QPSK 1/3   | R.50-1 TDD        | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | -0.73    | ≥1          | ≥6             |
| 1a          | 10 MHz QPSK 1/3   | R.50-2 TDD        | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | -0.6     | ≥1          | ≥6             |
| 3           | 20MHz 256QAM      | R. 66 TDD         | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 24.3     | 11-12       | ≥11            |
| 4           | 10 MHz QPSK 1/3   | R.50-1 TDD        | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | -0.73    | ≥1          | ≥6             |
| 5           | 10MHz 1024QAM     | R.101 TDD         | OP.1 TDD     | EPA5                  | 4x2 Low                                      | 70                                 | 29.0     | TBD         | 20, ≥ 22       |

Note 1: For UE that does not support aperiodic ZP-CSI-RS, test 1a will be run and test 1 will be skipped if the UE indicates support of *pdsch-CollisionHandling-r13*. Otherwise, test 1 will be run and test 1a will be skipped. For UE that does not support aperiodic ZP-CSI-RS, test 4 and test 4a will be skipped.

**Table 8.3.2.1A-3: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 2           | 10 MHz 64QAM 1/2  | R.44 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 22.1     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

### 8.3.2.1B Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.2.1B-2, with the addition of the parameters in Table 8.3.2.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed-loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.3.2.1B-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.3.2.1B-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model**

| parameter                 | Unit     | Cell 1 | Cell 2     |
|---------------------------|----------|--------|------------|
| Downlink power allocation | $\rho_A$ | dB     | 0          |
|                           | $\rho_B$ | dB     | 0 (Note 1) |
|                           | $\sigma$ | dB     | -3         |

|  |        |           |   |                              |
|--|--------|-----------|---|------------------------------|
| Cell-specific reference signals  |        |           | Antenna ports 0,1   | Antenna ports 0,1            |
| CSI reference signals  |        |           | Antenna ports 15,...,18   | N/A                          |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |        | Subframes | 5 / 4   | N/A                          |
| CSI reference signal configuration   |        |           | 0   | N/A                          |
| $N_{oc}$ at antenna port   |        | dBm/15kHz | -98   | N/A                          |
| DIP (Note 2)   |        | dB        | N/A   | -1.73                        |
| $BW_{\text{Channel}}$  |        | MHz       | 10  | 10                           |
| Cyclic Prefix  |        |           | Normal  | Normal                       |
| Cell Id  |        |           | 0   | 126                          |
| Number of control OFDM symbols   |        |           | 2   | 2                            |
| PDSCH transmission mode  |        |           | 9   | N/A                          |
| Beamforming model  |        |           | As specified in clause B.4.3 (Note 4, 5)  | N/A                          |
| Interference model   |        |           | N/A   | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 |           | N/A   | 70                           |
|  | Rank 2 |           | N/A   | 30                           |
| Precoder update granularity  |        | PRB       | 50  | 6                            |
| PMI delay (Note 5)   |        | ms        | 10 or 11  | N/A                          |
| Reporting interval   |        | ms        | 5   | N/A                          |
| Reporting mode   |        |           | PUCCH 1-1   | N/A                          |
| CodeBookSubsetRestriction bitmap   |        |           | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111                                | N/A                          |
| Symbols for unused PRBs  |        |           | OCNG (Note 6)   | N/A                          |
| Simultaneous transmission  |        |           | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A                          |
| Physical channel for CQI reporting   |        |           | PUSCH(Note 8)   | N/A                          |
| cqi-pmi-ConfigurationIndex   |        |           | 4   | N/A                          |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 6: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 7: All cells are time-synchronous.</p> |        |           |   |                              |

Note 8: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.

**Table 8.3.2.1B-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|--|-------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1  | R.48 TDD          | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 4x2 Low   | 70                                 | -1.0               | ≥1          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                   |              |        |                        |        |   |                                    |                    |             |
| Note 2: SINR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                 |                   |              |        |                        |        |   |                                    |                    |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                   |              |        |                        |        |   |                                    |                    |             |

### 8.3.2.1C Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.3.2.1C-2, with the addition of parameters in Table 8.3.2.1C-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.3.2.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.2.1C-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Parameter                       |           | Unit      | Cell 1                              | Cell 2      | Cell 3      |
|---------------------------------|-----------|-----------|-------------------------------------|-------------|-------------|
| Uplink downlink Configuration   |           |           | 1                                   | 1           | 1           |
| Special subframe configuration  |           |           | 4                                   | 4           | 4           |
| Downlink power allocation       | $\rho_A$  | dB        | 0                                   | -3          | -3          |
|                                 | $\rho_B$  | dB        | 0 (Note 1)                          | -3 (Note 1) | -3 (Note 1) |
|                                 | $\sigma$  | dB        | -3                                  | N/A         | N/A         |
| $N_{oc}$ at antenna port        | $N_{oc1}$ | dBm/15kHz | -98 (Note 2)                        | N/A         | N/A         |
|                                 | $N_{oc2}$ | dBm/15kHz | -98 (Note 3)                        | N/A         | N/A         |
|                                 | $N_{oc3}$ | dBm/15kHz | -93 (Note 4)                        | N/A         | N/A         |
| $\hat{E}_s/N_{oc2}$             |           | dB        | Reference Value in Table 8.3.2.1C-2 | 12          | 10          |
| BW <sub>Channel</sub>           |           | MHz       | 10                                  | 10          | 10          |
| Subframe Configuration          |           |           | Non-MBSFN                           | Non-MBSFN   | Non-MBSFN   |
| Time Offset between Cells       |           | μs        | N/A                                 | 3           | -1          |
| Frequency shift between Cells   |           | Hz        | N/A                                 | 300         | -100        |
| Cell Id                         |           |           | 0                                   | 1           | 126         |
| Cell-specific reference signals |           |           | Antenna ports 0,1                   |             |             |
| CSI reference signals           |           |           | Antenna ports 15,16                 | N/A         | N/A         |

|  |             |                       |  |                          |                          |
|--|-------------|-----------------------|--|--------------------------|--------------------------|
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |             | Subframes             | 5 / 4  | N/A                      | N/A                      |
| CSI reference signal configuration   |             |                       | 8  | N/A                      | N/A                      |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>$ZeroPowerCSI-RS$<br>bitmap   |             | Subframes /<br>bitmap | 4 /<br>00100000000000<br>00                  | N/A                      | N/A                      |
| ABS pattern (Note 5)   |             |                       | N/A  | 0000000001<br>0000000001 | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6)  |             |                       | 0000000001<br>0000000001                     | N/A                      | N/A                      |
| CSI Subframe Sets (Note7)  | $C_{CSI,0}$ |                       | 0000000001<br>0000000001                     | N/A                      | N/A                      |
|  | $C_{CSI,1}$ |                       | 1100111000<br>1100111000                     | N/A                      | N/A                      |
| Number of control OFDM symbols   |             |                       | 2  | Note 8                   | Note 8                   |
| PDSCH transmission mode  |             |                       | TM9-1layer                                   | Note 9                   | Note 9                   |
| Precoding granularity  |             |                       | Frequency domain: 1 PRG<br>Time domain: 1 ms | N/A                      | N/A                      |
| Beamforming model  |             |                       | Annex B.4.1                                  | N/A                      | N/A                      |
| Cyclic prefix  |             |                       | Normal                                       | Normal                   | Normal                   |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 5: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNB pattern as defined in Annex A.5.</p> <p>Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 11: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.</p> <p>Note 12: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 13: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> <p>Note 14: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.</p> |             |                       |  |                          |                          |

**Table 8.3.2.1C-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNB Pattern |          |          | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|----------|----------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.51 TDD          | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                           |        |        | 2x2 Low   | 70                                 | 8.5               | ≥2          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.

Note 3: SNR corresponds to  $\hat{E}_s/N_{oc2}$  of cell 1.

### 8.3.2.1D Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference

The requirements are specified in Table 8.3.2.1D-2, with the addition of the parameters in Table 8.3.2.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In 8.3.2.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1D-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM9 interference model**

| Parameter  |                          | Unit                  | Cell 1                            | Cell 2                       | Cell 3                       |
|--|--------------------------|-----------------------|-----------------------------------|------------------------------|------------------------------|
| Uplink downlink Configuration  |                          |                       | 1                                 | 1                            | 1                            |
| Special subframe configuration   |                          |                       | 4                                 | 4                            | 4                            |
| Downlink power allocation  | $\rho_A$                 | dB                    | 0                                 | 0                            | 0                            |
|  | $\rho_B$                 | dB                    | 0 (Note 1)                        | 0                            | 0                            |
|  | $\sigma$                 | dB                    | -3                                | -3                           | -3                           |
| Cell-specific reference signals  |                          |                       | Antenna ports<br>0,1              | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port   |                          | dBm/15kHz             | -98                               |                              |                              |
| $\hat{E}_s/N_{oc}$   |                          | dB                    | N/A                               | 13.91                        | 3.34                         |
| BW <sub>Channel</sub>  |                          | MHz                   | 10                                | 10                           | 10                           |
| Cyclic Prefix  |                          |                       | Normal                            | Normal                       | Normal                       |
| Cell Id  |                          |                       | 0                                 | 1                            | 6                            |
| Number of control OFDM symbols in normal subframes                       |                          |                       | 3                                 | 3                            | 3                            |
| CFI indicated in PCFICH in normal subframes                              |                          |                       | 3                                 | 3                            | 3                            |
| Number of control OFDM symbols in special subframes                      |                          |                       | 2                                 | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes                             |                          |                       | 2                                 | 2                            | 2                            |
| PDSCH transmission mode  |                          |                       | 9                                 | 9                            | 9                            |
| Interference model   |                          |                       | N/A                               | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding  |                          |                       | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals  |                          |                       | Antenna ports<br>15, 16, 17, 18   | Antenna ports<br>15, 16      | Antenna ports<br>15, 16      |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |                          | Subframes             | 10 / 4                            | 10 / 4                       | 10 / 4                       |
| CSI reference signal configuration                                       |                          |                       | 5                                 | 6                            | 7                            |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                          | Subframes /<br>bitmap | 9/<br>1000000000<br>00000         | 9/<br>01000000000<br>0000    | 9/<br>00100000000<br>00000   |
| Time offset to cell 1  |                          | us                    | N/A                               | 2                            | 3                            |
| Frequency offset to cell 1   |                          | Hz                    | N/A                               | 200                          | 300                          |
| MBSFN  |                          |                       | Not configured                    | Not configured               | Not configured               |
| NeighCellsInfo-r12<br>(Note 4)   | p-aList-r12              |                       | N/A                               | {dB-6, dB-3,<br>dB0}         | {dB-6, dB-3,<br>dB0}         |
|  | transmissionModeList-r12 |                       | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |

|         |  |
|---------|--|
| Note 1: | $P_B = 1$  |
| Note 2: | Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |
| Note 3: | CSI-RS configurations are according to [4] subclause 6.10.5.2.   |
| Note 4: | NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |

**Table 8.3.2.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM9 interference model**

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration |         |         | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------|------------------------|--------|--------|--|---------|---------|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 | Cell 1                                       | Cell 2  | Cell 3  | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1   | R.69 TDD          | OP. 1 TDD    | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 4x2 Low                                      | 2x2 Low | 2x2 Low | 85                                 | 18.0              | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |        |        |                        |        |        |  |         |         |                                    |                   |             |
| Note 2: SNR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.         |                   |              |        |        |                        |        |        |  |         |         |                                    |                   |             |

### 8.3.2.1E Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model

The requirements are specified in Table 8.3.2.1E-2, with the addition of the parameters in Table 8.3.2.1E-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by the CRS of the interfering cell, applying the CRS interference model defined in clause B.6.5. In 8.3.2.1E-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1E-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with CRS interference model**

| Parameter   | Unit      | Cell 1            | Cell 2                       | Cell 3                       |
|---|-----------|-------------------|------------------------------|------------------------------|
| Uplink downlink Configuration                       |           | 1                 | 1                            | 1                            |
| Special subframe configuration                      |           | 4                 | 4                            | 4                            |
| Downlink power allocation                           | $\rho_A$  | dB                | 0                            | 0                            |
|   | $\rho_B$  | dB                | 0 (Note 1)                   | 0                            |
|   | $\sigma$  | dB                | -3                           | -3                           |
| Cell-specific reference signals                     |           | Antenna ports 0,1 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port                            | dBm/15kHz | -98               |                              |                              |
| $\widehat{E}_s/N_{oc}$                              | dB        | N/A               | 13.91                        | 3.34                         |
| $BW_{Channel}$                                      | MHz       | 10                | 10                           | 10                           |
| Cyclic Prefix                                       |           | Normal            | Normal                       | Normal                       |
| Cell Id   |           | 0                 | 1                            | 6                            |
| Number of control OFDM symbols in normal subframes  |           | 3                 | 3                            | 3                            |
| CFI indicated in PCFICH in normal subframes         |           | 3                 | 3                            | 3                            |
| Number of control OFDM symbols in special subframes |           | 2                 | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes        |           | 2                 | 2                            | 2                            |
| PDSCH transmission mode                             |           | 8                 | N/A                          | N/A                          |
| Interference model                                  |           | N/A               | As specified in clause B.6.5 | As specified in clause B.6.5 |

|  |                          |    |                                   |                   |                   |
|--|--------------------------|----|-----------------------------------|-------------------|-------------------|
| Precoding  |                          |    | Random wideband precoding per TTI | N/A               | N/A               |
| Time offset to cell 1  |                          | us | N/A                               | 2                 | 3                 |
| Frequency offset to cell 1   |                          | Hz | N/A                               | 200               | 300               |
| MBSFN  |                          |    | Not configured                    | Not configured    | Not configured    |
| NeighCellsInfo-r12 (Note 3)  | p-aList-r12              |    | N/A                               | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
|  | transmissionModeList-r12 |    | N/A                               | {2,3,4,8,9}       | {2,3,4,8,9}       |
| Note 1: $P_B = 1$  |                          |    |                                   |                   |                   |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |    |                                   |                   |                   |
| Note 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |    |                                   |                   |                   |

**Table 8.3.2.1E-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with CRS interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.71 TDD          | OP. 1 TD D   | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 14.0              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.              |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                          |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

### 8.3.2.1F Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference

The requirements are specified in Table 8.3.2.1F-2, with the addition of the parameters in Table 8.3.2.1F-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 3 interference model defined in clause B.6.2. In 8.3.2.1F-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1F-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM3 interference model**

| Parameter                       | Unit      | Cell 1            | Cell 2            | Cell 3            |
|---------------------------------|-----------|-------------------|-------------------|-------------------|
| Uplink downlink Configuration   |           | 1                 | 1                 | 1                 |
| Special subframe configuration  |           | 4                 | 4                 | 4                 |
| Downlink power allocation       | $\rho_A$  | dB                | 0                 | -3                |
|                                 | $\rho_B$  | dB                | 0 (Note 1)        | -3                |
|                                 | $\sigma$  | dB                | -3                | 0                 |
| Cell-specific reference signals |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port        | dBm/15kHz |                   | -98               |                   |
| $\hat{E}_s/N_{oc}$              | dB        | N/A               | 3.28              | 0.74              |
| BW <sub>Channel</sub>           | MHz       | 10                | 10                | 10                |
| Cyclic Prefix                   |           | Normal            | Normal            | Normal            |



|  |                          |                                   |                              |                              |
|--|--------------------------|-----------------------------------|------------------------------|------------------------------|
| Cell Id  |                          | 0                                 | 1                            | 6                            |
| Number of control OFDM symbols in normal subframes                       |                          | 3                                 | 3                            | 3                            |
| CFI indicated in PCFICH in normal subframes                              |                          | 3                                 | Random from set {1,2,3}      | Random from set {1,2,3}      |
| Number of control OFDM symbols in special subframes                      |                          | 2                                 | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes                             |                          | 2                                 | Random from set {1,2}        | Random from set {1,2}        |
| PDSCH transmission mode  |                          | 8                                 | 3                            | 3                            |
| Interference model   |                          | N/A                               | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Precoding  |                          | Random wideband precoding per TTI | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Time offset to cell 1  | us                       | N/A                               | 2                            | 3                            |
| Frequency offset to cell 1   | Hz                       | N/A                               | 200                          | 300                          |
| MBSFN  |                          | Not configured                    | Not configured               | Not configured               |
| NeighCellsInfo-r12 (Note 4)  | p-aList-r12              | N/A                               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|  | transmissionModeList-r12 | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$  |                          |                                   |                              |                              |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |                                   |                              |                              |
| Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.   |                          |                                   |                              |                              |
| Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |                                   |                              |                              |

**Table 8.3.2.1F-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM3 interference model**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions |        |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                 | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |             |
| 1  | R.70 TDD          | OP. 1 TD D   | N/A    | N/A    | EP A5                  | EP A5  | EP A5  | 2x2 Low   | 85                                 | 11.3              | ≥1          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.              |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                          |                   |              |        |        |                        |        |        |   |                                    |                   |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. |                   |              |        |        |                        |        |        |   |                                    |                   |             |

**8.3.2.1G Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model**

The requirements are specified in Table 8.3.2.1G-2, with the addition of the parameters in Table 8.3.2.1G-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission configured with TM10 in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.6.3. The NAICS network assistance is provided when the serving cell TM10 is configured with QCL-type A and PCID based DM-RS scrambling. The neighbouring cell has transmission mode TM9 and NeighCellsInfo-r12 for interfering cell indicates presence of TM9. In 8.3.2.1G-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1G-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) Multiplexing with TM10 serving cell configuration and TM9 interference model**

| Parameter  |                          | Unit               | Cell 1                            | Cell 2                       | Cell 3                       |
|--|--------------------------|--------------------|-----------------------------------|------------------------------|------------------------------|
| Uplink downlink Configuration  |                          |                    | 1                                 | 1                            | 1                            |
| Special subframe configuration   |                          |                    | 4                                 | 4                            | 4                            |
| Downlink power allocation  | $\rho_A$                 | dB                 | 0                                 | 0                            | 0                            |
|  | $\rho_B$                 | dB                 | 0 (Note 1)                        | 0                            | 0                            |
|  | $\sigma$                 | dB                 | -3                                | -3                           | -3                           |
| Cell-specific reference signals  |                          |                    | Antenna ports 0,1                 | Antenna ports 0,1            | Antenna ports 0,1            |
| $N_{oc}$ at antenna port   |                          | dBm/15kHz          | -98                               |                              |                              |
| $\widehat{E}_s / N_{oc}$   |                          | dB                 | N/A                               | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                          | MHz                | 10                                | 10                           | 10                           |
| Cyclic Prefix  |                          |                    | Normal                            | Normal                       | Normal                       |
| Cell Id  |                          |                    | 0                                 | 1                            | 6                            |
| Number of control OFDM symbols in normal subframes                       |                          |                    | 3                                 | 3                            | 3                            |
| CFI indicated in PCFICH in normal subframes                              |                          |                    | 3                                 | 3                            | 3                            |
| Number of control OFDM symbols in special subframes                      |                          |                    | 2                                 | 2                            | 2                            |
| CFI indicated in PCFICH in special subframes                             |                          |                    | 2                                 | 2                            | 2                            |
| PDSCH transmission mode  |                          |                    | 10                                | 9                            | 9                            |
| Interference model   |                          |                    | N/A                               | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding  |                          |                    | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals  |                          |                    | Antenna ports 15, 16, 17, 18      | Antenna ports 15, 16         | Antenna ports 15, 16         |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    |                          | Subframes          | 10 / 4                            | 10 / 4                       | 10 / 4                       |
| CSI reference signal configuration                                       |                          |                    | 5                                 | 6                            | 7                            |
| Zero-power CSI-RS configuration $I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap    |                          | Subframes / bitmap | 9 / 10000000000000000000          | 9 / 01000000000000000000     | 9 / 00100000000000000000     |
| Time offset to cell 1  |                          | us                 | N/A                               | 2                            | 3                            |
| Frequency offset to cell 1   |                          | Hz                 | N/A                               | 200                          | 300                          |
| MBSFN  |                          |                    | Not configured                    | Not configured               | Not configured               |
| NeighCellsInfo-r12 (Note 4)  | p-aList-r12              |                    | N/A                               | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|  | transmissionModeList-r12 |                    | N/A                               | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: $P_B = 1$  |                          |                    |                                   |                              |                              |
| Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells. |                          |                    |                                   |                              |                              |
| Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.   |                          |                    |                                   |                              |                              |
| Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].       |                          |                    |                                   |                              |                              |

**Table 8.3.2.1G-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS Multiplexing with TM10 serving cell configuration and TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and Antenna Configuration | Reference Value | UE Category |
|-------------|-------------------|--------------|------------------------|--|-----------------|-------------|
|             |                   |              |                        |  |                 |             |

|   |          | Cell 1     | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1    | Cell 2    | Cell 3    | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) |    |
|---|----------|------------|--------|--------|--------|--------|--------|-----------|-----------|-----------|------------------------------------|-------------------|----|
| 1 | R.69 TDD | OP. 1 TD D | N/A    | N/A    | EP A5  | EP A5  | EP A5  | 4x 2 Lo w | 2x 2 Lo w | 2x 2 Lo w | 85                                 | 18.0              | ≥1 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

### 8.3.2.1H Single-layer Spatial Multiplexing (CRS assistance information is configured)

The requirements are specified in Table 8.3.2.1H-2, with the addition of parameters in Table 8.3.2.1H-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell with CRS assistance information. In Table 8.3.2.1H-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1, Cell 2 and Cell 3 is according to Annex C.3.2. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.2.1H-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports)**

| Parameter  | Unit               | Cell 1                              | Cell 2                       | Cell 3                       |
|--|--------------------|-------------------------------------|------------------------------|------------------------------|
| Uplink downlink Configuration  |                    | 1                                   | 1                            | 1                            |
| Special subframe configuration   |                    | 4                                   | 4                            | 4                            |
| Downlink power allocation  | $\rho_A$           | dB                                  | 0                            | 0                            |
|  | $\rho_B$           | dB                                  | 0 (Note 1)                   | 0 (Note 1)                   |
|  | $\sigma$           | dB                                  | -3                           | -3                           |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                                 | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$   | dB                 | Reference Value in Table 8.3.2.1H-2 | 10.45                        | 4.6                          |
| $BW_{Channel}$   | MHz                | 10                                  | 10                           | 10                           |
| Subframe Configuration   |                    | Non-MBSFN                           | Non-MBSFN                    | Non-MBSFN                    |
| Time Offset to Cell 1  | μs                 | N/A                                 | 3                            | -1                           |
| Frequency shift to Cell 1  | Hz                 | N/A                                 | 300                          | -100                         |
| Cell Id  |                    | 0                                   | 1                            | 126                          |
| Cell-specific reference signals  |                    | Antenna ports 0,1                   |                              |                              |
| CSI reference signals  |                    | Antenna ports 15,16                 | N/A                          | N/A                          |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes          | 5 / 4                               | N/A                          | N/A                          |
| CSI reference signal configuration                                       |                    | 8                                   | N/A                          | N/A                          |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap | Subframes / bitmap | 4 / 00100000000000                  | N/A                          | N/A                          |
| Number of control OFDM symbols   |                    | 2                                   | 2                            | 2                            |
| PDSCH transmission mode  |                    | TM9-1layer                          | N/A                          | N/A                          |
| Interference model   |                    | N/A                                 | As specified in clause B.5.4 | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells          | %                  | N/A                                 | 20                           | 20                           |

|   |        |   |  |        |        |
|---|--------|---|--|--------|--------|
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | % | N/A  | 80     | 80     |
|   | Rank 2 | % | N/A  | 20     | 20     |
| Precoding granularity   |        |   | Frequency domain: 1 PRG<br>Time domain: 1 ms | N/A    | N/A    |
| Beamforming model   |        |   | Annex B.4.1                                  | N/A    | N/A    |
| Cyclic prefix   |        |   | Normal                                       | Normal | Normal |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.<br>Note 5: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.<br>Note 6: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8. |        |   |  |        |        |

**Table 8.3.2.1H-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports)**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.51-1 TDD        | OP.1 TDD     | N/A    | N/A    | EVA5                           |        |        | 2x2 Low   | 70                                 | 11.9              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1. |                   |              |        |        |                                |        |        |   |                                    |                   |             |

**8.3.2.11 Single-layer Spatial Multiplexing (With Enhanced DMRS table configured)**

For single-layer transmission on antenna port 7, 8, 11 or 13 upon detection of a PDCCH with DCI format 2C, the requirement is specified in Table 8.3.2.1I-2, with the addition of the parameters in Table 8.3.2.1I-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of the test is to verify rank-1 performance on antenna port 11 with a simultaneous transmission on the antenna port 7, 8 or 13 with DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.3.2.1I-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| parameter  | Unit      | Test 1                  |            |
|--|-----------|-------------------------|------------|
| Downlink power allocation  | $\rho_A$  | dB                      | 0          |
|  | $\rho_B$  | dB                      | 0 (Note 1) |
|  | $\sigma$  | dB                      | -3         |
| Beamforming model  |           | Annex B.4.1A            |            |
| Cell-specific reference signals  |           | Antenna ports 0,1       |            |
| CSI reference signals  |           | Antenna ports 15,...,18 |            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes | 5 / 4                   |            |
| CSI reference signal configuration                                       |           | 3                       |            |

|  |                       |                         |
|--|-----------------------|-------------------------|
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}}$ /<br>ZeroPowerCSI-RS bitmap   | Subframes /<br>bitmap | 4 /<br>0010000000000000 |
| $N_{oc}$ at antenna port   | dBm/15kHz             | -98                     |
| Symbols for unused PRBs  |                       | OCNG (Note 4)           |
| Number of allocated resource blocks (Note 2)   | PRB                   | 50                      |
| Simultaneous transmission  |                       | Yes (Note 3, 5)         |
| dmrs-Enhancements-r13  |                       | Enable                  |
| PDSCH transmission mode  |                       | 9                       |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 11.</p> <p>Note 3: Modulation symbols of an interference signal are random mapped onto one antenna port among antenna port 7, 8 and 13. The update granularity for randomized mapping antenna port is 1 PRG in frequency domain and 1ms in time domain.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 5: The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =4.</p> |                       |                         |

**Table 8.3.2.1J-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM 1/2 | R.44 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 22.1     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

### 8.3.2.1J Single-layer Spatial Multiplexing (with assistance information for simultaneous transmission interfering PDSCH)

For single-layer transmission on a DMRS antenna port upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.1J-1, with the addition of the parameters in Table 8.3.2.1J-2 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one DMRS antenna port with a simultaneous transmission on one of the other DMRS antenna port with or without DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.3.2.1J-1: Test Parameters for Minimum Performance Requirement - Single-layer Spatial Multiplexing with assistance information for simultaneous transmission interfering PDSCH (FRC)**

| parameter                       |          | Unit | Test 1                  | Test 2 | Test 3 |
|---------------------------------|----------|------|-------------------------|--------|--------|
| Downlink power allocation       | $\rho_A$ | dB   | 0                       |        |        |
|                                 | $\rho_B$ | dB   | 0 (Note 1)              |        |        |
|                                 | $\sigma$ | dB   | -3                      |        |        |
| Beamforming model               |          |      | Annex B.4.1             |        |        |
| Cell-specific reference signals |          |      | Antenna ports 0,1       |        |        |
| CSI reference signals           |          |      | Antenna ports 15,...,18 |        |        |

|  |                       |                         |        |        |
|--|-----------------------|-------------------------|--------|--------|
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   | Subframes             | 5 / 4                   |        |        |
| CSI reference signal configuration   |                       | 3                       |        |        |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} /$<br>ZeroPowerCSI-RS bitmap   | Subframes /<br>bitmap | 4 /<br>0010000000000000 |        |        |
| $N_{oc}$ at antenna port   | dBm/15kHz             | -98                     |        |        |
| Symbols for unused PRBs  |                       | OCNG (Note 2)           |        |        |
| Number of allocated resource blocks  | PRB                   | 50                      |        |        |
| Simultaneous transmission  |                       | Yes                     |        |        |
| PDSCH transmission mode  |                       | 9                       |        |        |
| Number of MBSFN subframes  | Subframes             | NA                      |        |        |
| dmrs-Enhancements-r13  |                       | Disabled                | Enable | Enable |
| k-max-r14 (Note 5)   |                       | 1                       | 1      | 3      |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 3: In Test 1, the modulation symbols of the signal under test are mapped randomly onto antenna port 7 or 8. Modulation symbols of an interference signal are mapped randomly onto one of the remaining DMRS antenna port. The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =2.</p> <p>Note 4: In Test 2 and Test 3, the modulation symbols of the signal under test are mapped randomly onto antenna port 7, 8, 11 or 13. Modulation symbols of an interference signal are mapped randomly onto one of the remaining DMRS antenna port. The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =4.</p> <p>Note 5: k-max-r14 is described in subclause 6.3.2 of [7].</p> <p>Note 6: The update granularity for randomized mapping antenna port is 50 PRGs in frequency domain and 1ms in time domain.</p> |                       |                         |        |        |

**Table 8.3.2.1J-2: Minimum performance for Minimum Performance Requirement - Single-layer Spatial Multiplexing with assistance information for simultaneous transmission interfering PDSCH (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.cc TDD          | OP.1 TDD     | EPA5                  | 4x2 Low                                      | 70                                 | 15.2     | ≥2          |
| 2           |           |                   |              |                       |  |                                    |          |             |
| 3           |           |                   |              |                       |  |                                    |          |             |

### 8.3.2.2 Dual-Layer Spatial Multiplexing

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2B, the requirements are specified in Table 8.3.2.2-2, with the addition of the parameters in Table 8.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation.

**Table 8.3.2.2-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer)**

| Parameter                 |          | Unit | Test 1     | Test 2     |
|---------------------------|----------|------|------------|------------|
| Downlink power allocation | $\rho_A$ | dB   | 0          | 0          |
|                           | $\rho_B$ | dB   | 0 (Note 1) | 0 (Note 1) |
|                           | $\sigma$ | dB   | -3         | -3         |

|  |           |                                   |               |
|--|-----------|-----------------------------------|---------------|
| Cell-specific reference symbols  |           | Antenna port 0 and antenna port 1 |               |
| Beamforming model  |           | Annex B.4.2                       |               |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98                               | -98           |
| Symbols for unused PRBs  |           | OCNG (Note 2)                     | OCNG (Note 2) |
| Number of allocated resource blocks  | PRB       | 50                                | 50            |
| PDSCH transmission mode  |           | 8                                 | 8             |
| Note 1: $P_B = 1$ .<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |                                   |               |

Table 8.3.2.2-2: Minimum performance for CDM-multiplexed DM RS (FRC)

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz QPSK 1/3   | R.31 TDD          | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 4.5      | $\geq 2$    |
| 2           | 10 MHz 16QAM 1/2  | R.32 TDD          | OP.1 TDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 21.7     | $\geq 2$    |

### 8.3.2.2A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing

The requirements are specified in Table 8.3.2.2A-2, with the addition of the parameters in Table 8.3.2.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation upon antenna ports 7 and 8.

Table 8.3.2.2A-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer)

| Parameter                           | Unit      | Test 1                            |
|-------------------------------------|-----------|-----------------------------------|
| Downlink power allocation           | $\rho_A$  | dB                                |
|                                     | $\rho_B$  | dB                                |
|                                     | $\sigma$  | dB                                |
| Cell-specific reference symbols     |           | Antenna port 0 and antenna port 1 |
| Beamforming model                   |           | Annex B.4.2                       |
| $N_{oc}$ at antenna port            | dBm/15kHz | -98                               |
| Symbols for unused PRBs             |           | OCNG (Note 2)                     |
| Number of allocated resource blocks | PRB       | 50                                |
| PDSCH transmission mode             |           | 8                                 |

Note 1:  $P_B = 1$ .  
 Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.2.2A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC)**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.32 TDD          | OP.1 TDD     | EPA5                  | 2x2 Medium                                   | 70                                 | 17.0     | ≥2          |

### 8.3.2.3 Dual-Layer Spatial Multiplexing (with multiple CSI-RS configurations)

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.3-2, with the addition of the parameters in Table 8.3.2.3-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.3.2.3-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| Parameter  |          | Unit               | Test 1                             |                       |
|--|----------|--------------------|------------------------------------|-----------------------|
|  |          |                    | Cell 1                             | Cell 2                |
| Downlink power allocation  | $\rho_A$ | dB                 | 0                                  | 0                     |
|  | $\rho_B$ | dB                 | 0 (Note 1)                         | 0                     |
|  | $\sigma$ | dB                 | -3                                 | -3                    |
|  | PDSCH_RA | dB                 | 4                                  | NA                    |
|  | PDSCH_RB | dB                 | 4                                  | NA                    |
| Cell-specific reference signals  |          |                    | Antenna ports 0 and 1              | Antenna ports 0 and 1 |
| Cell ID  |          |                    | 0                                  | 126                   |
| CSI reference signals  |          |                    | Antenna ports 15,16                | NA                    |
| Beamforming model  |          |                    | Annex B.4.2                        | NA                    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |          | Subframes          | 5 / 4                              | NA                    |
| CSI reference signal configuration                                       |          |                    | 8                                  | NA                    |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |          | Subframes / bitmap | 4 / 0010000000000000               | NA                    |
| $N_{oc}$ at antenna port   |          | dBm/15kHz          | -98                                | -98                   |
| $\widehat{E}_s / N_{oc}$   |          |                    | Reference Value in Table 8.3.2.3-2 | Test specific, 7.25dB |
| Symbols for unused PRBs  |          |                    | OCNG (Note 2)                      | NA                    |
| Number of allocated resource blocks (Note 2)                             |          | PRB                | 50                                 | NA                    |



|  |  |    |         |
|--|--|----|---------|
| Simultaneous transmission  |  | No | NA      |
| PDSCH transmission mode  |  | 9  | Blanked |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |  |    |         |

**Table 8.3.2.3-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number   | Bandwidth and MCS   | Reference Channel | OCNB Pattern |        | Propagation Condition |        | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|---------------------|-------------------|--------------|--------|-----------------------|--------|--|------------------------------------|----------|-------------|
|   |                     |                   | Cell 1       | Cell 2 | Cell 1                | Cell 2 |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz<br>16QAM 1/2 | R.51 TDD          | OP.1 TDD     | N/A    | ETU5                  | ETU5   | 2x2 Low                                      | 70                                 | 14.8     | $\geq 2$    |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. |                     |                   |              |        |                       |        |  |                                    |          |             |

### 8.3.2.4 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

#### 8.3.2.4.1 Minimum requirement with Same Cell ID (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.2.4.1-3, with the additional parameters in Table 8.3.2.4.1-1 and Table 8.3.2.4.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6], configured according to Table 8.3.2.4.1-2. In Tables 8.3.2.4.1-1 and 8.3.2.4.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter   | Unit      | TP 1              | TP 2                   |
|---|-----------|-------------------|------------------------|
| Downlink power allocation   | $\rho_A$  | dB                | 0                      |
|   | $\rho_B$  | dB                | 0 (Note 1)             |
|   | $\sigma$  | dB                | -3                     |
| Cell-specific reference signals   |           | Antenna ports 0,1 | (Note 2)               |
| CSI-RS 0 antenna ports  |           | NA                | Port {15,16}           |
| $qcl\text{-}CSI\text{-}RS\text{-}ConfigNZPId\text{-}r11$ ,<br>CSI-RS 0 periodicity and subframe offset $T_{CSI\text{-}RS} / \Delta_{CSI\text{-}RS}$ | Subframes | NA                | 5/4                    |
| $qcl\text{-}CSI\text{-}RS\text{-}ConfigNZPId\text{-}r11$ ,<br>CSI-RS 0 configuration  |           | NA                | 8                      |
| $csi\text{-}RS\text{-}ConfigZPId\text{-}r11$ , Zero-power CSI-RS 0 configuration  |           | NA                | 4/<br>0000010000000000 |

|   |           |                                      |                                      |
|---|-----------|--------------------------------------|--------------------------------------|
| $I_{CSI-RS} /$<br>ZeroPower CSI-RS bitmap   |           |                                      |                                      |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98                                  | -98                                  |
| $\hat{E}_s / N_{oc}$  | dB        | Reference point in Table 8.3.2.4.1-3 | Reference point in Table 8.3.2.4.1-3 |
| BW <sub>Channel</sub>   | MHz       | 10                                   | 10                                   |
| Cyclic Prefix   |           | Normal                               | Normal                               |
| Cell Id   |           | 0                                    | 0                                    |
| Number of control OFDM symbols  |           | 2                                    | 2                                    |
| PDSCH transmission mode   |           | Blanked                              | 10                                   |
| Number of allocated PRB   | PRB       | NA                                   | 50                                   |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'   |           | Type B, '00'                         |                                      |
| Time offset between TPs   | μs        | NA                                   | Reference point in Table 8.3.2.4.1-3 |
| Frequency error between TPs   | Hz        | NA                                   | 0                                    |
| Beamforming model   |           | NA                                   | Port 7 as specified in clause B.4.1  |
| Symbols for unused PRBs   |           | NA                                   | OCNG (Note 3)                        |
| Note 1: $P_B = 1$<br>Note 2: REs for antenna ports 0 and 1 have zero transmission power.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |                                      |                                      |

**Table 8.3.2.4.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | Blanked                                     | PDSCH |

**Table 8.3.2.4.1-3: Minimum performance for quasi co-location type B: same Cell ID**

| Test Number   | Reference Channel | OGCN pattern |          | Time offset between TPs (μs) | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|----------|------------------------------|--------------------------------|------|---|------------------------------------|-------------------|-------------|
|   |                   | TP 1         | TP 2     |                              | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.52 TDD          | NA           | OP.1 TDD | 2                            | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 12                | ≥2          |
| 2   | R.52 TDD          | NA           | OP.1 TDD | -0.5                         | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 12.4              | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 2 as defined in clause 8.1.1. |                   |              |          |                              |                                |      |   |                                    |                   |             |

### 8.3.2.4.2 Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources)

The requirements are specified in Table 8.3.2.4.2-3, with the additional parameters in Tables 8.3.2.4.2-1 and 8.3.2.4.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6]. In Tables 8.3.2.4.2-1 and 8.3.2.4.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.2.4.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter  | Unit              | TP 1                                 | TP 2                                 |
|--|-------------------|--------------------------------------|--------------------------------------|
| Downlink power allocation  | $\rho_A$          | dB                                   | 0                                    |
|  | $\rho_B$          | dB                                   | 0 (Note 1)                           |
|  | $\sigma$          | dB                                   | -3                                   |
| Beamforming model  |                   | As specified in clause B.4.1         | As specified in clause B.4.1         |
| Cell-specific reference signals  |                   | Antenna ports 0,1                    | (Note 2)                             |
| CSI reference signals 0  |                   | Antenna ports {15,16}                | N/A                                  |
| CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$        | Subframes         | 5 / 4                                | N/A                                  |
| CSI reference signal 0 configuration   |                   | 0                                    | N/A                                  |
| CSI reference signals 1  |                   | N/A                                  | Antenna ports {15,16}                |
| CSI-RS 1 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$        | Subframes         | N/A                                  | 5 / 4                                |
| CSI reference signal 1 configuration   |                   | N/A                                  | 8                                    |
| Zero-power CSI-RS 0 configuration<br>$I_{\text{CSI-RS}} /$<br><i>ZeroPower CSI-RS</i> bitmap | Subframes /bitmap | 4/<br>0010000000000000               | N/A                                  |
| Zero-power CSI-RS1 configuration<br>$I_{\text{CSI-RS}} /$<br><i>ZeroPower CSI-RS</i> bitmaps | Subframes /bitmap | N/A                                  | 4/<br>0000010000000000               |
| $\hat{E}_s / N_{oc}$   | dB                | Reference Value in Table 8.3.2.4.2-3 | Reference Value in Table 8.3.2.4.2-3 |
| $N_{oc}$ at antenna port   | dBm/15kHz         | -98                                  | -98                                  |
| $BW_{\text{Channel}}$  | MHz               | 10                                   | 10                                   |
| Cyclic Prefix  |                   | Normal                               | Normal                               |
| Cell Id  |                   | 0                                    | 0                                    |
| Number of control OFDM symbols   |                   | 2                                    | 2                                    |
| Timing offset between TPs  |                   | N/A                                  | Reference Value in Table 8.3.2.4.2-3 |
| Frequency offset between TPs   | Hz                | N/A                                  | 0                                    |

|  |     |               |               |
|--|-----|---------------|---------------|
| Number of allocated resource blocks  | PRB | 50            | 50            |
| PDSCH transmission mode  |     | 10            | 10            |
| Probability of occurrence of PDSCH transmission(Note 3)  | %   | 30            | 70            |
| Symbols for unused PRBs  |     | OCNG (Note 4) | OCNG (Note 4) |
| Note 1: $P_B = 1$<br>Note 2: REs for antenna ports 0 and 1 have zero transmission power.<br>Note 3: PDSCH transmission from TPs shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.<br>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |     |               |               |

**Table 8.3.2.4.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |         |
|---------------|--|-------------------------|---|---------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2    |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blanked |
| PQI set 1     | CSI-RS 1                                 | ZP CSI-RS 1             | Blanked                                     | PDSCH   |

**Table 8.3.2.4.2-3: Performance Requirements for timing offset compensation with DPS transmission**

| Test Number | Timing offset(us) | Reference Channel | OCNG Pattern |          | Propagation Conditions |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|-------------------|--------------|----------|------------------------|------|---|------------------------------------|-------------------|-------------|
|             |                   |                   | TP 1         | TP 2     | TP 1                   | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | 2                 | R.53 TDD          | OP.1 TDD     | OP.1 TDD | EPA5                   | EPA5 | 2x2 Low   | 70                                 | 12.3              | ≥2          |
| 2           | -0.5              | R.53 TDD          | OP.1 TDD     | OP.1 TDD | EPA5                   | EPA5 | 2x2 Low   | 70                                 | 12.5              | ≥2          |

Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.  
 Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.  
 Note 3: SNR corresponds to  $\hat{E}_s / N_{oc}$  of both TP 1 and TP 2 as defined in clause 8.1.1.

**8.3.2.4.3 Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)**

The requirements are specified in Table 8.3.2.4.3-2, with the additional parameters in Table 8.3.2.4.3-1. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where the two transmission points have different Cell ID and colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference between two transmission points, channel parameters estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.3.2.4.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.3-1: Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter | Unit | TP 1 | TP 2 |
|-----------|------|------|------|
|-----------|------|------|------|

|   |          |                   |  |                                      |
|---|----------|-------------------|--|--------------------------------------|
| Downlink power allocation   | $\rho_A$ | dB                | 0  | 0                                    |
|   | $\rho_B$ | dB                | 0 (Note 1)                                 | 0                                    |
|   | $\sigma$ | dB                | -3   | -3                                   |
| Beamforming model   |          |                   | N/A  | As specified in clause B.4.2         |
| Cell-specific reference signals   |          |                   | Antenna ports 0,1                          | Antenna ports 0,1                    |
| CSI reference signals 0   |          |                   | N/A  | Antenna ports {15,16}                |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   |          | Subframes         | N/A  | 5 / 4                                |
| CSI reference signal 0 configuration  |          |                   | N/A  | 0                                    |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$  |          | Subframes /bitmap | N/A  | 4/<br>0010000000000000               |
| $\hat{E}_s / N_{oc}$  |          | dB                | Reference point in Table 8.3.2.4.3-2 + 4dB | Reference Value in Table 8.3.2.4.3-2 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz         | -98  | -98                                  |
| $BW_{Channel}$  |          | MHz               | 10   | 10                                   |
| Cyclic Prefix   |          |                   | Normal                                     | Normal                               |
| Cell Id   |          |                   | 0  | 126                                  |
| Number of control OFDM symbols  |          |                   | 1  | 2                                    |
| Timing offset between TPs   |          | us                | N/A  | 0                                    |
| Frequency offset between TPs  |          | Hz                | N/A  | 200                                  |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'   |          |                   | Type B, '00'                               |                                      |
| PDSCH transmission mode   |          |                   | Blank                                      | 10                                   |
| Number of allocated resource block  |          |                   | N/A  | 50                                   |
| Symbols for unused PRBs   |          |                   | N/A  | OCNG(Note2)                          |
| Note 1: $P_B = 1$   |          |                   |  |                                      |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                   |  |                                      |

**Table 8.3.2.4.3-2: Performance Requirements for quasi co-location type B with different Cell ID and Colliding CRS**

| Test Number  | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|----------|--------------------------------|------|---|------------------------------------|-------------------|-------------|
|  |                   | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.54 TDD          | N/A          | OP.1 TDD | EPA5                           | ETU5 | 2x2 Low   | 70                                 | 14.7              | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.              |                   |              |          |                                |      |   |                                    |                   |             |
| Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2. |                   |              |          |                                |      |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 2 as defined in clause 8.1.1.              |                   |              |          |                                |      |   |                                    |                   |             |

#### 8.3.2.4.4 Minimum requirement with Different Cell ID and non-Colliding CRS (with single NZP CSI-RS resource and CRS assistance information is configured)

The requirements are specified in Table 8.3.2.4.4-3, with the additional parameters in Table 8.3.2.4.4-1 and Table 8.3.2.4.4-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario where three transmission points have different Cell ID and non-colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference and time difference between two transmission points, channel parameters estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. Further, the test verifies that the UE, configured with the CRS assistance information [7], can mitigate interference from CRS for demodulation. The CRS assistance information [7] includes TP 3. In Table 8.3.2.4.4-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, transmission point 2 (TP 2) transmits PDSCH with different Cell ID, and Transmission point 3 (TP 3) is the aggressor transmission point. The downlink physical channel setup for TP 1 is according to Table C.3.4-1, for TP 2 is according to Table C.3.4-2, and for TP 3 is according to Annex C.3.2.

**Table 8.3.2.4.4-1: Test Parameters for quasi co-location type B with different Cell ID and non-colliding CRS when CRS assistance information is configured**

| parameter  |          | Unit              | TP 1              | TP 2                                 | TP 3              |
|--|----------|-------------------|-------------------|--------------------------------------|-------------------|
| Downlink power allocation  | $\rho_A$ | dB                | 0                 | 0                                    | 0                 |
|  | $\rho_B$ | dB                | 0 (Note 1)        | 0                                    | 0                 |
|  | $\sigma$ | dB                | -3                | -3                                   | -3                |
| Beamforming model  |          |                   | N/A               | Port 7 as specified in clause B.4.1  | N/A               |
| Cell-specific reference signals  |          |                   | Antenna ports 0,1 | Antenna ports 0,1                    | Antenna ports 0,1 |
| CSI reference signals 0  |          |                   | N/A               | Antenna ports {15,16}                | N/A               |
| CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          | Subframes         | N/A               | 5 / 4                                | N/A               |
| CSI reference signal 0 configuration   |          |                   | N/A               | 0                                    | N/A               |
| Zero-power CSI-RS 0 configuration $I_{\text{CSI-RS}} / \text{ZeroPower CSI-RS bitmap}$ |          | Subframes /bitmap | N/A               | 4/<br>0010000000000000               | N/A               |
| $\widehat{E}_s / N_{oc}$   |          | dB                | 10.45             | Reference Value in Table 8.3.2.4.4-3 | 8.45              |
| $N_{oc}$ at antenna port   |          | dBm/15kHz         | -98               | -98                                  | N/A               |
| $BW_{\text{Channel}}$  |          | MHz               | 10                | 10                                   | 10                |
| Cyclic Prefix  |          |                   | Normal            | Normal                               | Normal            |
| Cell Id  |          |                   | 0                 | 1                                    | 128               |
| Number of control OFDM symbols   |          |                   | 1                 | 2                                    | 2                 |
| Timing offset to TP 1  |          | us                | N/A               | -0.5                                 | 3                 |
| Frequency offset to TP 1   |          | Hz                | N/A               | 200                                  | -100              |
| $qcl\text{-Operation}$ , ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’            |          |                   | Type B, ‘00’      |                                      | N/A               |
| PDSCH transmission mode  |          |                   | Blank             | 10                                   | 9                 |
| Number of allocated resource block   |          |                   | N/A               | 50                                   | N/A               |
| Symbols for unused PRBs  |          |                   | N/A               | OCNG(Note2)                          | N/A               |

|  |        |   |     |     |                              |
|--|--------|---|-----|-----|------------------------------|
| Interference model   |        |   | N/A | N/A | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells  |        | % | N/A | N/A | 20                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | % | N/A | N/A | 80                           |
|  | Rank 2 | % | N/A | N/A | 20                           |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |        |   |     |     |                              |

**Table 8.3.2.4.4-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         |  | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|--|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration |  | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             |  | Blanked                                     | PDSCH |

**Table 8.3.2.4.4-3: Performance Requirements for quasi co-location type B with different Cell ID and non-Colliding CRS when CRS assistance information is configured**

| Test Number  | Reference Channel | OCNG Pattern |          |     | Propagation Conditions (Note1) |      |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|----------|-----|--------------------------------|------|------|---|------------------------------------|-------------------|-------------|
|  |                   | TP 1         | TP 2     | TP3 | TP 1                           | TP 2 | TP3  |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.52-1 TDD        | N/A          | OP.1 TDD | N/A | EVA5                           | EVA5 | EVA5 | 2x2 Low   | 70                                 | 11.1              | ≥2          |
| Note 1: The propagation conditions for TP.1, TP.2 and TP.3 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP.1, TP.2 and TP.3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP.2 as defined in clause 8.1.1. |                   |              |          |     |                                |      |      |   |                                    |                   |             |

**8.3.2.4.5 Minimum requirements with different Cell ID and non-colliding CRS (with multiple NZP CSI-RS resources and CRS assistance information is configured)**

The requirements are specified in Table 8.3.2.4.5-3, with the additional parameters in Tables 8.3.2.4.5-1 and 8.3.2.4.5-2. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where three transmission point have the different Cell ID and non-colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference and timing difference between two transmission points, channel parameters estimation and rate matching according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ (PQI) signalling defined in [6]. Further, the test verifies that the UE, configured with the CRS assistance information [7], can mitigate interference from CRS for demodulation. The CRS assistance information [7] includes TP 3. In Tables 8.3.2.4.5-1 and 8.3.2.4.5-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, Transmission point 2 (TP 2) has different Cell ID as TP 1, and Transmission point 3 (TP3) is the aggressor transmission point. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between TP 1 and TP 2 with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.2.4.5-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1, for TP 2 is according to Table C.3.4-2, and for TP 3 is according to Annex C.3.2

Table 8.3.2.4.5-1: Test Parameters for DPS transmission with CRS assistance information

| parameter   |          | Unit              | TP 1                                 | TP 2                                 | TP 3                         |
|---|----------|-------------------|--------------------------------------|--------------------------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB                | 0                                    | 0                                    | 0                            |
|   | $\rho_B$ | dB                | 0 (Note 1)                           | 0                                    | 0                            |
|   | $\sigma$ | dB                | -3                                   | -3                                   | -3                           |
| Beamforming model   |          |                   | As specified in clause B.4.1         | As specified in clause B.4.1         | N/A                          |
| Cell-specific reference signals   |          |                   | Antenna ports 0,1                    | Antenna ports 0,1                    | Antenna ports 0,1            |
| CSI reference signals 0   |          |                   | Antenna ports {15,16}                | N/A                                  | N/A                          |
| CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes         | 5 / 4                                | N/A                                  | N/A                          |
| CSI reference signal 0 configuration  |          |                   | 0                                    | N/A                                  | N/A                          |
| CSI reference signals 1   |          |                   | N/A                                  | Antenna ports {15,16}                | N/A                          |
| CSI-RS 1 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes         | N/A                                  | 5 / 4                                | N/A                          |
| CSI reference signal 1 configuration  |          |                   | N/A                                  | 8                                    | N/A                          |
| Zero-power CSI-RS 0 configuration<br>$I_{\text{CSI-RS}} /$<br>ZeroPower CSI-RS bitmap |          | Subframes /bitmap | 4/<br>0010000000000000               | N/A                                  | N/A                          |
| Zero-power CSI-RS1 configuration<br>$I_{\text{CSI-RS}} /$<br>ZeroPower CSI-RS bitmaps |          | Subframes /bitmap | N/A                                  | 4/<br>0000010000000000               | N/A                          |
| $\widehat{E}_s / N_{oc}$ (Note 2)   |          | dB                | Reference Value in Table 8.3.2.4.5-3 | Reference Value in Table 8.3.2.4.5-3 | 8.45                         |
| $N_{oc}$ at antenna port  |          | dBm/15kHz         | -98                                  | -98                                  | N/A                          |
| BW <sub>Channel</sub>   |          | MHz               | 10                                   | 10                                   | 10                           |
| Cyclic Prefix   |          |                   | Normal                               | Normal                               | Normal                       |
| Cell Id   |          |                   | 0                                    | 1                                    | 128                          |
| Number of control OFDM symbols  |          |                   | 2                                    | 2                                    | 2                            |
| Timing offset to TP 1   |          |                   | N/A                                  | -0.5                                 | 3                            |
| Frequency offset to TP 1  |          | Hz                | N/A                                  | 200                                  | -100                         |
| Number of allocated resource blocks   |          | PRB               | 50                                   | 50                                   | N/A                          |
| PDSCH transmission mode   |          |                   | 10                                   | 10                                   | 9                            |
| Probability of occurrence of PDSCH transmission(Note 3)                               |          | %                 | 30                                   | 70                                   | N/A                          |
| Symbols for unused PRBs   |          |                   | OCNG (Note 4)                        | OCNG (Note 4)                        | N/A                          |
| Interference model  |          |                   | N/A                                  | N/A                                  | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells                       |          | %                 | N/A                                  | N/A                                  | 20                           |
| Probability of occurrence of transmission rank in interfering cells                   | Rank 1   | %                 | N/A                                  | N/A                                  | 80                           |
|   | Rank 2   | %                 | N/A                                  | N/A                                  | 20                           |



|         |   |
|---------|---|
| Note 1: | $P_B = 1$   |
| Note 2: | $\widehat{E}_s / N_{oc}$ of TP 1 is set the same as that of TP 2.   |
| Note 3: | PDSCH transmission from TP 1 and TP 2 shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.   |
| Note 4: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |

**Table 8.3.2.4.5-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |         |
|---------------|--|-------------------------|---|---------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2    |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blanked |
| PQI set 1     | CSI-RS 1                                 | ZP CSI-RS 1             | Blanked                                     | PDSCH   |

**Table 8.3.2.4.5-3: Performance Requirements for DPS transmission with CRS assistance information**

| Test Number | Reference Channel | OCNG Pattern |          |     | Propagation Conditions (Note1) |      |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|----------|-----|--------------------------------|------|------|---|------------------------------------|-------------------|-------------|
|             |                   | TP 1         | TP 2     | TP3 | TP 1                           | TP 2 | TP3  |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.52-1 TDD        | OP.1 TDD     | OP.1 TDD | N/A | EVA5                           | EVA5 | EVA5 | 2x2 Low   | 70                                 | 11.2              | ≥2          |

Note 1: The propagation conditions for TP.1, TP.2 and TP.3 are statistically independent.  
 Note 2: Correlation matrix and antenna configuration parameters apply for each of TP.1, TP.2 and TP.3.  
 Note 3: SNR corresponds to  $\widehat{E}_s / N_{oc}$  of both TP.1 and TP.2 as defined in clause 8.1.1.

**8.3.2.4.6 Minimum requirements for QCL Type C and 2 Layers Spatial Multiplexing**

The requirements are specified in Table 8.3.2.4.6-3, with the additional parameters in Table 8.3.2.4.6-1 and Table 8.3.2.4.6-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.3.2.4.6-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP 1 and TP 2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

**Table 8.3.2.4.6-1: Test Parameters**

| Parameter                      | Unit     | TP 1                        | TP 2                        |
|--------------------------------|----------|-----------------------------|-----------------------------|
| Uplink downlink configuration  |          | 1                           | 1                           |
| Special subframe configuration |          | 4                           | 4                           |
| Downlink power allocation      | $\rho_A$ | dB                          | 0                           |
|                                | $\rho_B$ | dB                          | 0 (Note 1)                  |
|                                | $\sigma$ | dB                          | -3                          |
| Beamforming model              |          | Random beamforming (rank 1) | Random beamforming (rank 1) |

|   |                  |                        |                        |
|---|------------------|------------------------|------------------------|
| Cell-specific reference signals   |                  | Antenna ports 0,1      | Antenna ports 0,1      |
| CSI reference signals 0   |                  | Antenna ports {15,16}  | N/A                    |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   | Subframes        | 5 / 4                  |                        |
| CSI reference signal 0 configuration  |                  | 0                      |                        |
| CSI reference signals 1   |                  | N/A                    | Antenna ports {15,16}  |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   | Subframes        |                        | 5 / 4                  |
| CSI reference signal 1 configuration  |                  |                        | 8                      |
| Zero-power CSI-RS 0 configuration $l_{CSI-RS} / \text{ZeroPower CSI-RS bitmap}$   | Subframes/bitmap | 4/<br>0010000000000000 | N/A                    |
| Zero-power CSI-RS1 configuration $l_{CSI-RS} / \text{ZeroPower CSI-RS bitmap}$  | Subframes/bitmap | N/A                    | 4/<br>0010000000000000 |
| $\hat{E}_s / N_{oc}$  | dB               | SNR1                   | SNR2 = SNR1            |
| $N_{oc}$ at antenna port  | dBm/15kHz        | -98                    | -98                    |
| $BW_{Channel}$  | MHz              | 10                     | 10                     |
| Cyclic Prefix   |                  | Normal                 | Normal                 |
| Cell ID   |                  | 0                      | 126                    |
| Number of control OFDM symbols / PDSCH start  |                  | 2                      | 2                      |
| Timing offset relative to TP 1  | us               | N/A                    | 2                      |
| Frequency offset relative to TP 1   | Hz               | N/A                    | 200                    |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'   |                  | Type C, '00'           |                        |
| PDSCH transmission mode (Note 2)  |                  | 10                     | 10                     |
| Number of allocated resource block  |                  | 50                     | 50                     |
| Note 1: $P_B = 1$<br>Note 2: PDSCH transmission is done from both TPs (CW1 is transmitted from TP 1 and CW2 is transmitted from TP 2) |                  |                        |                        |

**Table 8.3.2.4.6-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |  |                         |  | DL transmission hypothesis for each PQI Set |       |
|---------------|--|--|-------------------------|--|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) |  | ZP CSI-RS configuration |  | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     |  | ZP CSI-RS 0             |  | PDSCH                                       | PDSCH |

**Table 8.3.2.4.6-3: Performance Requirements**

| Test Number | Reference Channel |           | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|-------------|-------------------|-----------|--------------|----------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|             | TP 1              | TP 2      | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1           | R.97 TDD          | [R.97 TDD | OP.1T DD     | OP.1T DD | EPA5                           | EPA5 | 2x2 Low   | 70                                 | 10.7               | ≥2          |

- Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.
- Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.
- Note 3: SNR corresponds to  $\widehat{E}_s/N_{oc}$  of TP 1 and TP 2 as defined in clause 8.1.1.

### 8.3.2.5 Performance Requirements for semiOpenLoop transmission

The requirements are specified in Table 8.3.2.5-2, with the addition of the parameters in Table 8.3.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank one and rank two performances for full RB allocation upon antenna ports 7 and 8 with higher layer parameter *semiOpenLoop* is configured.

**Table 8.3.2.5-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) when high layer parameter *semiOpenLoop* is configured**

| parameter   | Unit                  | Test 1                 | Test 2                    |
|---|-----------------------|------------------------|---------------------------|
| Downlink power allocation   | $\rho_A$              | dB                     | 0                         |
|   | $\rho_B$              | dB                     | 0 (Note 1)                |
|   | $\sigma$              | dB                     | -3                        |
| Cell-specific reference signals   |                       | Antenna ports 0 and 1  | Antenna ports 0 and 1     |
| CSI reference signals   |                       | Antenna ports 15,16    | Antenna ports 15,16,17,18 |
| Beamforming model   |                       | B.4.3 (Note 3)         | B.4.3 (Note 3)            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  | Subframes             | 5 / 4                  | 5 / 4                     |
| CSI reference signal configuration  |                       | 0                      | 0                         |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$<br>bitmap   | Subframes /<br>bitmap | 4/<br>0010000000000000 | 4/<br>0010000000000000    |
| $N_{oc}$ at antenna port  | dBm/15kHz             | -98                    | -98                       |
| Symbols for unused PRBs   |                       | OCNG (Note 2)          | OCNG (Note 2)             |
| Number of allocated resource blocks (Note 2)  | PRB                   | 50                     | 50                        |
| Simultaneous transmission   |                       | No                     | No                        |
| PDSCH transmission mode   |                       | 9                      | 9                         |
| Rank Number of PDSCH  |                       | 1                      | 2                         |
| <i>semiOpenLoop</i>   |                       | True                   | True                      |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 3: For 2 antenna ports {15, 16}, the precoding matrix corresponding to codebook index 0 from Table 6.3.4.2.3-1 in [4] with <math>v = 2</math>;<br/>For 4 antenna ports { 15,16,17,18 }, the precoding matrix random selected from Table 6.3.4.2.3-2 in [4] with <math>v = 2</math></p> |                       |                        |                           |

**Table 8.3.2.5-2: Minimum Performance Requirements for CDM-multiplexed DM RS (FRC) when high layer parameter *semiOpenLoop* is configured**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz QPSK 1/3   | R.76A TDD         | OP.1 TDD     | EVA 70Hz              | 2x2 Medium                                   | 70                                 | 0.9      | ≥1          |
| 2           | 10 MHz 16QAM 1/2  | R.61A TDD         | OP.1 TDD     | EVA 70Hz              | 4x2 Low                                      | 70                                 | 15.6     | ≥2          |

### 8.3.3 LAA

#### 8.3.3.1 Dual-Layer Spatial Multiplexing with DM-RS

##### 8.3.3.1.1 FDD PCell (FDD single carrier)

The parameters specified in Table 8.3.3.1.1-1 are valid for FDD CC and LAA SCell(s) unless otherwise stated. And the additional parameters specified in Table 8.3.3.1.1-2 are valid for LAA SCell(s).

**Table 8.3.3.1.1-1: Common Test Parameters**

| Parameter                                    | Unit   | Value  |
|--|--|--|
| Cyclic prefix                                |  | Normal   |
| Cell ID                                      |  | 0  |
| Inter-TTI Distance                           |  | 1  |
| Number of HARQ processes                     | Processes  | 8  |
| Maximum number of HARQ transmission (Note 1) |  | 4  |
| Redundancy version coding sequence           |  | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM |
| Precoder update granularity                  |  | Frequency domain: 1 PRG<br>Time domain: 1 ms                   |
| Note 1:                                      | For retransmission in partial subframes, the TB size should be kept the same as the initial transmission regardless of the initial transmission is performed in full subframes or partial subframes. |  |
| Note 2:                                      | Void.  |  |

**Table 8.3.3.1.1-2: Additional Test Parameters for LAA SCell(s)**

| Parameter                            | Unit     | Value   |
|--------------------------------------|----------|---|
| DMTC Periodicity                     | ms       | 80  |
| dmtc-PeriodOffset-r12<br>ms80-r12    |          | 0   |
| Discovery signal occasion duration   | subframe | 1   |
| Power allocation of discovery signal |          | Same as power allocation of CRS within a transmission burst in the test |

For CA with LAA SCell(s), the requirements for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C are specified in Table 8.3.3.1.1-7, with the addition of the parameters in Table 8.3.3.1.1-3, Table 8.3.3.1.1-4 and Table 8.3.3.1.1-5. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation for CA with LAA SCell(s).

Table 8.3.3.1.1-3: Test Parameters for Large Delay CDD (FRC) for PCell

| Parameter  | Unit      | Value     |             |
|--|-----------|-----------|-------------|
| Downlink power allocation                            | $\rho_A$  | dB        | -3          |
|  | $\rho_B$  | dB        | -3 (NOTE 1) |
|  | $\sigma$  | dB        | 0           |
| $N_{oc}$ at antenna port                             | dBm/15kHz | -98       |             |
| PDSCH transmission mode                              |           | TM3       |             |
| Subframe configuration                               |           | Non-MBSFN |             |
| NOTE 1: $P_B = 1$ .                                  |           |           |             |
| NOTE 2: PUCCH format 3 is used to feedback ACK/NACK. |           |           |             |
| NOTE 3: Void.  |           |           |             |

Table 8.3.3.1.1-4: Test Parameters for CDM-multiplexed DM RS (dual layer) for CA with LAA SCell(s)

| Parameter  | Unit               | Test 1                |            |
|--|--------------------|-----------------------|------------|
| Downlink power allocation  | $\rho_A$           | dB                    | 0          |
|  | $\rho_B$           | dB                    | 0 (Note 1) |
|  | $\sigma$           | dB                    | -3         |
| Cell-specific reference signals  |                    | Antenna ports 0 and 1 |            |
| CSI reference signals  |                    | Antenna ports 15,16   |            |
| DMRS ports (dual layer transmission)                                     |                    | port 7 and port 8     |            |
| Beamforming model  |                    | Annex B.4.2           |            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes          | 5/2                   |            |
| CSI reference signal configuration                                       |                    | 8                     |            |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap | Subframes / bitmap | 3 / 0010000000000000  |            |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                   |            |
| Symbols for unused PRBs  |                    | OCNG (Note 2)         |            |
| PDSCH transmission mode  |                    | 9                     |            |
| DL Burst transmission pattern for LAA SCell                              |                    | As specified in B.8   |            |
| The number of subframes set ( $S_1$ ) in a burst                         |                    | {1,3,5,8}             |            |
| Occupied OFDM symbols set in the last subframe                           |                    | {6,9,12,14}           |            |
| Random variable $p$ defined in B.8                                       |                    | 0.5                   |            |
| timing error relative of LAA SCell to PCell                              | $\mu s$            | 0                     |            |
| Frequency offset of the $i$ -th LAA SCell relative to PCell              | Hz                 | 200                   |            |
| Note 1: $P_B = 1$  |                    |                       |            |

Note 2: These physical resource blocks are assigned only within burst transmissions to a LAA UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.3.1.1-5: Single carrier performance Large Delay CDD (FRC) for PCell for multiple CA configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                            |          |
|-----------|-------------------|--------------|-----------------------|--|--|----------|
|           |                   |              |                       |  | Fraction of Nominal maximum throughput (%) | SNR (dB) |
| 1.4MHz    | R.11-5 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 13.6     |
| 3MHz      | R.11-6 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 12.3     |
| 5MHz      | R.11-2 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 12.3     |
| 10MHz     | R.11 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 12.9     |
| 15MHz     | R.11-7 FDD        | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 12.8     |
| 20MHz     | R.30 FDD          | OP.1 FDD     | EVA70                 | 2x2 Low                                | 70   | 12.9     |

**Table 8.3.3.1.1-6: Single carrier performance for CDM-multiplexed DM RS (dual layer) for LAA SCell for multiple CA configurations**

| Bandwidth | Sub-test (Note 2) | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                             |          |
|-----------|-------------------|-------------------|--------------|-----------------------|--|---|----------|
|           |                   |                   |              |                       |  | Fraction of maximum throughput (%) (Note 1) | SNR (dB) |
| 20MHz     | 1                 | R.2 FS3           | OP.1 FS3     | EVA5                  | 2x2 Low                                | 70  | 14.1     |
|           | 2                 | R.2 FS3           | OP.1 FS3     | EVA5                  | 2x2 Low                                | 70  | 14       |
|           | 3                 | R.2 FS3           | OP.1 FS3     | EVA5                  | 2x2 Low                                | 70  | 14.2     |
|           | 4                 | R.2 FS3           | OP.1 FS3     | EVA5                  | 2x2 Low                                | 70  | 14.2     |

Note 1: Fraction of nominal maximum throughput is calculated based on random occasions of LAA PDSCH transmission.

Note 2: An UE is required to fulfill only one test of Sub-test 1-4 depending on UE capabilities of endingDwPTS and secondSlotStartingPosition. For an UE not supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 1; For an UE not supporting endingDwPTS but supporting secondSlotStartingPosition, it is required to fulfill Sub-test 2; For an UE supporting endingDwPTS but not supporting secondSlotStartingPosition, it is required to fulfill Sub-test 3; and For an UE supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 4.

**Table 8.3.3.1.1-7: Minimum performance (FRC) based on single carrier performance for CA with one LAA SCell**

| Test number | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|----------------------------|-------|-----------|---|-------------|
|             | Total                      | PCell | LAA SCell |   |             |
| 1           | 2x20                       | 20    | 20        | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 2           | 15+20                      | 15    | 20        | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 3           | 10+20                      | 10    | 20        | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.

Note 2: Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell.

**Table 8.3.3.1.1-8: Minimum performance (FRC) based on single carrier performance for CA with two LAA SCells**

| Test number | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2) | UE Category |
|-------------|----------------------------|-------|-----------|--|-------------|
|             | Total                      | PCell | LAA SCell |  |             |

|         |  |    |      |   |    |
|---------|--|----|------|---|----|
| 1       | 3x20   | 20 | 2x20 | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5 |
| 2       | 15+2x20  | 15 | 2x20 | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5 |
| 3       | 10+2x20  | 10 | 2x20 | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5 |
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |    |      |   |    |
| Note 2: | Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell. |    |      |   |    |

**Table 8.3.3.1.1-9: Minimum performance (FRC) based on single carrier performance for CA with three LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 4x20   | 20    | 3x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 2           | 15+3x20  | 15    | 3x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 3           | 10+3x20  | 10    | 3x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.1-10: Minimum performance (FRC) based on single carrier performance for CA with four LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 5x20   | 20    | 4x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 2           | 15+4x20  | 15    | 4x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 3           | 10+4x20  | 10    | 4x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.1-11: Minimum performance (FRC) based on single carrier performance for CA with five LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 6x20   | 20    | 5x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 2           | 15+5x20  | 15    | 5x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 3           | 10+5x20  | 10    | 5x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.1-12: Minimum performance (FRC) based on single carrier performance for CA with six LAA SCells**

| Test number | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|----------------------------|-------|-----------|---|-------------|
|             | Total                      | PCell | LAA SCell |   |             |
| 1           | 7x20                       | 20    | 6x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 2           | 15+6x20                    | 15    | 6x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |
| 3           | 10+6x20                    | 10    | 6x20      | As defined in Table 8.3.3.1.1-5 and Table 8.3.3.1.1-6 | ≥5          |

|         |  |
|---------|--|
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |
| Note 2: | Apply a per-CC requirement defined in Table 8.3.3.1.1-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.1-6 for LAA SCell. |

### 8.3.3.1.2 TDD Pcell (TDD single carrier)

The parameters specified in Table 8.3.3.1.2-1 are valid for TDD CC and LAA SCell(s) unless otherwise stated. And the additional parameters specified in Table 8.3.3.1.2-2 are valid for LAA SCell(s).

**Table 8.3.3.1.2-1: Common Test Parameters**

| Parameter                                    | Unit   | Value  |
|--|--|--|
| Uplink downlink configuration (Note 1)       |  | 1  |
| Special subframe configuration (Note 2)      |  | 4  |
| Cyclic prefix                                |  | Normal   |
| Cell ID                                      |  | 0  |
| Inter-TTI Distance                           |  | 1  |
| Number of HARQ processes                     | Processes  | 7  |
| Maximum number of HARQ transmission (Note 3) |  | 4  |
| Redundancy version coding sequence           |  | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM           |
| Precoder update granularity                  |  | Frequency domain: 1 PRG for<br>Transmission modes 9<br>Time domain: 1 ms |
| ACK/NACK feedback mode                       |  | Multiplexing   |
| Note 1:                                      | As specified in Table 4.2-2 in TS 36.211 [4]   |  |
| Note 2:                                      | As specified in Table 4.2-1 in TS 36.211 [4]   |  |
| Note 3:                                      | For retransmission in partial subframes, the TB size should be kept the same as the initial transmission regardless of the initial transmission is performed in full subframes or partial subframes. |  |

**Table 8.3.3.1.2-2: Additional Test Parameters for LAA SCell(s)**

| Parameter                            | Unit     | Value   |
|--------------------------------------|----------|---|
| DMTC Periodicity                     | ms       | 80  |
| dmtc-PeriodOffset-r12<br>ms80-r12    |          | 0   |
| Discovery signal occasion duration   | subframe | 1   |
| Power allocation of discovery signal |          | Same as power allocation of CRS within a transmission burst in the test |

For CA with LAA SCell(s), the requirements for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C are specified in Table 8.3.3.1.2-7, with the addition of the parameters in Table 8.3.3.1.2-3, Table 8.3.3.1.2-4 and Table 8.3.3.1.2-5. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation for CA with LAA SCell(s).

**Table 8.3.3.1.2-3: Test Parameters for Large Delay CDD (FRC) for PCell**

| Parameter                 | Unit     | Value       |
|---------------------------|----------|-------------|
| Downlink power allocation | $\rho_A$ | dB          |
|                           | $\rho_B$ | dB          |
|                           |          | -3 (NOTE 1) |



|  |          |           |           |
|--|----------|-----------|-----------|
|  | $\sigma$ | dB        | 0         |
| $N_{oc}$ at antenna port                             |          | dBm/15kHz | -98       |
| PDSCH transmission mode                              |          |           | TM3       |
| Subframe configuration                               |          |           | Non-MBSFN |
| NOTE 1: $P_B = 1$ .                                  |          |           |           |
| NOTE 2: PUCCH format 3 is used to feedback ACK/NACK. |          |           |           |
| NOTE 3: Void.  |          |           |           |

**Table 8.3.3.1.2-4: Test Parameters for CDM-multiplexed DM RS (dual layer) for LAA SCell(s)**

| Parameter   |          | Unit               | Test 1                 |
|---|----------|--------------------|------------------------|
| Downlink power allocation   | $\rho_A$ | dB                 | 0                      |
|   | $\rho_B$ | dB                 | 0 (Note 1)             |
|   | $\sigma$ | dB                 | -3                     |
| Cell-specific reference signals   |          |                    | Antenna ports 0 and 1  |
| CSI reference signals   |          |                    | Antenna ports 15,16    |
| DMRS ports (dual layer transmission)  |          |                    | port 7 and port 8      |
| Beamforming model   |          |                    | Annex B.4.2            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  |          | Subframes          | 5/4                    |
| CSI reference signal configuration  |          |                    | 8                      |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>ZeroPowerCSI-RS<br>bitmap  |          | Subframes / bitmap | 4/<br>0010000000000000 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz          | -98                    |
| Symbols for unused PRBs   |          |                    | OCNG (Note 2)          |
| PDSCH transmission mode   |          |                    | 9                      |
| DL Burst transmission pattern for LAA SCell   |          |                    | As specified in B.8    |
| The number of subframes set ( $S_1$ ) in a burst  |          |                    | {1,3,5,8}              |
| Occupied OFDM symbols set in the last subframe  |          |                    | {6,9,12,14}            |
| Random variable $p$ defined in B.8  |          |                    | 0.5                    |
| Timing error relative of LAA SCell to PCell   |          | $\mu$ s            | 0                      |
| Frequency offset of the $i$ -th LAA SCell relative to PCell   |          | Hz                 | 200                    |
| Note 1: $P_B = 1$   |          |                    |                        |
| Note 2: These physical resource blocks are assigned only within burst transmissions to a LAA UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                    |                        |

**Table 8.3.3.1.2-5: Single carrier performance Large Delay CDD (FRC) for PCell for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                    |          |
|------------|-------------------|--------------|------------------------|--|------------------------------------|----------|
|            |                   |              |                        |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz     | R.11-5 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 13.2     |
| 3MHz       | R.11-6 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 12.8     |
| 5MHz       | R.11-7 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 12.6     |
| 10MHz      | R.11-8 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 12.8     |
| 15MHz      | R.11-9 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 12.9     |
| 20MHz      | R.30-1 TDD        | OP.1 TDD     | EVA70                  | 2x2 Low                                | 70                                 | 13.0     |

**Table 8.3.3.1.2-6: Single carrier performance for CDM-multiplexed DM RS (dual layer) for LAA SCell(s) for multiple CA configurations**

| Band-width  | Sub-test (Note2) | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value                                      |          |
|---|------------------|-------------------|--------------|------------------------|--|--|----------|
|   |                  |                   |              |                        |  | Fraction of Norminal maximum throughput (%) (Note 1) | SNR (dB) |
| 20MHz   | 1                | R.2 FS3           | OP.1 FS3     | EVA5                   | 2x2 Low                                | 70   | 14.1     |
|   | 2                | R.2 FS3           | OP.1 FS3     | EVA5                   | 2x2 Low                                | 70   | 14       |
|   | 3                | R.2 FS3           | OP.1 FS3     | EVA5                   | 2x2 Low                                | 70   | 14.2     |
|   | 4                | R.2 FS3           | OP.1 FS3     | EVA5                   | 2x2 Low                                | 70   | 14.2     |
| Note 1: Fraction of nominal maximum throughput is calculated based on random occasions of LAA PDSCH transmission.<br>Note 2: An UE is required to fulfill only one test of Sub-test 1-4 depending on UE capabilities of endingDwPTS and secondSlotStartingPosition. For an UE not supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 1; For an UE not supporting endingDwPTS but supporting secondSlotStartingPosition, it is required to fulfill Sub-test 2; For an UE supporting endingDwPTS but not supporting secondSlotStartingPosition, it is required to fulfill Sub-test 3; and For an UE supporting both endingDwPTS and secondSlotStartingPosition, it is required to fulfill Sub-test 4. |                  |                   |              |                        |  |  |          |

**Table 8.3.3.1.2-7: Minimum performance (FRC) based on single carrier performance for CA with one LAA SCell**

| Test number  | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|--|----------------------------|-------|-----------|---|-------------|
|  | Total                      | PCell | LAA SCell |   |             |
| 1  | 2x20                       | 20    | 20        | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.<br>Note 2: Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |                            |       |           |   |             |

**Table 8.3.3.1.2-8: Minimum performance (FRC) based on single carrier performance for CA with two LAA SCells**

| Test number  | Aggregated Bandwidth (MHz) |       |           | Minimum performance requirement (Note 2)              | UE Category |
|--|----------------------------|-------|-----------|---|-------------|
|  | Total                      | PCell | LAA SCell |   |             |
| 1  | 3x20                       | 20    | 2x20      | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.<br>Note 2: Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |                            |       |           |   |             |

**Table 8.3.3.1.2-9: Minimum performance (FRC) based on single carrier performance for CA with three LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 4x20   | 20    | 3x20      | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.2-10: Minimum performance (FRC) based on single carrier performance for CA with four LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 5x20   | 20    | 4x20      | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.2-11: Minimum performance (FRC) based on single carrier performance for CA with five LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 6x20   | 20    | 5x20      | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |       |           |   |             |

**Table 8.3.3.1.2-12: Minimum performance (FRC) based on single carrier performance for CA with six LAA SCells**

| Test number | Aggregated Bandwidth (MHz)   |       |           | Minimum performance requirement (Note 2)              | UE Category |
|-------------|--|-------|-----------|---|-------------|
|             | Total  | PCell | LAA SCell |   |             |
| 1           | 7x20   | 20    | 6x20      | As defined in Table 8.3.3.1.2-5 and Table 8.3.3.1.2-6 | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3D.                     |       |           |   |             |
| Note 2:     | Apply a per-CC requirement defined in Table 8.3.3.1.2-5 for PCell and apply a per-CC requirement defined in Table 8.3.3.1.2-6 for LAA SCell. |       |           |   |             |

## 8.4 Demodulation of PDCCH/PCFICH

The receiver characteristics of the PDCCH/PCFICH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). PDCCH and PCFICH are tested jointly, i.e. a miss detection of PCFICH implies a miss detection of PDCCH.

### 8.4.1 FDD

The parameters specified in Table 8.4.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.4.1-1: Test Parameters for PDCCH/PCFICH**

| Parameter  |  | Unit      | Single antenna port | Transmit diversity |
|--|--|-----------|---------------------|--------------------|
| Number of PDCCH symbols                          |  | symbols   | 2                   | 2                  |
| PHICH Ng (Note 1)                                |  |           | 1                   | 1                  |
| PHICH duration                                   |  |           | Normal              | Normal             |
| Unused RE-s and PRB-s                            |  |           | OCNG                | OCNG               |
| Cell ID  |  |           | 0                   | 0                  |
| Downlink power allocation                        | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | 0                   | -3                 |
|  | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port                         |  | dBm/15kHz | -98                 | -98                |
| Cyclic prefix                                    |  |           | Normal              | Normal             |
| Note 1: According to Clause 6.9 in TS 36.211 [4] |  |           |                     |                    |

### 8.4.1.1 Single-antenna port performance

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.1.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 FDD          | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 1               | -1.7     |

### 8.4.1.2 Transmit diversity performance

#### 8.4.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.1.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 FDD          | OP.1 FDD     | EVA70                 | 2 x 2 Low                                    | 1               | -0.6     |

#### 8.4.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.1.2.2-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |

|   |       |       |          |          |      |              |   |     |
|---|-------|-------|----------|----------|------|--------------|---|-----|
| 1 | 5 MHz | 2 CCE | R.17 FDD | OP.1 FDD | EPA5 | 4 x 2 Medium | 1 | 6.3 |
|---|-------|-------|----------|----------|------|--------------|---|-----|

#### 8.4.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters for non-MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.4.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

For the parameters for MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-4. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.4.1.2.3-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter                                     |  | Unit      | Cell 1   | Cell 2   |
|---|--|-----------|--|--|
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3   | -3   |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3   | -3   |
| $N_{oc}$ at antenna port                      | $N_{oc1}$                                    | dBm/15kHz | -100.5 (Note 1)  | N/A  |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)   | N/A  |
|   | $N_{oc3}$                                    | dBm/15kHz | -95.3 (Note 3)   | N/A  |
| $\widehat{E}_s/N_{oc2}$                       |  | dB        | Reference Value in Table 8.4.1.2.3-2                     | 1.5  |
| BW <sub>Channel</sub>                         |  | MHz       | 10   | 10   |
| Subframe Configuration                        |  |           | Non-MBSFN  | Non-MBSFN  |
| Time Offset between Cells                     |  | μs        | 2.5 (synchronous cells)                                  |  |
| Cell Id                                       |  |           | 0  | 1  |
| ABS pattern (Note 4)                          |  |           | N/A  | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  |
| CSI Subframe Sets (Note 6)                    | $C_{CSI,0}$                                  |           | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 | N/A  |
|   | $C_{CSI,1}$                                  |           | 11111011<br>11111011<br>11111011<br>10111011<br>11111011 | N/A  |
| Number of control OFDM symbols                |  |           | 3  | 3  |
| PHICH Ng (Note 9)                             |  |           | 1  | N/A  |
| PHICH duration                                |  |           | Extended   | N/A  |
| Unused RE-s and PRB-s                         |  |           | OCNG   | OCNG   |
| Cyclic prefix                                 |  |           | Normal   | Normal   |

|         |   |
|---------|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.   |
| Note 2: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.   |
| Note 3: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS  |
| Note 4: | ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7];  |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7];  |
| Note 7: | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.   |
| Note 8: | SIB-1 will not be transmitted in Cell2 in the test.   |
| Note 9: | According to Clause 6.9 in TS 36.211 [4]  |

**Table 8.4.1.2.3-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number   | Aggregation Level | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value |                   |
|---|-------------------|-------------------|--------------|----------|---------------------------------|--------|--|-----------------|-------------------|
|   |                   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Pm-dsg (%)      | SNR (dB) (Note 2) |
| 1   | 8 CCE             | R15-1 FDD         | OP.1 FDD     | OP.1 FDD | EVA5                            | EVA5   | 2x2 Low                                      | 1               | -3.9              |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |                   |              |          |                                 |        |  |                 |                   |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.                               |                   |                   |              |          |                                 |        |  |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.   |                   |                   |              |          |                                 |        |  |                 |                   |

**Table 8.4.1.2.3-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter                                     |  | Unit      | Cell 1   | Cell 2   |
|---|--|-----------|--|--|
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3   | -3   |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3   | -3   |
| $N_{oc}$ at antenna port                      | $N_{oc1}$                                    | dBm/15kHz | -100.5 (Note 1)                                    | N/A  |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                                       | N/A  |
|   | $N_{oc3}$                                    | dBm/15kHz | -95.3 (Note 3)                                     | N/A  |
| $\hat{E}_s/N_{oc2}$                           |  | dB        | Reference Value in Table 8.4.1.2.3-4               | 1.5  |
| BW <sub>Channel</sub>                         |  | MHz       | 10   | 10   |
| Subframe Configuration                        |  |           | Non-MBSFN  | MBSFN  |
| Time Offset between Cells                     |  | μs        | 2.5 (synchronous cells)                            |  |
| Cell Id                                       |  |           | 0  | 126  |
| ABS pattern (Note 4)                          |  |           | N/A  | 000100000<br>010000010<br>0000001000<br>0000000000 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 000100000<br>010000010<br>0000001000<br>0000000000 | N/A  |

|  |                    |  |  |                                      |
|--|--------------------|--|--|--------------------------------------|
| CSI Subframe Sets<br>(Note 6)  | C <sub>CSI,0</sub> |  | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A                                  |
|  | C <sub>CSI,1</sub> |  | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A                                  |
| MBSFN Subframe Allocation (Note 9)   |                    |  | N/A  | 001000<br>100001<br>000100<br>000000 |
| Number of control OFDM symbols   |                    |  | 3  | 3                                    |
| PHICH Ng (Note 11)   |                    |  | 1  | N/A                                  |
| PHICH duration   |                    |  | extended   | N/A                                  |
| Unused RE-s and PRB-s  |                    |  | OCNG   | OCNG                                 |
| Cyclic prefix  |                    |  | Normal   | Normal                               |
| <p>Note 1: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 2: This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 4: ABS pattern as defined in [9]. The 4<sup>th</sup>, 12<sup>th</sup>, 19<sup>th</sup> and 27<sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].</p> <p>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>Note 8: SIB-1 will not be transmitted in Cell2 in this test.</p> <p>Note 9: MBSFN Subframe Allocation as defined in [7], four frames with 24 bits is chosen for MBSFN subframe allocation.</p> <p>Note 10: The maximum number of uplink HARQ transmission is ≤ 2 so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test.</p> <p>Note 11: According to Clause 6.9 in TS 36.211 [4]</p> |                    |  |  |                                      |

**Table 8.4.1.2.3-4: Minimum performance PDCCH/PCHICH – MBSFN ABS**

| Test Number  | Aggregation Level | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value |                   |
|--|-------------------|-------------------|--------------|----------|---------------------------------|--------|--|-----------------|-------------------|
|  |                   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Pm-dsg (%)      | SNR (dB) (Note 2) |
| 1  | 8 CCE             | R15-1 FDD         | OP.1 FDD     | OP.1 FDD | EVA5                            | EVA5   | 2x2 Low                                      | 1               | -4.2              |
| <p>Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.</p> <p>Note 2: SNR corresponds to <math>\hat{E}_s / N_{oc2}</math> of cell 1.</p> <p>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.</p> |                   |                   |              |          |                                 |        |  |                 |                   |

**8.4.1.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

For the parameters for non-MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.4-2.

For the parameters for MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.4-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.4-4.

In Tables 8.4.1.2.4-1 and 8.4.1.2.4-3, Cell 1 is the serving cell, and Cell 2 and Cell3are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.4.1.2.4-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter                                     |  | Unit      | Cell 1   | Cell 2   | Cell 3   |
|---|--|-----------|--|--|--|
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3   | -3   | -3   |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3   | -3   | -3   |
| $N_{oc}$ at antenna port                      | $N_{oc1}$                                    | dBm/15kHz | -98(Note 1)  | N/A  | N/A  |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)   | N/A  | N/A  |
|   | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)   | N/A  | N/A  |
| $\hat{E}_s / N_{oc2}$                         |  | dB        | Reference Value in Table 8.4.1.2.4-2                     | 5  | 3  |
| BW <sub>Channel</sub>                         |  | MHz       | 10   | 10   | 10   |
| Subframe Configuration                        |  |           | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  |
| Time Offset between Cells                     |  | μs        | N/A  | 3  | -1   |
| Frequency shift between Cells                 |  | Hz        | N/A  | 300  | -100   |
| Cell Id                                       |  |           | 0  | 126  | 1  |
| ABS pattern (Note 4)                          |  |           | N/A  | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  | N/A  |
| CSI Subframe Sets (Note 6)                    | C <sub>CSI,0</sub>                           |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  | N/A  |
|   | C <sub>CSI,1</sub>                           |           | 11111011<br>11111011<br>11111011<br>11111011<br>11111011 | N/A  | N/A  |
| Number of control OFDM symbols                |  |           | 2  | Note 7   | Note 7   |
| PHICH Ng (Note 10)                            |  |           | 1  | N/A  | N/A  |
| PHICH duration                                |  |           | Normal   | N/A  | N/A  |
| Unused RE-s and PRB-s                         |  |           | OCNG   | OCNG   | OCNG   |
| Cyclic prefix                                 |  |           | Normal   | Normal   | Normal   |



|          |   |
|----------|---|
| Note 1:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.   |
| Note 2:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.   |
| Note 3:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS  |
| Note 4:  | ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell. |
| Note 5:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7];  |
| Note 6:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7];  |
| Note 7:  | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.  |
| Note 8:  | The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.   |
| Note 9:  | SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.  |
| Note 10: | According to Clause 6.9 in TS 36.211 [4]  |

**Table 8.4.1.2.4-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value |                   |
|-------------|-------------------|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|             |                   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 3) |
| 1           | 8 CCE             | R.15-2 FDD        | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EVA5                            | EVA5   | EVA5   | 2x2 Low   | 1               | -2.2              |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
 Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.  
 Note 3: SNR corresponds to  $\hat{E}_s / N_{oc2}$  of cell 1.

**Table 8.4.1.2.4-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter                     |  | Unit      | Cell 1                               | Cell 2   | Cell 3   |
|-------------------------------|--|-----------|--------------------------------------|--|--|
| Downlink power allocation     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3                                   | -3   | -3   |
|                               | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                                   | -3   | -3   |
| $N_{oc}$ at antenna port      | $N_{oc1}$                                    | dBm/15kHz | -98 (Note 1)                         | N/A  | N/A  |
|                               | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                         | N/A  | N/A  |
|                               | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)                         | N/A  | N/A  |
| $\hat{E}_s / N_{oc2}$         |  | dB        | Reference Value in Table 8.4.1.2.4-4 | 5  | 3  |
| $BW_{Channel}$                |  | MHz       | 10                                   | 10   | 10   |
| Subframe Configuration        |  |           | Non-MBSFN                            | MBSFN  | MBSFN  |
| Time Offset between Cells     |  | μs        | N/A                                  | 3  | -1   |
| Frequency shift between Cells |  | Hz        | N/A                                  | 300  | -100   |
| Cell Id                       |  |           | 0                                    | 126  | 1  |
| ABS pattern (Note 4)          |  |           | N/A                                  | 0001000000<br>0100000010<br>0000001000<br>0000000000 | 0001000000<br>0100000010<br>0000001000<br>0000000000 |

|  |                    |  |  |                                      |                                      |
|--|--------------------|--|--|--------------------------------------|--------------------------------------|
| RLM/RRM Measurement Subframe Pattern (Note 5)  |                    |  | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A                                  | N/A                                  |
| CSI Subframe Sets (Note 6)   | C <sub>CSI,0</sub> |  | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A                                  | N/A                                  |
|  | C <sub>CSI,1</sub> |  | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A                                  | N/A                                  |
| MBSFN Subframe Allocation (Note 7)   |                    |  | N/A  | 001000<br>100001<br>000100<br>000000 | 001000<br>100001<br>000100<br>000000 |
| Number of control OFDM symbols   |                    |  | 2  | Note 8                               | Note 8                               |
| PHICH Ng (Note 12)   |                    |  | 1  | N/A                                  | N/A                                  |
| PHICH duration   |                    |  | Normal   | N/A                                  | N/A                                  |
| Unused RE-s and PRB-s  |                    |  | OCNG   | OCNG                                 | OCNG                                 |
| Cyclic prefix  |                    |  | Normal   | Normal                               | Normal                               |
| <p>Note 1: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 2: This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 4: ABS pattern as defined in [9]. The 4<sup>th</sup>, 12<sup>th</sup>, 19<sup>th</sup> and 27<sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].</p> <p>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 7: MBSFN Subframe Allocation as defined in [7], four frames with 24 bits are chosen for MBSFN subframe allocation.</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: The maximum number of uplink HARQ transmission is ≤ 2 so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test.</p> <p>Note 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</p> <p>Note 12: According to Clause 6.9 in TS 36.211 [4]</p> |                    |  |  |                                      |                                      |

**Table 8.4.1.2.4-4: Minimum performance PDCCH/PCFICH – MBSFN ABS**

| Test Number   | Aggregation Level | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value |                   |
|---|-------------------|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 3) |
| 1   | 8 CCE             | R.15-2 FDD        | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EVA5                            | EVA5   | EVA5   | 2x2 Low   | 1               | -2.0              |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s / N_{oc2}</math> of cell 1.</p> |                   |                   |              |          |          |                                 |        |        |   |                 |                   |

**8.4.1.2.5 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port under Asynchronous Network**

The test purpose is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with interference model defined in clause B.5.2. For the parameters specified in Table 8.4.1-1 and Table 8.4.1.2.5-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.5-2 for the Enhanced Downlink Control

Channel Performance Requirement Type A. In Table 8.4.1.2.5-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is not provided.

**Table 8.4.1.2.5-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|---|--|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>PHICH_RA<br>PDSCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>PDSCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
| Cell-specific reference signals   |  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port  |  | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$  |  | dB        | N/A                  | 13.91                        | 3.34                         |
| $BW_{Channel}$  |  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix   |  |           | Normal               | Normal                       | Normal                       |
| Cell Id   |  |           | 0                    | 1                            | 6                            |
| Subframe Configuration  |  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols                                  |  |           | 3                    | 3                            | 3                            |
| PHICH Ng (Note 1)   |  |           | 1                    | N/A                          | N/A                          |
| PHICH duration  |  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM  |  |           | 4                    | 3                            | 3                            |
| Interference model  |  |           | N/A                  | As specified in clause B.5.2 | As specified in clause B.5.2 |
| Probability of occurrence of PDSCH transmission rank in interfering cells | Rank 1   | %         | N/A                  | 80                           | 80                           |
|   | Rank 2   | %         | N/A                  | 20                           | 20                           |
| Unused RE-s and PRB-s   |  |           | OCNG                 | OCNG                         | OCNG                         |
| Time offset relative to Cell 1  |  | ms        | N/A                  | 0.33                         | 0.67                         |
| Frequency shift relative to Cell 1  |  | Hz        | N/A                  | 0                            | 0                            |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                         |  |           |                      |                              |                              |

**Table 8.4.1.2.5-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 2 CCE             | R.16-1 FDD        | OP.1 FDD              | EVA70                           | EVA70  | EVA70  | 2x2 Low   | 1               | 16.5              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

**8.4.1.2.6 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer**

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and

applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.1-1 and Table 8.4.1.2.6-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.6-2. In Table 8.4.1.2.6-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.4.1.2.6-1: Test Parameters for PDCCH/PCFICH**

| Parameter  |                                  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                   | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                   | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                                  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal               | Normal                       | Normal                       |
| Cell Id  |                                  |           | 0                    | 1                            | 6                            |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 3                    | 3                            | 3                            |
| CFI indicated in PCFICH  |                                  |           | 3                    | 3                            | 3                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                  | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                    | N/A                          | N/A                          |
| Interference model   |                                  |           | NA                   | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | $\mu$ s   | N/A                  | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                              |                              |

**Table 8.4.1.2.6-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 4 CCE             | R.16-2 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 12.8              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

**8.4.1.2.7 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Port with Colliding CRS Dominant Interferer**

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type B for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.1-1 and Table 8.4.1.2.7-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.7-2. In Table 8.4.1.2.7-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink

physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.4.1.2.7-1: Test Parameters for PDCCH/PCFICH**

| Parameter  |                                  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                   | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                   | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                                  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal               | Normal                       | Normal                       |
| Cell Id  |                                  |           | 0                    | 6                            | 1                            |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 1                    | 1                            | 1                            |
| CFI indicated in PCFICH  |                                  |           | 1                    | 1                            | 1                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                  | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                    | N/A                          | N/A                          |
| Interference model   |                                  |           | NA                   | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | $\mu$ s   | N/A                  | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                              |                              |

**Table 8.4.1.2.7-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 2 CCE             | R.16-3 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 12.7              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.1.2.8 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type B for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.1-1 and Table 8.4.1.2.8-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.8-2. In Table 8.4.1.2.8-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.4.1.2.8-1: Test Parameters for PDCCH/PCFICH

| Parameter  |                                  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                   | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                   | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                        | 3.34                         |
| BW <sub>Channel</sub>  |                                  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal               | Normal                       | Normal                       |
| Cell Id  |                                  |           | 0                    | 1                            | 6                            |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 1                    | 1                            | 1                            |
| CFI indicated in PCFICH  |                                  |           | 1                    | 1                            | 1                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                  | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                    | N/A                          | N/A                          |
| Interference model   |                                  |           |                      | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | μs        | N/A                  | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                              |                              |

Table 8.4.1.2.8-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type B

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 4 CCE             | R.16-4 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 10.3              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.1.2.9 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.4.1-1 and Table 8.4.1.2.9-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.9-2. In Table 8.4.1.2.9-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes information on Cell 2 and Cell 3.

**Table 8.4.1.2.8-1: Test Parameters for PDCCH/PCFICH**

| Parameter  |                                  | Unit      | Cell 1                          | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|---------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                              | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                              | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports 0,1,2,3           |                              |                              |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                             |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | As defined in Table 8.4.1.2.9-2 | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                                  | MHz       | 10                              | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal                          | Normal                       | Normal                       |
| Cell ID  |                                  |           | 0                               | 1                            | 6                            |
| Subframe Configuration   |                                  |           | Non-MBSFN                       | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 2                               | 2                            | 2                            |
| CFI indicated in PCFICH  |                                  |           | 2                               | 2                            | 2                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                             | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal                          | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                               | N/A                          | N/A                          |
| Interference model   |                                  |           | NA                              | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                            | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | $\mu$ s   | N/A                             | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                             | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                                 |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                 |                              |                              |

**Table 8.4.1.2.9-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 2 CCE             | R.17-1 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 4x2 Low   | 1               | 14.1              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.4.2 TDD

The parameters specified in Table 8.4.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.4.2-1: Test Parameters for PDCCH/PCFICH**

| Parameter                               | Unit    | Single antenna port | Transmit diversity |
|---|---------|---------------------|--------------------|
| Uplink downlink configuration (Note 1)  |         | 0                   | 0                  |
| Special subframe configuration (Note 2) |         | 4                   | 4                  |
| Number of PDCCH symbols                 | symbols | 2                   | 2                  |
| PHICH Ng (Note 3)                       |         | 1                   | 1                  |
| PHICH duration                          |         | Normal              | Normal             |

|   |  |           |              |              |
|---|--|-----------|--------------|--------------|
| Unused RE-s and PRB-s                                 |  |           | OCNG         | OCNG         |
| Cell ID   |  |           | 0            | 0            |
| Downlink power allocation                             | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | 0            | -3           |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | 0            | -3           |
| $N_{oc}$ at antenna port                              |  | dBm/15kHz | -98          | -98          |
| Cyclic prefix   |  |           | Normal       | Normal       |
| ACK/NACK feedback mode                                |  |           | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. |  |           |              |              |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. |  |           |              |              |
| Note 3: According to Clause 6.9 in TS 36.211 [4]      |  |           |              |              |

### 8.4.2.1 Single-antenna port performance

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 TDD          | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 1               | -1.6     |

### 8.4.2.2 Transmit diversity performance

#### 8.4.2.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.2.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 TDD          | OP.1 TDD     | EVA70                 | 2 x 2 Low                                    | 1               | 0.1      |

#### 8.4.2.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.2.2.2-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 5 MHz     | 2 CCE             | R.17 TDD          | OP.1 TDD     | EPA5                  | 4 x 2 Medium                                 | 1               | 6.5      |



### 8.4.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters for non-MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.4.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

For the parameters for MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.3-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.3-4. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.4.2.2.3-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter                                       |  | Unit      | Cell 1                                     | Cell 2                   |
|---|--|-----------|--|--------------------------|
| Uplink downlink configuration                   |  |           | 1  | 1                        |
| Special subframe configuration                  |  |           | 4  | 4                        |
| Downlink power allocation                       | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3   | -3                       |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3   | -3                       |
| $N_{oc}$ at antenna port                        | $N_{oc1}$                                    | dBm/15kHz | -100.5 (Note 1)                            | N/A                      |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                               | N/A                      |
|   | $N_{oc3}$                                    | dBm/15kHz | -95.3 (Note 3)                             | N/A                      |
| $\hat{E}_s / N_{oc2}$                           |  | dB        | Reference Value<br>in Table<br>8.4.2.2.3-2 | 1.5                      |
| BW <sub>Channel</sub>                           |  | MHz       | 10   | 10                       |
| Subframe Configuration                          |  |           | Non-MBSFN                                  | Non-MBSFN                |
| Time Offset between Cells                       |  | μs        | 2.5 (synchronous cells)                    |                          |
| Cell Id   |  |           | 0  | 1                        |
| ABS pattern (Note 4)                            |  |           | N/A  | 0000010001<br>0000000001 |
| RLM/RRM Measurement Subframe<br>Pattern(Note 5) |  |           | 0000000001<br>0000000001                   | N/A                      |
| CSI Subframe<br>Sets(Note 6)                    | C <sub>CSI,0</sub>                           |           | 0000010001<br>0000000001                   | N/A                      |
|   | C <sub>CSI,1</sub>                           |           | 1100101000<br>1100111000                   | N/A                      |
| Number of control OFDM symbols                  |  |           | 3  | 3                        |
| ACK/NACK feedback mode                          |  |           | Multiplexing                               | N/A                      |
| PHICH Ng (Note 9)                               |  |           | 1  | N/A                      |
| PHICH duration                                  |  |           | extended                                   | N/A                      |
| Unused RE-s and PRB-s                           |  |           | OCNG                                       | OCNG                     |
| Cyclic prefix                                   |  |           | Normal                                     | Normal                   |

|         |   |
|---------|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.   |
| Note 2: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.   |
| Note 3: | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS  |
| Note 4: | ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].  |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].  |
| Note 7: | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.   |
| Note 8: | SIB-1 will not be transmitted in Cell2 in the test.   |
| Note 9: | According to Clause 6.9 in TS 36.211 [4]  |

**Table 8.4.2.2.3-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value |                   |
|-------------|-------------------|-------------------|--------------|----------|---------------------------------|--------|--|-----------------|-------------------|
|             |                   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Pm-dsg (%)      | SNR (dB) (Note 2) |
| 1           | 8 CCE             | R15-1 TDD         | OP.1 TDD     | OP.1 TDD | EVA5                            | EVA5   | 2x2 Low                                      | 1               | -3.9              |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SNR corresponds to  $\hat{E}_s / N_{oc2}$  of cell 1.

Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.

**Table 8.4.2.2.3-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter                                     |  | Unit      | Cell 1                               | Cell 2                 |
|---|--|-----------|--------------------------------------|------------------------|
| Uplink configuration                          |  |           | 1                                    | 1                      |
| Downlink configuration                        |  |           | 4                                    | 4                      |
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3                                   | -3                     |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                                   | -3                     |
| $N_{oc}$ at antenna port                      | $N_{oc1}$                                    | dBm/15kHz | -100.5 (Note 1)                      | N/A                    |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                         | N/A                    |
|   | $N_{oc3}$                                    | dBm/15kHz | -95.3 (Note 3)                       | N/A                    |
| $\hat{E}_s / N_{oc2}$                         |  | dB        | Reference Value in Table 8.4.2.2.3-4 | 1.5                    |
| $BW_{Channel}$                                |  | MHz       | 10                                   | 10                     |
| Subframe Configuration                        |  |           | Non-MBSFN                            | MBSFN                  |
| Time Offset between Cells                     |  | $\mu$ s   | 2.5 (synchronous cells)              |                        |
| Cell Id                                       |  |           | 0                                    | 126                    |
| ABS pattern (Note 4)                          |  |           | N/A                                  | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 000000001<br>000000001               | N/A                    |
| CSI Subframe Sets (Note 6)                    | $C_{CSI,0}$                                  |           | 000000001<br>000000001               | N/A                    |

|                                    |  |  |                          |        |
|------------------------------------|--|--|--------------------------|--------|
|                                    | C <sub>CSI,1</sub>   |  | 1100111000<br>1100111000 | N/A    |
| MBSFN Subframe Allocation (Note 9) |  |  | N/A                      | 000010 |
| Number of control OFDM symbols     |  |  | 3                        | 3      |
| ACK/NACK feedback mode             |  |  | Multiplexing             | N/A    |
| PHICH Ng (Note 10)                 |  |  | 1                        | N/A    |
| PHICH duration                     |  |  | extended                 | N/A    |
| Unused RE-s and PRB-s              |  |  | OCNG                     | OCNG   |
| Cyclic prefix                      |  |  | Normal                   | Normal |
| Note 1:                            | This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.   |  |                          |        |
| Note 2:                            | This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.   |  |                          |        |
| Note 3:                            | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS   |  |                          |        |
| Note 4:                            | ABS pattern as defined in [9]. The 10 <sup>th</sup> and 20 <sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |  |                          |        |
| Note 5:                            | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].   |  |                          |        |
| Note 6:                            | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].   |  |                          |        |
| Note 7:                            | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.  |  |                          |        |
| Note 8:                            | SIB-1 will not be transmitted in Cell2 in this test.   |  |                          |        |
| Note 9:                            | MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.  |  |                          |        |
| Note 10:                           | According to Clause 6.9 in TS 36.211 [4]   |  |                          |        |

**Table 8.4.2.2.3-4: Minimum performance PDCCH/PCFICH – MBSFN ABS**

| Test Number | Aggregation Level  | Reference Channel | OCNG Pattern |          | Propagation Conditions(Note 1) |        | Correlation Matrix and Antenna Configuration | Reference Value |                   |
|-------------|--|-------------------|--------------|----------|--------------------------------|--------|--|-----------------|-------------------|
|             |  |                   | Cell 1       | Cell 2   | Cell 1                         | Cell 2 |  | Pm-dsg (%)      | SNR (dB) (Note 2) |
| 1           | 8 CCE  | R15-1 TDD         | OP.1 TDD     | OP.1 TDD | EVA5                           | EVA5   | 2x2 Low                                      | 1               | -4.1              |
| Note 1:     | The propagation conditions for Cell 1 and Cell2 are statistically independent. |                   |              |          |                                |        |  |                 |                   |
| Note 2:     | SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.                            |                   |              |          |                                |        |  |                 |                   |
| Note 3:     | The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.  |                   |              |          |                                |        |  |                 |                   |

**8.4.2.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

For the parameters for non-MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.4-2.

For the parameters for MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.4-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.4-4.

In Tables 8.4.2.2.4-1 and 8.4.2.2.4-3, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.4.2.2.4-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter                      |                                 | Unit | Cell 1 | Cell 2 | Cell 3 |
|--------------------------------|---------------------------------|------|--------|--------|--------|
| Uplink downlink configuration  |                                 |      | 1      | 1      | 1      |
| Special subframe configuration |                                 |      | 4      | 4      | 4      |
| Downlink power allocation      | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB   | -3     | -3     | -3     |

|  |  |           |                                      |                        |                        |
|--|--|-----------|--------------------------------------|------------------------|------------------------|
|  | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                                   | -3                     | -3                     |
| $N_{oc}$ at antenna port   | $N_{oc1}$                                    | dBm/15kHz | -98(Note 1)                          | N/A                    | N/A                    |
|  | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                         | N/A                    | N/A                    |
|  | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)                         | N/A                    | N/A                    |
| $\hat{E}_s/N_{oc2}$  |  | dB        | Reference Value in Table 8.4.2.2.4-2 | 5                      | 3                      |
| BW <sub>Channel</sub>  |  | MHz       | 10                                   | 10                     | 10                     |
| Subframe Configuration   |  |           | Non-MBSFN                            | Non-MBSFN              | Non-MBSFN              |
| Time Offset between Cells  |  | μs        | N/A                                  | 3                      | -1                     |
| Frequency shift between Cells  |  | Hz        | N/A                                  | 300                    | -100                   |
| Cell Id  |  |           | 0                                    | 126                    | 1                      |
| ABS pattern (Note 4)   |  |           | N/A                                  | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5)  |  |           | 000000001<br>000000001               | N/A                    | N/A                    |
| CSI Subframe Sets (Note 6)   | $C_{csi,0}$                                  |           | 000000001<br>000000001               | N/A                    | N/A                    |
|  | $C_{csi,1}$                                  |           | 1100111000<br>1100111000             | N/A                    | N/A                    |
| Number of control OFDM symbols   |  |           | 2                                    | Note 7                 | Note 7                 |
| ACK/NACK feedback mode   |  |           | Multiplexing                         | N/A                    | N/A                    |
| PHICH Ng (Note 10)   |  |           | 1                                    | N/A                    | N/A                    |
| PHICH duration   |  |           | Normal                               | N/A                    | N/A                    |
| Unused RE-s and PRB-s  |  |           | OCNG                                 | OCNG                   | OCNG                   |
| Cyclic prefix  |  |           | Normal                               | Normal                 | Normal                 |
| <p>Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 4: ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell.</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7];</p> <p>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7];</p> <p>Note 7: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 8: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.</p> <p>Note 9: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.</p> <p>Note 10: According to Clause 6.9 in TS 36.211 [4]</p> |  |           |                                      |                        |                        |

**Table 8.4.2.2.4-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number   | Aggregation Level | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value |                   |
|---|-------------------|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 3) |
| 1   | 8 CCE             | R.15-2 TDD        | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                            | EVA5   | EVA5   | 2x2 Low   | 1               | -2.0              |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc2}</math> of cell 1.</p> |                   |                   |              |          |          |                                 |        |        |   |                 |                   |

Table 8.4.2.2.4-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS

| Parameter   |  | Unit      | Cell 1                               | Cell 2                 | Cell 3                 |
|---|--|-----------|--------------------------------------|------------------------|------------------------|
| Uplink downlink configuration   |  |           | 1                                    | 1                      | 1                      |
| Special subframe configuration  |  |           | 4                                    | 4                      | 4                      |
| Downlink power allocation   | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3                                   | -3                     | -3                     |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                                   | -3                     | -3                     |
| $N_{oc}$ at antenna port  | $N_{oc1}$                                    | dBm/15kHz | -98 (Note 1)                         | N/A                    | N/A                    |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                         | N/A                    | N/A                    |
|   | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)                         | N/A                    | N/A                    |
| $\hat{E}_s / N_{oc2}$   |  | dB        | Reference Value in Table 8.4.2.2.4-4 | 5                      | 3                      |
| BW <sub>Channel</sub>   |  | MHz       | 10                                   | 10                     | 10                     |
| Subframe Configuration  |  |           | Non-MBSFN                            | MBSFN                  | MBSFN                  |
| Time Offset between Cells   |  | μs        | N/A                                  | 3                      | -1                     |
| Frequency shift between Cells   |  | Hz        | N/A                                  | 300                    | -100                   |
| Cell Id   |  |           | 0                                    | 126                    | 1                      |
| ABS pattern (Note 4)  |  |           | N/A                                  | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5)   |  |           | 000000001<br>000000001               | N/A                    | N/A                    |
| CSI Subframe Sets (Note 6)  | C <sub>CSI,0</sub>                           |           | 000000001<br>000000001               | N/A                    | N/A                    |
|   | C <sub>CSI,1</sub>                           |           | 1100111000<br>1100111000             | N/A                    | N/A                    |
| MBSFN Subframe Allocation (Note 7)  |  |           | N/A                                  | 000010                 | 000010                 |
| Number of control OFDM symbols  |  |           | 2                                    | Note 8                 | Note 8                 |
| ACK/NACK feedback mode  |  |           | Multiplexing                         | N/A                    | N/A                    |
| PHICH Ng (Note 11)  |  |           | 1                                    | N/A                    | N/A                    |
| PHICH duration  |  |           | Normal                               | N/A                    | N/A                    |
| Unused RE-s and PRB-s   |  |           | OCNG                                 | OCNG                   | OCNG                   |
| Cyclic prefix   |  |           | Normal                               | Normal                 | Normal                 |
| <p>Note 1: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 2: This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.</p> <p>Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 4: ABS pattern as defined in [9]. The 10<sup>th</sup> and 20<sup>th</sup> subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].</p> <p>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 7: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.</p> <p>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 9: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>Note 10: SIB-1 will not be transmitted in Cell2 in this test.</p> <p>Note 11: According to Clause 6.9 in TS 36.211 [4]</p> |  |           |                                      |                        |                        |

Table 8.4.2.2.4-4: Minimum performance PDCCH/PCFICH – MBSFN ABS

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value |                   |
|-------------|-------------------|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|             |                   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 3) |
| 1           | 8 CCE             | R.15-2 TDD        | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EVA5                            | EVA5   | EVA5   | 2x2 Low   | 1               | -1.8              |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.  
Note 3: SNR corresponds to  $\hat{E}_s/N_{oc2}$  of cell 1.

#### 8.4.2.2.5 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port with Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.2-1 and Table 8.4.2.2.5-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.5-2. In Table 8.4.2.2.5-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.4.2.2.5-1: Test Parameters for PDCCH/PCFICH

| Parameter                                |                                  | Unit      | Cell 1   | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|--|------------------------------|------------------------------|
| Downlink power allocation                | PDCCH_RA<br>OCNG_RA              | dB        | -3   | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3   | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3   | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3   | N/A                          | N/A                          |
| Cell-specific reference signals          |                                  |           | Antenna ports<br>0,1                               | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port                 |                                  | dBm/15kHz | -98  |                              |                              |
| $\hat{E}_s/N_{oc}$                       |                                  | dB        | N/A  | 13.91                        | 3.34                         |
| BW <sub>Channel</sub>                    |                                  | MHz       | 10   | 10                           | 10                           |
| Cyclic Prefix                            |                                  |           | Normal   | Normal                       | Normal                       |
| Cell Id                                  |                                  |           | 0  | 6                            | 1                            |
| UL/DL Configuration                      |                                  |           | 0  | 0                            | 0                            |
| Special Subframe Configuration           |                                  |           | 4  | 4                            | 4                            |
| Subframe Configuration                   |                                  |           | Non-MBSFN  | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols |                                  |           | 3 for subframes 0 and 5<br>2 for subframes 1 and 6 |                              |                              |
| CFI indicated in PCFICH                  |                                  |           | 3 for subframes 0 and 5<br>2 for subframes 1 and 6 |                              |                              |
| PHICH Ng (Note 1)                        |                                  |           | 1/6  | N/A                          | N/A                          |
| PHICH duration                           |                                  |           | Normal   | N/A                          | N/A                          |
| PDSCH TM                                 |                                  |           | 4  | N/A                          | N/A                          |
| Interference model                       |                                  |           |  | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)           |                                  |           | OCNG   | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1           |                                  | μs        | N/A  | 2                            | 3                            |
| Frequency shift relative to Cell 1       |                                  | Hz        | N/A  | 200                          | 300                          |

Note 1: According to Clause 6.9 in TS 36.211 [4].  
Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs.

**Table 8.4.2.2.5-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 2 CCE             | R.16-1 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 16.1              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.2.2.6 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.2-1 and Table 8.4.2.2.6-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.6-2. In Table 8.4.2.2.6-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.4.2.2.6-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |                                  | Unit      | Cell 1   | Cell 2                       | Cell 3                       |
|---|----------------------------------|-----------|--|------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3   | -3                           | -3                           |
|   | PHICH_RA                         | dB        | -3   | N/A                          | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3   | -3                           | -3                           |
|   | PHICH_RB                         | dB        | -3   | N/A                          | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports<br>0,1                               | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98  |                              |                              |
| $\hat{E}_s/N_{oc}$  |                                  | dB        | N/A  | 13.91                        | 3.34                         |
| $BW_{Channel}$  |                                  | MHz       | 10   | 10                           | 10                           |
| Cyclic Prefix   |                                  |           | Normal   | Normal                       | Normal                       |
| Cell Id   |                                  |           | 0  | 1                            | 6                            |
| UL/DL Configuration   |                                  |           | 0  | 0                            | 0                            |
| Special Subframe Configuration  |                                  |           | 4  | 4                            | 4                            |
| Subframe Configuration  |                                  |           | Non-MBSFN  | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols  |                                  |           | 3 for subframes 0 and 5<br>2 for subframes 1 and 6 |                              |                              |
| CFI indicated in PCFICH   |                                  |           | 3 for subframes 0 and 5<br>2 for subframes 1 and 6 |                              |                              |
| PHICH Ng (Note 1)   |                                  |           | 1/6  | N/A                          | N/A                          |
| PHICH duration  |                                  |           | Normal   | N/A                          | N/A                          |
| PDSCH TM  |                                  |           | 4  | N/A                          | N/A                          |
| Interference model  |                                  |           |  | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG   | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1  |                                  | $\mu$ s   | N/A  | 2                            | 3                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].<br>Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |  |                              |                              |

**Table 8.4.2.2.6-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 4 CCE             | R.16-2 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 13.3              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.2.2.7 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Port with Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type B for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.2-1 and Table 8.4.2.2.7-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.7-2. In Table 8.4.2.2.7-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.4.2.2.7-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |                                  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|---|----------------------------------|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|   | PHICH_RA                         | dB        | -3                   | N/A                          | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
|   | PHICH_RB                         | dB        | -3                   | N/A                          | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$  |                                  | dB        | N/A                  | 13.91                        | 3.34                         |
| $BW_{Channel}$  |                                  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix   |                                  |           | Normal               | Normal                       | Normal                       |
| Cell Id   |                                  |           | 0                    | 6                            | 1                            |
| UL/DL Configuration   |                                  |           | 0                    | 0                            | 0                            |
| Special Subframe Configuration  |                                  |           | 4                    | 4                            | 4                            |
| Subframe Configuration  |                                  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols  |                                  |           | 1                    | 1                            | 1                            |
| CFI indicated in PCFICH   |                                  |           | 1                    | 1                            | 1                            |
| PHICH Ng (Note 1)   |                                  |           | 1/6                  | N/A                          | N/A                          |
| PHICH duration  |                                  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM  |                                  |           | 4                    | N/A                          | N/A                          |
| Interference model  |                                  |           |                      | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG                 | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1  |                                  | μs        | N/A                  | 2                            | 3                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A                  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].<br>Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                              |                              |



**Table 8.4.2.2.7-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 2 CCE             | R.16-3 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 13.7              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\widehat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.2.2.8 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.2-1 and Table 8.4.2.2.8-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.8-2. In Table 8.4.2.2.8-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.4.2.2.8-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |                                  | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|---|----------------------------------|-----------|----------------------|------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                           | -3                           |
|   | PHICH_RA                         | dB        | -3                   | N/A                          | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                           | -3                           |
|   | PHICH_RB                         | dB        | -3                   | N/A                          | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98                  |                              |                              |
| $\widehat{E}_s / N_{oc}$  |                                  | dB        | N/A                  | 13.91                        | 3.34                         |
| $BW_{Channel}$  |                                  | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix   |                                  |           | Normal               | Normal                       | Normal                       |
| Cell Id   |                                  |           | 0                    | 1                            | 6                            |
| UL/DL Configuration   |                                  |           | 0                    | 0                            | 0                            |
| Special Subframe Configuration  |                                  |           | 4                    | 4                            | 4                            |
| Subframe Configuration  |                                  |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols  |                                  |           | 1                    | 1                            | 1                            |
| CFI indicated in PCFICH   |                                  |           | 1                    | 1                            | 1                            |
| PHICH Ng (Note 1)   |                                  |           | 1/6                  | N/A                          | N/A                          |
| PHICH duration  |                                  |           | Normal               | N/A                          | N/A                          |
| PDSCH TM  |                                  |           | 4                    | N/A                          | N/A                          |
| Interference model  |                                  |           |                      | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG                 | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1  |                                  | $\mu$ s   | N/A                  | 2                            | 3                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A                  | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].<br>Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                              |                              |

**Table 8.4.2.2.8-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 4 CCE             | R.16-4 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 1               | 11.2              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

#### 8.4.2.2.9 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.4.1-1 and Table 8.4.2.2.9-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.9-2. In Table 8.4.2.2.9-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes information on Cell 2 and Cell 3.

**Table 8.4.2.2.9-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |                                  | Unit      | Cell 1                          | Cell 2                       | Cell 3                       |
|---|----------------------------------|-----------|---------------------------------|------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3                              | -3                           | -3                           |
|   | PHICH_RA                         | dB        | -3                              | N/A                          | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                              | -3                           | -3                           |
|   | PHICH_RB                         | dB        | -3                              | N/A                          | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports 0,1,2,3           |                              |                              |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98                             |                              |                              |
| $\hat{E}_s / N_{oc}$  |                                  | dB        | As defined in Table 8.4.1.2.9-2 | 13.91                        | 3.34                         |
| $BW_{Channel}$  |                                  | MHz       | 10                              | 10                           | 10                           |
| Cyclic Prefix   |                                  |           | Normal                          | Normal                       | Normal                       |
| Cell ID   |                                  |           | 0                               | 1                            | 6                            |
| UL/DL Configuration   |                                  |           | 0                               | 0                            | 0                            |
| Special Subframe Configuration  |                                  |           | 4                               | 4                            | 4                            |
| Subframe Configuration  |                                  |           | Non-MBSFN                       | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols  |                                  |           | 2                               |                              |                              |
| CFI indicated in PCFICH   |                                  |           | 2                               |                              |                              |
| PHICH Ng (Note 1)   |                                  |           | 1/6                             | N/A                          | N/A                          |
| PHICH duration  |                                  |           | Normal                          | N/A                          | N/A                          |
| PDSCH TM  |                                  |           | 4                               | N/A                          | N/A                          |
| Interference model  |                                  |           | N/A                             | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG                            | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1  |                                  | $\mu$ s   | N/A                             | 2                            | 3                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A                             | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].<br>Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                 |                              |                              |

**Table 8.4.2.2.9-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 2 CCE             | R.17-1 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 4x2 Low   | 1               | 14.4              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.4.3 LAA

The parameters specified in Table 8.4.3-1 are valid for all LAA PDCCH tests unless otherwise stated.

**Table 8.4.3-1: Common test Parameters for PDCCH**

| Parameter   |  | Unit      | Transmit diversity |
|---|--|-----------|--------------------|
| Downlink power allocation (Note 1)  | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3                 |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                 |
| $N_{oc}$ at antenna port  |  | dBm/15kHz | -98                |
| PHICH Ng (Note 1)   |  |           | 1                  |
| PHICH duration  |  |           | Normal             |
| Unused RE-s and PRB-s (Note 2)  |  |           | OCNG               |
| Cell ID   |  |           | 0                  |
| Cyclic prefix   |  |           | Normal             |
| ACK/NACK feedback mode  |  |           | Multiplexing       |
| Note 1: In LAA Scell(s), PCFICH_RB, PHICH_RA, and PHICH_RB are not available.<br>Note 2: OCNG is applied only within LAA burst. |  |           |                    |

#### 8.4.3.1 Transmit diversity performance

##### 8.4.3.1.1 FDD Pcell (FDD single carrier)

###### 8.4.3.1.1.1 Minimum Requirement 2 Tx Antenna Port

The average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.3.1.1.1-2 for Pcell and in Table 8.4.3.1.1.1-3 for LAA Scell(s), with the addition of the parameters in Table 8.4.3-1, and Table 8.4.3.1.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.3.1.1.1-1: Test Parameters for LAA Scell(s)**

| Parameter                      | Unit | Value |
|--------------------------------|------|-------|
| DMTC Periodicity               | ms   | 80    |
| dmtc-PeriodOffset-r12 ms80-r12 |      | 0     |

|  |         |                     |
|--|---------|---------------------|
| Downlink Burst transmission pattern for LAA SCell  |         | As specified in B.8 |
| The number of subframes set ( $S_i$ ) in a burst   |         | {1,3, 5, 8}         |
| Uniform random number ( $p$ ) in the burst model   |         | 0.5                 |
| Occupied OFDM symbols set in the last subframe   |         | {6, 9, 12,14}       |
| timing error relative of LAA SCell to PCell  | $\mu$ s | 15                  |
| Frequency offset of th $i$ -th LAA SCell relative to PCell   | Hz      | 200                 |
| Note 1: The same PDSCH transmission mode is applied to each component carrier.<br>Note 2: The OCNNG shall be applied for the non-scheduled OFDM symbols within the burst, and which OFDM symbols are scheduled within the burst is according to UE capability. |         |                     |

**Table 8.4.3.1.1-2: Single carrier performance for CCs which are not LAA Scells for multiple CA configurations**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 FDD          | OP.1 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | -0.6     |

**Table 8.4.3.1.1-3: Single carrier performance for LAA Scell(s) for multiple CA configurations**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 20 MHz    | 4 CCE             | R.3 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.2      |
| 2           | 20 MHz    | 4 CCE             | R.3 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.2      |
| 3           | 20 MHz    | 4 CCE             | R.3 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.3      |
| 4           | 20 MHz    | 4 CCE             | R.3 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.1      |

Note1 : UE is required to fulfill only one test among test 1-4 depending on it's capability for endingDwPTS and secondSlotStartingPosition. For UE don't support endingDwPTS and secondSlotStartingPosition, it is required to fulfill test 1; For UE don't support endingDwPTS and support secondSlotStartingPosition, it is required to fulfill test 2; For UE support endingDwPTS and don't support secondSlotStartingPosition, it is required to fulfill test 3; and For UE support both endingDwPTS and secondSlotStartingPosition, it is required to fulfill test 4.

8.4.3.1.2 TDD Pcell (TDD single carrier)

8.4.3.1.2.1 Minimum Requirement 2 Tx Antenna Port

The average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.3.1.2.1-2 for Pcell and in Table 8.4.3.1.2.1-3 for LAA Scell(s), with the additional of the parameters in Table 8.4.3-1, and Table 8.4.3.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.3.1.2.1-1: Test Parameters for LAA Scell(s)**

| Parameter | Unit | Value |
|-----------|------|-------|
|-----------|------|-------|

|   |         |                     |
|---|---------|---------------------|
| DMTC Periodicity  | ms      | 80                  |
| dmtc-PeriodOffset-r12 ms80-r12  |         | 0                   |
| Downlink Burst transmission pattern for LAA SCell   |         | As specified in B.8 |
| The number of subframes set ( $S_i$ ) in a burst  |         | {1,3, 5, 8}         |
| Uniform random number ( $p$ ) in the burst model  |         | 0.5                 |
| subframeStartPosition   |         | 's07'               |
| Occupied OFDM symbols set in the last subframe  |         | {6, 9, 12,14}       |
| timing error relative of LAA SCell to PCell   | $\mu$ s | 15                  |
| Frequency offset of the $i$ -th LAA SCell relative to PCell   | Hz      | 200                 |
| Note 1: The same PDSCH transmission mode is applied to each component carrier.<br>Note 2: The OCNG shall be applied for the non-scheduled OFDM symbols within the burst, and which OFDM symbols are scheduled within the burst is according to UE capability. |         |                     |

**Table 8.4.3.1.2.1-2: Single carrier performance for CCs which are not LAA Scells for multiple CA configurations**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 TDD          | OP.1 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | -0.6     |

**Table 8.4.3.1.2.1-3: Single carrier performance for LAA Scell(s) for multiple CA configurations**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 20 MHz    | 4 CCE             | R.4 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.2      |
| 2           | 20 MHz    | 4 CCE             | R.4 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.2      |
| 3           | 20 MHz    | 4 CCE             | R.4 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.3      |
| 4           | 20 MHz    | 4 CCE             | R.4 FS3           | OP.1 FS3     | EVA5                  | 2 x 2 Low                                    | 1               | 0.1      |

Note1 : UE is required to fulfill only one test among test 1-4 depending on it's capability for endingDwPTS and secondSlotStartingPosition. For UE don't support endingDwPTS and secondSlotStartingPosition, it is required to fulfill test 1; For UE don't support endingDwPTS and support secondSlotStartingPosition, it is required to fulfill test 2; For UE support endingDwPTS and don't support secondSlotStartingPosition, it is required to fulfill test 3; and For UE support both endingDwPTS and secondSlotStartingPosition, it is required to fulfill test 4.

## 8.5 Demodulation of PHICH

The receiver characteristics of the PHICH are determined by the probability of miss-detecting an ACK for a NACK (Pm-an). It is assumed that there is no bias applied to the detection of ACK and NACK (zero-threshold detection).

### 8.5.1 FDD

The parameters specified in Table 8.5.1-1 are valid for all FDD tests unless otherwise stated.

Table 8.5.1-1: Test Parameters for PHICH

| Parameter  |  | Unit      | Single antenna port   | Transmit diversity |
|--|--|-----------|---|--------------------|
| Downlink power allocation                        | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | 0   | -3                 |
|  | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | 0   | -3                 |
| PHICH duration                                   |  |           | Normal  | Normal             |
| PHICH Ng (Note 1)                                |  |           | Ng = 1  | Ng = 1             |
| PDCCH Content                                    |  |           | UL Grant should be included with the proper information aligned with A.3.6. |                    |
| Unused RE-s and PRB-s                            |  |           | OCNG  | OCNG               |
| Cell ID  |  |           | 0   | 0                  |
| $N_{oc}$ at antenna port                         |  | dBm/15kHz | -98   | -98                |
| Cyclic prefix                                    |  |           | Normal  | Normal             |
| Note 1: according to Clause 6.9 in TS 36.211 [4] |  |           |   |                    |

### 8.5.1.1 Single-antenna port performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.5.1.1-1: Minimum performance PHICH

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.18              | OP.1 FDD     | ETU70                 | 1 x 2 Low                                    | 0.1             | 5.5      |
| 2           | 10 MHz    | R.24              | OP.1 FDD     | ETU70                 | 1 x 2 Low                                    | 0.1             | 0.6      |

### 8.5.1.2 Transmit diversity performance

#### 8.5.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.1.2-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.5.1.2.1-1: Minimum performance PHICH

| Test number  | Bandwidth     | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|--|---------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|  |               |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1  | 10 MHz        | R.19              | OP.1 FDD     | EVA70                 | 2 x 2 Low                                    | 0.1             | 4.4      |
| 1A   | 5MHz (Note 1) | R.19-1            | OP.1 FDD     | EVA 70                | 2x2 Low                                      | 0.1             | 4        |
| Note 1: Test case applicability is defined in 8.1.2.1. |               |                   |              |                       |  |                 |          |

#### 8.5.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.5.1.2.2-1: Minimum performance PHICH

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 5 MHz     | R.20              | OP.1 FDD     | EPA5                  | 4 x 2 Medium                                 | 0.1             | 6.1      |

### 8.5.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.3-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.5.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

Table 8.5.1.2.3-1: Test Parameters for PHICH

| Parameter                                     |  | Unit      | Cell 1   | Cell 2   |     |
|---|--|-----------|--|--|-----|
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3   | -3   |     |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3   | -3   |     |
|   | $N_{oc}$ at antenna port                     | $N_{oc1}$ | dBm/15kHz  | -100.5 (Note 1)  | N/A |
|   |  | $N_{oc2}$ | dBm/15kHz  | -98 (Note 2)   | N/A |
|   |  | $N_{oc3}$ | dBm/15kHz  | -95.3 (Note 3)   | N/A |
| $\hat{E}_s / N_{oc2}$                         |  | dB        | Reference Value in Table 8.5.1.2.3-2                     | 1.5  |     |
| BW <sub>Channel</sub>                         |  | MHz       | 10   | 10   |     |
| Subframe Configuration                        |  |           | Non-MBSFN  | Non-MBSFN  |     |
| Time Offset between Cells                     |  | μs        | 2.5 (synchronous cells)                                  |  |     |
| Cell Id                                       |  |           | 0  | 1  |     |
| ABS pattern (Note 4)                          |  |           | N/A  | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 |     |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  |     |
| CSI Subframe Sets (Note 6)                    | $C_{csi,0}$                                  |           | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 | N/A  |     |
|   | $C_{csi,1}$                                  |           | 11111011<br>11111011<br>11111011<br>10111011<br>11111011 | N/A  |     |
| Number of control OFDM symbols                |  |           | 3  | 3  |     |
| PHICH Ng (Note 9)                             |  |           | 1  | N/A  |     |

|                       |   |          |        |
|-----------------------|---|----------|--------|
| PHICH duration        |   | extended | N/A    |
| Unused RE-s and PRB-s |   | OCNG     | OCNG   |
| Cyclic prefix         |   | Normal   | Normal |
| Note 1:               | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS  |          |        |
| Note 2:               | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS  |          |        |
| Note 3:               | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS  |          |        |
| Note 4:               | ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in the 26 <sup>th</sup> subframe indicated by the ABS pattern. |          |        |
| Note 5:               | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]   |          |        |
| Note 6:               | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]   |          |        |
| Note 7:               | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.   |          |        |
| Note 8:               | SIB-1 will not be transmitted in Cell2 in the test.   |          |        |
| Note 9:               | According to Clause 6.9 in TS 36.211 [4]  |          |        |

**Table 8.5.1.2.3-2: Minimum performance PHICH**

| Test Number   | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Antenna Configuration and Correlation Matrix | Reference Value |                   |
|---|-------------------|--------------|----------|---------------------------------|--------|--|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Pm-an (%)       | SNR (dB) (Note 2) |
| 1   | R.19              | OP.1 FDD     | OP.1 FDD | EPA5                            | EPA5   | 2x2 Low                                      | 0.1             | 4.6               |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |              |          |                                 |        |  |                 |                   |
| Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.                             |                   |              |          |                                 |        |  |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.   |                   |              |          |                                 |        |  |                 |                   |

**8.5.1.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)**

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.4-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.4-2. In Table 8.5.1.2.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.5.1.2.4-1: Test Parameters for PHICH**

| Parameter                 |  | Unit      | Cell 1                               | Cell 2    | Cell 3    |
|---------------------------|--|-----------|--------------------------------------|-----------|-----------|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3                                   | -3        | -3        |
|                           | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3                                   | -3        | -3        |
| $N_{oc}$ at antenna port  | $N_{oc1}$                                    | dBm/15kHz | -98 (Note 1)                         | N/A       | N/A       |
|                           | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)                         | N/A       | N/A       |
|                           | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)                         | N/A       | N/A       |
| $\hat{E}_s / N_{oc2}$     |  | dB        | Reference Value in Table 8.5.1.2.4-2 | 5         | 3         |
| BW <sub>Channel</sub>     |  | MHz       | 10                                   | 10        | 10        |
| Subframe Configuration    |  |           | Non-MBSFN                            | Non-MBSFN | Non-MBSFN |



|  |                    |    |   |  |  |
|--|--------------------|----|---|--|--|
| Time Offset between Cells  |                    | μs | N/A   | 3  | -1   |
| Frequency shift between Cells  |                    | Hz | N/A   | 300  | -100   |
| Cell Id  |                    |    | 0   | 126  | 1  |
| PDCCH Content  |                    |    | UL Grant should be included with the proper information aligned with A.3.6. | N/A  | N/A  |
| ABS pattern (Note 4)   |                    |    | N/A   | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5)  |                    |    | 00000100<br>00000100<br>00000100<br>00000100<br>00000100                    | N/A  | N/A  |
| CSI Subframe Sets (Note 6)   | C <sub>CSI,0</sub> |    | 00000100<br>00000100<br>00000100<br>00000100<br>00000100                    | N/A  | N/A  |
|  | C <sub>CSI,1</sub> |    | 11111011<br>11111011<br>11111011<br>11111011<br>11111011                    | N/A  | N/A  |
| Number of control OFDM symbols   |                    |    | 2   | Note 7   | Note 7   |
| PHICH Ng (Note 10)   |                    |    | 1   | N/A  | N/A  |
| PHICH duration   |                    |    | Normal  | N/A  | N/A  |
| Unused RE-s and PRB-s  |                    |    | OCNG  | OCNG   | OCNG   |
| Cyclic prefix  |                    |    | Normal  | Normal   | Normal   |
| <p>Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS</p> <p>Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS</p> <p>Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS</p> <p>Note 4: ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in the 26<sup>th</sup> subframe indicated by the ABS pattern.</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]</p> <p>Note 7: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.</p> <p>Note 8: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.</p> <p>Note 9: SIB-1 will not be transmitted in Cell 2 and Cell 3 in the test</p> <p>Note 10: According to Clause 6.9 in TS 36.211 [4].</p> |                    |    |   |  |  |

**Table 8.5.1.2.4-2: Minimum performance PHICH**

| Test Number   | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1 FDD     | OP.1 FDD | OP.1 FDD | EPA5                            | EVA5   | EVA5   | 2x2 Low   | 0.1             | 5.0               |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\bar{E}_s / N_{oc2}</math> of Cell 1.</p> |                   |              |          |          |                                 |        |        |   |                 |                   |

### 8.5.1.2.5 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Ports under Asynchronous Network

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.5-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.5-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells and applying interference model defined in clause B.5.2. In Table 8.5.1.2.5-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is not provided.

**Table 8.5.1.2.5-1: Test Parameters for PHICH**

| Parameter   |  | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|---|--|-----------|----------------------|---------------------------------|---------------------------------|
| Downlink power allocation   | PDCCH_RA<br>PHICH_RA<br>PDSCH_RA<br>OCNG_RA              | dB        | -3                   | -3                              | -3                              |
|   | PCFICH_RB<br>PHICH_RB<br>PDCCH_RB<br>PDSCH_RB<br>OCNG_RB | dB        | -3                   | -3                              | -3                              |
| Cell-specific reference signals   |  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port  |  | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$  |  | dB        | N/A                  | 13.91                           | 3.34                            |
| $BW_{Channel}$  |  | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix   |  |           | Normal               | Normal                          | Normal                          |
| Cell ID   |  |           | 0                    | 1                               | 6                               |
| Subframe Configuration  |  |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Number of control OFDM symbols  |  |           | 1                    | 1                               | 1                               |
| PHICH Ng (Note 1)   |  |           | 1                    | N/A                             | N/A                             |
| PHICH duration  |  |           | Normal               | N/A                             | N/A                             |
| Interference model  |  |           | N/A                  | As specified in<br>clause B.5.2 | As specified in<br>clause B.5.2 |
| Probability of occurrence of PDSCH transmission rank in interfering cells | Rank 1   | %         | N/A                  | 80                              | 80                              |
|   | Rank 2   | %         | N/A                  | 20                              | 20                              |
| Unused RE-s and PRB-s   |  |           | OCNG                 | OCNG                            | OCNG                            |
| Time offset relative to Cell 1  |  | ms        | N/A                  | 0.33                            | 0.67                            |
| Frequency offset relative to Cell 1                                       |  | Hz        | N/A                  | 0                               | 0                               |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                         |  |           |                      |                                 |                                 |

**Table 8.5.1.2.5-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Reference Channel | OCNG Pattern |             |             | Propagation Conditions (Note 1) |           |           | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|-------------|-------------|---------------------------------|-----------|-----------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2      | Cell 3      | Cell 1                          | Cell 2    | Cell 3    |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1<br>FDD  | OP.1<br>FDD | OP.1<br>FDD | EVA7<br>0                       | EVA7<br>0 | EVA7<br>0 | 2x2 Low   | 0.1             | 17.9              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |             |             |                                 |           |           |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |             |             |                                 |           |           |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.            |                   |              |             |             |                                 |           |           |   |                 |                   |

### 8.5.1.2.6 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Ports with Non-Colliding CRS Dominant Interferer

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.6-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.6-2. The purpose of this test is to verify the PHICH

performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the non-colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.1.2.6-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.5.1.2.6-1: Test Parameters for PHICH**

| Parameter  |                                  | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|--|----------------------------------|-----------|----------------------|---------------------------------|---------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                              | -3                              |
|  | PHICH_RA                         | dB        | -3                   | N/A                             | N/A                             |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                              | -3                              |
|  | PHICH_RB                         | dB        | -3                   | N/A                             | N/A                             |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                           | 3.34                            |
| $BW_{Channel}$   |                                  | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |                                  |           | Normal               | Normal                          | Normal                          |
| Cell ID  |                                  |           | 0                    | 1                               | 6                               |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Number of control OFDM symbols   |                                  |           | 1                    | 1                               | 1                               |
| PHICH Ng (Note 1)  |                                  |           | 1                    | N/A                             | N/A                             |
| PHICH duration   |                                  |           | Normal               | N/A                             | N/A                             |
| Interference model   |                                  |           | N/A                  | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                            | OCNG                            |
| Time offset to cell 1  |                                  | us        | N/A                  | 2                               | 3                               |
| Frequency offset to cell 1   |                                  | Hz        | N/A                  | 200                             | 300                             |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                                 |                                 |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                                 |                                 |

**Table 8.5.1.2.6-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Reference Channel | OCNG Pattern |             |             | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|-------------|-------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2      | Cell 3      | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1<br>FDD  | OP.1<br>FDD | OP.1<br>FDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 15.8              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.            |                   |              |             |             |                                 |        |        |   |                 |                   |

### 8.5.1.2.7 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Ports with Colliding CRS Dominant Interferer

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.7-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.7-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.1.2.7-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.5.1.2.7-1: Test Parameters for PHICH

| Parameter  |                                  | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|--|----------------------------------|-----------|----------------------|---------------------------------|---------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                   | -3                              | -3                              |
|  | PHICH_RA                         | dB        | -3                   | N/A                             | N/A                             |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                              | -3                              |
|  | PHICH_RB                         | dB        | -3                   | N/A                             | N/A                             |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                           | 3.34                            |
| $BW_{Channel}$   |                                  | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |                                  |           | Normal               | Normal                          | Normal                          |
| Cell ID  |                                  |           | 0                    | 6                               | 1                               |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Number of control OFDM symbols   |                                  |           | 1                    | 1                               | 1                               |
| PHICH Ng (Note 1)  |                                  |           | 1                    | N/A                             | N/A                             |
| PHICH duration   |                                  |           | Normal               | N/A                             | N/A                             |
| Interference model   |                                  |           | N/A                  | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                            | OCNG                            |
| Time offset to cell 1  |                                  | us        | N/A                  | 2                               | 3                               |
| Frequency offset to cell 1   |                                  | Hz        | N/A                  | 200                             | 300                             |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                                 |                                 |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                                 |                                 |

Table 8.5.1.2.7-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type B

| Test Number   | Reference Channel | OCNG Pattern |             |             | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|-------------|-------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2      | Cell 3      | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1<br>FDD  | OP.1<br>FDD | OP.1<br>FDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 13.4              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.            |                   |              |             |             |                                 |        |        |   |                 |                   |

### 8.5.1.2.8 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Ports with Non-Colliding CRS Dominant Interferer

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.8-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.8-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the non-colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.1.2.8-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.5.1.2.8-1: Test Parameters for PHICH

| Parameter                 |                     | Unit | Cell 1 | Cell 2 | Cell 3 |
|---------------------------|---------------------|------|--------|--------|--------|
| Downlink power allocation | PDCCH_RA<br>OCNG_RA | dB   | -3     | -3     | -3     |
|                           | PHICH_RA            | dB   | -3     | N/A    | N/A    |

|  |                                  |           |                      |                                 |                                 |
|--|----------------------------------|-----------|----------------------|---------------------------------|---------------------------------|
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                   | -3                              | -3                              |
|  | PHICH_RB                         | dB        | -3                   | N/A                             | N/A                             |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | N/A                  | 13.91                           | 3.34                            |
| $BW_{Channel}$   |                                  | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |                                  |           | Normal               | Normal                          | Normal                          |
| Cell ID  |                                  |           | 0                    | 1                               | 6                               |
| Subframe Configuration   |                                  |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Number of control OFDM symbols   |                                  |           | 1                    | 1                               | 1                               |
| PHICH Ng (Note 1)  |                                  |           | 1                    | N/A                             | N/A                             |
| PHICH duration   |                                  |           | Normal               | N/A                             | N/A                             |
| Interference model   |                                  |           | N/A                  | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                 | OCNG                            | OCNG                            |
| Time offset to cell 1  |                                  | us        | N/A                  | 2                               | 3                               |
| Frequency offset to cell 1   |                                  | Hz        | N/A                  | 200                             | 300                             |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                      |                                 |                                 |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                      |                                 |                                 |

**Table 8.5.1.2.8-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number   | Reference Channel | OCNG Pattern |             |             | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|-------------|-------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2      | Cell 3      | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1<br>FDD  | OP.1<br>FDD | OP.1<br>FDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 15.0              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.            |                   |              |             |             |                                 |        |        |   |                 |                   |

### 8.5.2 TDD

The parameters specified in Table 8.5.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.5.2-1: Test Parameters for PHICH**

| Parameter                               | Unit   | Single antenna port | Transmit diversity |
|---|--|---------------------|--------------------|
| Uplink downlink configuration (Note 1)  |  | 1                   | 1                  |
| Special subframe configuration (Note 2) |  | 4                   | 4                  |
| Downlink power allocation               | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB                  | -3                 |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB                  | -3                 |
| PHICH duration                          |  | Normal              | Normal             |
| PHICH Ng (Note 3)                       |  | Ng = 1              | Ng = 1             |

|                          |  |   |              |
|--------------------------|--|---|--------------|
| PDCCH Content            |  | UL Grant should be included with the proper information aligned with A.3.6. |              |
| Unused RE-s and PRB-s    |  | OCNG  | OCNG         |
| Cell ID                  |  | 0   | 0            |
| $N_{oc}$ at antenna port | dBm/15kHz                                    | -98   | -98          |
| Cyclic prefix            |  | Normal  | Normal       |
| ACK/NACK feedback mode   |  | Multiplexing  | Multiplexing |
| Note 1:                  | as specified in Table 4.2-2 in TS 36.211 [4] |   |              |
| Note 2:                  | as specified in Table 4.2-1 in TS 36.211 [4] |   |              |
| Note 3:                  | according to Clause 6.9 in TS 36.211 [4]     |   |              |

### 8.5.2.1 Single-antenna port performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.5.2.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.18              | OP.1 TDD     | ETU70                 | 1 x 2 Low                                    | 0.1             | 5.8      |
| 2           | 10 MHz    | R.24              | OP.1 TDD     | ETU70                 | 1 x 2 Low                                    | 0.1             | 1.3      |

### 8.5.2.2 Transmit diversity performance

#### 8.5.2.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.5.2.2.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.19              | OP.1 TDD     | EVA70                 | 2 x 2 Low                                    | 0.1             | 4.2      |

#### 8.5.2.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.5.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.5.2.2.2-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 5 MHz     | R.20              | OP.1 TDD     | EPA5                  | 4 x 2 Medium                                 | 0.1             | 6.2      |

### 8.5.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.3-1, the average probability of a miss-detecting ACK for NACK (P<sub>m-an</sub>) shall be below the specified value in Table 8.5.2.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3, In Table 8.5.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.5.2.2.3-1: Test Parameters for PHICH**

| Parameter                                     |  | Unit      | Cell 1                               | Cell 2                   |
|---|--|-----------|--------------------------------------|--------------------------|
| Uplink downlink configuration                 |  |           | 1                                    | 1                        |
| Special subframe configuration                |  |           | 4                                    | 4                        |
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA  | dB        | -3                                   | -3                       |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB   | dB        | -3                                   | -3                       |
| $N_{oc}$ at antenna port                      | $N_{oc1}$  | dBm/15kHz | -100.5 (Note 1)                      | N/A                      |
|   | $N_{oc2}$  | dBm/15kHz | -98 (Note 2)                         | N/A                      |
|   | $N_{oc3}$  | dBm/15kHz | -95.3 (Note 3)                       | N/A                      |
| $\hat{E}_s / N_{oc2}$                         |  | dB        | Reference Value in Table 8.5.2.2.3-2 | 1.5                      |
| BW <sub>Channel</sub>                         |  | MHz       | 10                                   | 10                       |
| Subframe Configuration                        |  |           | Non-MBSFN                            | Non-MBSFN                |
| Time Offset between Cells                     |  | μs        | 2.5 (synchronous cells)              |                          |
| Cell Id                                       |  |           | 0                                    | 1                        |
| ABS pattern (Note 4)                          |  |           | N/A                                  | 0000010001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 0000000001<br>0000000001             | N/A                      |
| CSI Subframe Sets (Note 6)                    | C <sub>CSI,0</sub>   |           | 0000010001<br>0000000001             | N/A                      |
|   | C <sub>CSI,1</sub>   |           | 1100101000<br>1100111000             | N/A                      |
| Number of control OFDM symbols                |  |           | 3                                    | 3                        |
| ACK/NACK feedback mode                        |  |           | Multiplexing                         | N/A                      |
| PHICH Ng (Note 9)                             |  |           | 1                                    | N/A                      |
| PHICH duration                                |  |           | extended                             | N/A                      |
| Unused RE-s and PRB-s                         |  |           | OCNG                                 | OCNG                     |
| Cyclic prefix                                 |  |           | Normal                               | Normal                   |
| Note 1:                                       | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS   |           |                                      |                          |
| Note 2:                                       | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS   |           |                                      |                          |
| Note 3:                                       | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS   |           |                                      |                          |
| Note 4:                                       | ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in subframe 5 |           |                                      |                          |
| Note 5:                                       | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |           |                                      |                          |
| Note 6:                                       | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]  |           |                                      |                          |
| Note 7:                                       | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.  |           |                                      |                          |
| Note 8:                                       | SIB-1 will not be transmitted in Cell2 in the test.  |           |                                      |                          |
| Note 9:                                       | According to Clause 6.9 in TS 36.211 [4]   |           |                                      |                          |

Table 8.5.2.2.3-2: Minimum performance PHICH

| Test Number   | Reference Channel | OCNG Pattern |          | Propagation Conditions (Note 1) |        | Antenna Configuration and Correlation Matrix | Reference Value |                   |
|---|-------------------|--------------|----------|---------------------------------|--------|--|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 1                          | Cell 2 |  | Pm-an (%)       | SNR (dB) (Note 2) |
| 1   | R.19              | OP.1 TDD     | OP.1 TDD | EPA5                            | EPA5   | 2x2 Low                                      | 0.1             | 4.6               |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |              |          |                                 |        |  |                 |                   |
| Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.                             |                   |              |          |                                 |        |  |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.   |                   |              |          |                                 |        |  |                 |                   |

#### 8.5.2.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.4-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.4-2. In Table 8.5.2.2.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

Table 8.5.2.2.4-1: Test Parameters for PHICH

| Parameter                                     |  | Unit      | Cell 1  | Cell 2                 | Cell 3                 |
|---|--|-----------|---|------------------------|------------------------|
| Uplink downlink configuration                 |  |           | 1   | 1                      | 1                      |
| Special subframe configuration                |  |           | 4   | 4                      | 4                      |
| Downlink power allocation                     | PDCCH_RA<br>PHICH_RA<br>OCNG_RA              | dB        | -3  | -3                     | -3                     |
|   | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB        | -3  | -3                     | -3                     |
| $N_{oc}$ at antenna port                      | $N_{oc1}$                                    | dBm/15kHz | -98 (Note 1)  | N/A                    | N/A                    |
|   | $N_{oc2}$                                    | dBm/15kHz | -98 (Note 2)  | N/A                    | N/A                    |
|   | $N_{oc3}$                                    | dBm/15kHz | -93 (Note 3)  | N/A                    | N/A                    |
| $\hat{E}_s / N_{oc2}$                         |  | dB        | Reference Value in Table 8.5.2.2.4-2  | 5                      | 3                      |
| $BW_{Channel}$                                |  | MHz       | 10  | 10                     | 10                     |
| Subframe Configuration                        |  |           | Non-MBSFN   | Non-MBSFN              | Non-MBSFN              |
| Time Offset between Cells                     |  | $\mu$ s   | N/A   | 3                      | -1                     |
| Frequency shift between Cells                 |  | Hz        | N/A   | 300                    | -100                   |
| Cell Id                                       |  |           | 0   | 126                    | 1                      |
| PDCCH Content                                 |  |           | UL Grant should be included with the proper information aligned with A.3.6. | N/A                    | N/A                    |
| ABS pattern (Note 4)                          |  |           | N/A   | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) |  |           | 000000001<br>000000001  | N/A                    | N/A                    |
| CSI Subframe Sets (Note 6)                    | $C_{CSI,0}$                                  |           | 000000001<br>000000001  | N/A                    | N/A                    |



|                                |  |  |                          |        |        |
|--------------------------------|--|--|--------------------------|--------|--------|
|                                | C <sub>CSI,1</sub>   |  | 1100111000<br>1100111000 | N/A    | N/A    |
| Number of control OFDM symbols |  |  | 2                        | Note 7 | Note 7 |
| ACK/NACK feedback mode         |  |  | Multiplexing             | N/A    | N/A    |
| PHICH Ng (Note 10)             |  |  | 1                        | N/A    | N/A    |
| PHICH duration                 |  |  | Normal                   | N/A    | N/A    |
| Unused RE-s and PRB-s          |  |  | OCNG                     | OCNG   | OCNG   |
| Cyclic prefix                  |  |  | Normal                   | Normal | Normal |
| Note 1:                        | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS  |  |                          |        |        |
| Note 2:                        | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS   |  |                          |        |        |
| Note 3:                        | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS   |  |                          |        |        |
| Note 4:                        | ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in subframe 5 |  |                          |        |        |
| Note 5:                        | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |  |                          |        |        |
| Note 6:                        | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]  |  |                          |        |        |
| Note 7:                        | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.   |  |                          |        |        |
| Note 8:                        | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.  |  |                          |        |        |
| Note 9:                        | SIB-1 will not be transmitted in Cell 2 and Cell 3 in the test.  |  |                          |        |        |
| Note 10:                       | According to Clause 6.9 in TS 36.211 [4]   |  |                          |        |        |

**Table 8.5.2.2.4-2: Minimum performance PHICH**

| Test Number   | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EPA5                            | EVA5   | EVA5   | 2x2 Low   | 0.1             | 5.7               |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of Cell 1. |                   |              |          |          |                                 |        |        |   |                 |                   |

**8.5.2.2.5 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Ports with Colliding CRS Dominant Interferer**

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.5-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.5-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.2.2.5-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.5.2.2.5-1: Test Parameters for PHICH**

| Parameter                       | Unit                             | Cell 1               | Cell 2               | Cell 3               |
|---------------------------------|----------------------------------|----------------------|----------------------|----------------------|
| Uplink downlink configuration   |                                  | 1                    | 1                    | 1                    |
| Special subframe configuration  |                                  | 4                    | 4                    | 4                    |
| Downlink power allocation       | PDCCH_RA<br>OCNG_RA              | dB                   | -3                   | -3                   |
|                                 | PHICH_RA                         | dB                   | -3                   | N/A                  |
|                                 | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB                   | -3                   | -3                   |
|                                 | PHICH_RB                         | dB                   | -3                   | N/A                  |
| Cell-specific reference signals |                                  | Antenna ports<br>0,1 | Antenna ports<br>0,1 | Antenna ports<br>0,1 |

|  |           |           |                              |                              |
|--|-----------|-----------|------------------------------|------------------------------|
| $N_{oc}$ at antenna port   | dBm/15kHz | -98       |                              |                              |
| $\widehat{E}_s/N_{oc}$   | dB        | N/A       | 13.91                        | 3.34                         |
| $BW_{Channel}$   | MHz       | 10        | 10                           | 10                           |
| Cyclic Prefix  |           | Normal    | Normal                       | Normal                       |
| Cell ID  |           | 0         | 6                            | 1                            |
| Subframe Configuration   |           | Non-MBSFN | Non-MBSFN                    | Non-MBSFN                    |
| Number of control OFDM symbols   |           | 1         | 1                            | 1                            |
| PHICH Ng (Note 1)  |           | 1         | N/A                          | N/A                          |
| PHICH duration   |           | Normal    | N/A                          | N/A                          |
| Interference model   |           | N/A       | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |           | OCNG      | OCNG                         | OCNG                         |
| Time offset to cell 1  | us        | N/A       | 2                            | 3                            |
| Frequency offset to cell 1   | Hz        | N/A       | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |           |           |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |           |           |                              |                              |

**Table 8.5.2.5-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 16.2              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |          |          |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |          |          |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\widehat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.        |                   |              |          |          |                                 |        |        |   |                 |                   |

**8.5.2.2.6 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Ports with Non-Colliding CRS Dominant Interferer**

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.6-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.6-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the non-colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.2.2.6-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.5.2.2.6-1: Test Parameters for PHICH**

| Parameter                       | Unit                             | Cell 1            | Cell 2            | Cell 3            |
|---------------------------------|----------------------------------|-------------------|-------------------|-------------------|
| Uplink downlink configuration   |                                  | 1                 | 1                 | 1                 |
| Special subframe configuration  |                                  | 4                 | 4                 | 4                 |
| Downlink power allocation       | PDCCH_RA<br>OCNG_RA              | dB                | -3                | -3                |
|                                 | PHICH_RA                         | dB                | -3                | N/A               |
|                                 | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB                | -3                | -3                |
|                                 | PHICH_RB                         | dB                | -3                | N/A               |
| Cell-specific reference signals |                                  | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port        | dBm/15kHz                        | -98               |                   |                   |
| $\widehat{E}_s/N_{oc}$          | dB                               | N/A               | 13.91             | 3.34              |
| $BW_{Channel}$                  | MHz                              | 10                | 10                | 10                |
| Cyclic Prefix                   |                                  | Normal            | Normal            | Normal            |
| Cell ID                         |                                  | 0                 | 1                 | 6                 |

|  |    |           |                              |                              |
|--|----|-----------|------------------------------|------------------------------|
| Subframe Configuration   |    | Non-MBSFN | Non-MBSFN                    | Non-MBSFN                    |
| Number of control OFDM symbols   |    | 1         | 1                            | 1                            |
| PHICH Ng (Note 1)  |    | 1         | N/A                          | N/A                          |
| PHICH duration   |    | Normal    | N/A                          | N/A                          |
| Interference model   |    | N/A       | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |    | OCNG      | OCNG                         | OCNG                         |
| Time offset to cell 1  | us | N/A       | 2                            | 3                            |
| Frequency offset to cell 1   | Hz | N/A       | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |    |           |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |    |           |                              |                              |

**Table 8.5.2.2.6-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number   | Reference Channel | OCNG Pattern |             |             | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|-------------|-------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2      | Cell 3      | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1<br>TDD  | OP.1<br>TDD | OP.1<br>TDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 16.1              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |             |             |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1.            |                   |              |             |             |                                 |        |        |   |                 |                   |

### 8.5.2.2.7 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Ports with Colliding CRS Dominant Interferer

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.7-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.7-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.2.2.7-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.5.2.2.7-1: Test Parameters for PHICH**

| Parameter                       | Unit                             | Cell 1               | Cell 2                       | Cell 3                       |
|---------------------------------|----------------------------------|----------------------|------------------------------|------------------------------|
| Uplink downlink configuration   |                                  | 1                    | 1                            | 1                            |
| Special subframe configuration  |                                  | 4                    | 4                            | 4                            |
| Downlink power allocation       | PDCCH_RA<br>OCNG_RA              | dB                   | -3                           | -3                           |
|                                 | PHICH_RA                         | dB                   | -3                           | N/A                          |
|                                 | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB                   | -3                           | -3                           |
|                                 | PHICH_RB                         | dB                   | -3                           | N/A                          |
| Cell-specific reference signals |                                  | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port        | dBm/15kHz                        |                      | -98                          |                              |
| $\hat{E}_s/N_{oc}$              | dB                               | N/A                  | 13.91                        | 3.34                         |
| BW <sub>Channel</sub>           | MHz                              | 10                   | 10                           | 10                           |
| Cyclic Prefix                   |                                  | Normal               | Normal                       | Normal                       |
| Cell ID                         |                                  | 0                    | 6                            | 1                            |
| Subframe Configuration          |                                  | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Number of control OFDM symbols  |                                  | 1                    | 1                            | 1                            |
| PHICH Ng (Note 1)               |                                  | 1                    | N/A                          | N/A                          |
| PHICH duration                  |                                  | Normal               | N/A                          | N/A                          |
| Interference model              |                                  | N/A                  | As specified in clause B.7.1 | As specified in clause B.7.1 |

|  |    |      |      |      |
|--|----|------|------|------|
| Unused RE-s and PRB-s (Note 2)   |    | OCNG | OCNG | OCNG |
| Time offset to cell 1  | us | N/A  | 2    | 3    |
| Frequency offset to cell 1   | Hz | N/A  | 200  | 300  |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |    |      |      |      |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |    |      |      |      |

**Table 8.5.2.2.7-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number   | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|---|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1   | R.19              | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 14.0              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |          |          |                                 |        |        |   |                 |                   |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |          |          |                                 |        |        |   |                 |                   |
| Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of Cell 1 as defined in clause 8.1.1.          |                   |              |          |          |                                 |        |        |   |                 |                   |

### 8.5.2.2.8 Enhanced Downlink Control Channel Performance Requirement Type B - 2 Tx Antenna Ports with Non-Colliding CRS Dominant Interferer

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.8-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.8-2. The purpose of this test is to verify the PHICH performance with 2 transmit antennas when the serving cell PHICH transmission is interfered by two interfering cells with the dominant interferer having the non-colliding CRS pattern and applying interference model defined in clause B.7.1. In Table 8.5.2.2.8-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.5.2.2.8-1: Test Parameters for PHICH**

| Parameter  | Unit                             | Cell 1               | Cell 2                          | Cell 3                          |     |
|--|----------------------------------|----------------------|---------------------------------|---------------------------------|-----|
| Uplink downlink configuration  |                                  | 1                    | 1                               | 1                               |     |
| Special subframe configuration   |                                  | 4                    | 4                               | 4                               |     |
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB                   | -3                              | -3                              | -3  |
|  | PHICH_RA                         | dB                   | -3                              | N/A                             | N/A |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB                   | -3                              | -3                              | -3  |
|  | PHICH_RB                         | dB                   | -3                              | N/A                             | N/A |
| Cell-specific reference signals  |                                  | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |     |
| $N_{oc}$ at antenna port   | dBm/15kHz                        |                      | -98                             |                                 |     |
| $\hat{E}_s / N_{oc}$   | dB                               | N/A                  | 13.91                           | 3.34                            |     |
| $BW_{Channel}$   | MHz                              | 10                   | 10                              | 10                              |     |
| Cyclic Prefix  |                                  | Normal               | Normal                          | Normal                          |     |
| Cell ID  |                                  | 0                    | 1                               | 6                               |     |
| Subframe Configuration   |                                  | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |     |
| Number of control OFDM symbols   |                                  | 1                    | 1                               | 1                               |     |
| PHICH Ng (Note 1)  |                                  | 1                    | N/A                             | N/A                             |     |
| PHICH duration   |                                  | Normal               | N/A                             | N/A                             |     |
| Interference model   |                                  | N/A                  | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |     |
| Unused RE-s and PRB-s (Note 2)   |                                  | OCNG                 | OCNG                            | OCNG                            |     |
| Time offset to cell 1  | us                               | N/A                  | 2                               | 3                               |     |
| Frequency offset to cell 1   | Hz                               | N/A                  | 200                             | 300                             |     |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |                      |                                 |                                 |     |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |                      |                                 |                                 |     |

**Table 8.5.2.2.8-2: Minimum performance PHICH for Enhanced Downlink Control Channel Performance Requirement Type B**

| Test Number  | Reference Channel | OCNG Pattern |          |          | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|--|-------------------|--------------|----------|----------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   | Cell 1       | Cell 2   | Cell 3   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-an (%)       | SNR (dB) (Note 3) |
| 1  | R.19              | OP.1 TDD     | OP.1 TDD | OP.1 TDD | EPA5                            | EPA5   | EPA5   | 2x2 Low   | 0.1             | 15.5              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of Cell 1 as defined in clause 8.1.1. |                   |              |          |          |                                 |        |        |   |                 |                   |

## 8.6 Demodulation of PBCH

The receiver characteristics of the PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$P_{m-bch} = 1 - \frac{A}{B}$$

Where A is the number of correctly decoded MIB PDUs and B is the Number of transmitted MIB PDUs (Redundancy versions for the same MIB are not counted separately).

### 8.6.1 FDD

**Table 8.6.1-1: Test Parameters for PBCH**

| Parameter  |         | Unit      | Single antenna port | Transmit diversity |
|--|---------|-----------|---------------------|--------------------|
| Downlink power allocation                            | PBCH_RA | dB        | 0                   | -3                 |
|  | PBCH_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port                             |         | dBm/15kHz | -98                 | -98                |
| Cyclic prefix  |         |           | Normal              | Normal             |
| Cell ID  |         |           | 0                   | 0                  |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4] |         |           |                     |                    |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4] |         |           |                     |                    |

#### 8.6.1.1 Single-antenna port performance

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detecting PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.21              | ETU70                 | 1 x 2 Low                                    | 1               | -6.1     |

## 8.6.1.2 Transmit diversity performance

### 8.6.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.22              | EPA5                  | 2 x 2 Low                                    | 1               | -4.8     |

### 8.6.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.2.2-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.23              | EVA5                  | 4 x 2 Medium                                 | 1               | -3.5     |

### 8.6.1.2.3 Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information

For the parameters specified in Table 8.6.1.2.3-1 and Table 8.6.1.2.3-2, the averaged probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.3-2. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.6.1.2.3-1: Test Parameters for PBCH**

| Parameter                     |                    | Unit      | Cell 1                               | Cell 2 | Cell 3 |
|-------------------------------|--------------------|-----------|--------------------------------------|--------|--------|
| Downlink power allocation     | PBCH_RA<br>OCNG_RA | dB        | -3                                   | -3     | -3     |
|                               | PBCH_RB<br>OCNG_RB | dB        | -3                                   | -3     | -3     |
| $N_{oc}$ at antenna port      |                    | dBm/15kHz | -98                                  | N/A    | N/A    |
| $\hat{E}_s/N_{oc}$            |                    | dB        | Reference Value in Table 8.6.1.2.3-2 | 4      | 2      |
| BW <sub>Channel</sub>         |                    | MHz       | 1.4                                  | 1.4    | 1.4    |
| Time Offset between Cells     |                    | μs        | N/A                                  | 3      | -1     |
| Frequency shift between Cells |                    | Hz        | N/A                                  | 300    | -100   |
| Cell Id                       |                    |           | 0                                    | 126    | 1      |

|  |  |        |  |  |
|--|--|--------|--|--|
| ABS Pattern (Note 4)   |  | N/A    | 01000000<br>01000000<br>01000000<br>01000000<br>01000000 | 01000000<br>01000000<br>01000000<br>01000000<br>01000000 |
| Unused RE-s and PRB-s  |  | OCNG   | OCNG   | OCNG   |
| Cyclic prefix  |  | Normal | Normal   | Normal   |
| <p>Note 1: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.</p> <p>Note 2: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.</p> <p>Note 3: The PBCH transmission from Cell 1, Cell 2 and Cell 3 overlap. The same PBCH transmission redundancy version is used for Cell 1, Cell 2 and Cell 3.</p> <p>Note 4: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> |  |        |  |  |

Table 8.6.1.2.3-2: Minimum performance PBCH

| Test Number  | Reference Channel | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|--|-------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-bch (%)      | SNR (dB) (Note 3) |
| 1  | R.22              | ETU30                           | ETU30  | ETU30  | 2x2 Low   | 1               | -3.0              |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s / N_{oc}</math> of cell 1.</p> |                   |                                 |        |        |   |                 |                   |

## 8.6.2 TDD

Table 8.6.2-1: Test Parameters for PBCH

| Parameter   |         | Unit      | Single antenna port | Transmit diversity |
|---|---------|-----------|---------------------|--------------------|
| Uplink downlink configuration (Note 1)  |         |           | 1                   | 1                  |
| Special subframe configuration (Note 2)   |         |           | 4                   | 4                  |
| Downlink power allocation   | PBCH_RA | dB        | 0                   | -3                 |
|   | PBCH_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port  |         | dBm/15kHz | -98                 | -98                |
| Cyclic prefix   |         |           | Normal              | Normal             |
| Cell ID   |         |           | 0                   | 0                  |
| <p>Note 1: as specified in Table 4.2-2 in TS 36.211 [4].</p> <p>Note 2: as specified in Table 4.2-1 in TS 36.211 [4].</p> |         |           |                     |                    |

### 8.6.2.1 Single-antenna port performance

For the parameters specified in Table 8.6.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.6.2.1-1: Minimum performance PBCH

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.21              | ETU70                 | 1 x 2 Low                                    | 1               | -6.4     |

## 8.6.2.2 Transmit diversity performance

### 8.6.2.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.6.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.2.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.22              | EPA5                  | 2 x 2 Low                                    | 1               | -4.8     |

### 8.6.2.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.6.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.2.2.2-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |
| 1           | 1.4 MHz   | R.23              | EVA5                  | 4 x 2 Medium                                 | 1               | -4.1     |

### 8.6.2.2.3 Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information

For the parameters specified in Table 8.6.2.2.3-1 and Table 8.6.2.2.3-2, the averaged probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.2.2.3-2. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.6.2.2.3-1: Test Parameters for PBCH**

| Parameter                     |                    | Unit      | Cell 1                               | Cell 2                 | Cell 3                 |
|-------------------------------|--------------------|-----------|--------------------------------------|------------------------|------------------------|
| Downlink power allocation     | PBCH_RA<br>OCNG_RA | dB        | -3                                   | -3                     | -3                     |
|                               | PBCH_RB<br>OCNG_RB | dB        | -3                                   | -3                     | -3                     |
| $N_{oc}$ at antenna port      |                    | dBm/15kHz | -98                                  | N/A                    | N/A                    |
| $\hat{E}_s/N_{oc}$            |                    | dB        | Reference Value in Table 8.6.2.2.3-2 | 4                      | 2                      |
| BW <sub>Channel</sub>         |                    | MHz       | 1.4                                  | 1.4                    | 1.4                    |
| Time Offset between Cells     |                    | μs        | N/A                                  | 3                      | -1                     |
| Frequency shift between Cells |                    | Hz        | N/A                                  | 300                    | -100                   |
| Cell Id                       |                    |           | 0                                    | 126                    | 1                      |
| ABS Pattern (Note 4)          |                    |           | N/A                                  | 000000001<br>000000001 | 000000001<br>000000001 |
| Unused RE-s and PRB-s         |                    |           | OCNG                                 | OCNG                   | OCNG                   |
| Cyclic prefix                 |                    |           | Normal                               | Normal                 | Normal                 |



Note 1: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.  
 Note 2: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.  
 Note 3: The PBCH transmission from Cell 1, Cell 2 and Cell 3 overlap. The same PBCH transmission redundancy version is used for Cell 1, Cell 2 and Cell 3.  
 Note 4: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.

**Table 8.6.2.2.3-2: Minimum performance PBCH**

| Test Number  | Reference Channel | Propagation Conditions (Note 1) |        |        | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value |                   |
|--|-------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   | Cell 1                          | Cell 2 | Cell 3 |   | Pm-bch (%)      | SNR (dB) (Note 3) |
| 1  | R.22              | ETU30                           | ETU30  | ETU30  | 2x2 Low   | 1               | -3.0              |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of cell 1. |                   |                                 |        |        |   |                 |                   |

## 8.7 Sustained downlink data rate provided by lower layers

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum number of DL-SCH transport block bits received within a TTI for the UE category indicated. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement. The size of the TB per TTI corresponds to the largest possible DL-SCH transport block for each UE category using the maximum number of layers for spatial multiplexing. Transmission modes 1 and 3 are used with radio conditions resembling a scenario where sustained maximum data rates are available.

Test case is selected according to table 8.7-1 depending on UE capability for CA and EPDCCH.

**Table 8.7-1: SDR test applicability**

|            | Single carrier UE not supporting EPDCCH | CA UE not supporting EPDCCH | Single carrier UE supporting EPDCCH | CA UE supporting EPDCCH |
|------------|---|-----------------------------|-------------------------------------|-------------------------|
| <b>FDD</b> | <b>8.7.1</b>                            | <b>8.7.1</b>                | <b>8.7.3</b>                        | <b>8.7.1, 8.7.3</b>     |
| <b>TDD</b> | <b>8.7.2</b>                            | <b>8.7.2</b>                | <b>8.7.4</b>                        | <b>8.7.2, 8.7.4</b>     |

### 8.7.1 FDD (single carrier and CA)

The parameters specified in Table 8.7.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.7.1-1: Common Test Parameters (FDD)**

| Parameter                                      | Unit      | Value  |
|--|-----------|--------|
| Cyclic prefix                                  |           | Normal |
| Cell ID  |           | 0      |
| Inter-TTI Distance                             |           | 1      |
| Number of HARQ processes per component carrier | Processes | 8      |

|  |              |   |
|--|--------------|---|
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.1-3, with the addition of the parameters in Table 8.7.1-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.1-4. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.1-6, with the addition of the parameters in Table 8.7.1-5 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.1-7, the TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.1-3 is not applicable.

For UE supporting 256QAM and category 9/10 and category 13, the requirements are specified in both Table 8.7.1-3 and Table 8.7.1-6, with the addition of the parameters in Table 8.7.1-2 and in Table 8.7.1-5 respectively. The downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.1-4 and in Table 8.7.1-7 for the category 9/10 and category 13, the TB success rate shall be sustained during at least 300 frames.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.1-2: test parameters for sustained downlink data rate (FDD 64QAM)**

| Test   | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|--------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|---|-------------------------|
|        |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ |   |                         |
| 1      | 10              | 1                 | 1 x 2                 | N/A                         | 0                              | 0        | 0        | -85                                     | OP.6 FDD                |
| 1A     | 10              | 1                 | 1x1                   | N/A                         | 0                              | 0        | 0        | -85                                     | OP.6 FDD                |
| 1B     | 20              | 1                 | 1x1                   | N/A                         | 0                              | 0        | 0        | -85                                     | OP.6 FDD                |
| 2      | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 3,4,6  | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 3A     | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 3B, 4A | 2x10            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 3C, 4B | 15              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6A     | 2x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6B     | 10+15           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6C     | 10+20           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6D     | 15+20           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6E     | 2x15            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 6F     | 15+5            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |

|    |             |   |       |    |    |    |   |     |             |
|----|-------------|---|-------|----|----|----|---|-----|-------------|
| 6G | 20+5        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7  | 3x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7A | 15+20+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7B | 10+20+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7C | 15+15+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7D | 10+15+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7E | 10+10+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7F | 10+15+15    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7G | 5+10+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7H | 5+15+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7I | 5+10+10     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7J | 5+5+20      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7K | 3x10        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7L | 5+5+10      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8  | 4x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8A | 20+20+20+10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8B | 20+20+10+10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8C | 20+20+10+5  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8D | 20+10+10+5  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8E | 15+3x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8F | 2x15+2x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8G | 10+15+2x20  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8H | 3x10+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8I | 2x5+2x20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8J | 2x5+10+20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8K | 4x10        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9  | 5x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9A | 15+4x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9B | 10+4x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9C | 2x10+3x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9D | 5+10+3x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9E | 3x10+2x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9F | 4x10+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |

|    |      |   |       |    |    |    |   |     |             |
|----|------|---|-------|----|----|----|---|-----|-------------|
| 10 | 6x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 11 | 7x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |

NOTE 1: For CA test cases, PUCCH format 1b with channel selection is used to feedback ACK/NACK for Test 1-6E, and PUCCH format 3 is used to feedback ACK/NACK for Test 7-7G.

Table 8.7.1-3: Minimum requirement (FDD 64QAM)

| Test | Number of bits of a DL-SCH transport block received within a TTI                          | Measurement channel  | Reference value     |
|------|---|--|---------------------|
|      |   |  | TB success rate [%] |
| 1    | 10296   | R.31-1 FDD   | 95                  |
| 1A   | 10296   | R.31-1 FDD   | 95                  |
| 1B   | 10296   | R.31-1A FDD  | 95                  |
| 2    | 25456   | R.31-2 FDD   | 95                  |
| 3    | 51024   | R.31-3 FDD   | 95                  |
| 3A   | 36696 (Note 2)  | R.31-3A FDD  | 85                  |
| 3B   | 25456   | R.31-2 FDD   | 95                  |
| 3C   | 51024   | R.31-3C FDD  | 85                  |
| 4    | 75376 (Note 3)  | R.31-4 FDD   | 85                  |
| 4A   | 36696 (Note 2)  | R.31-3A FDD  | 85                  |
| 4B   | 55056 (Note 5)  | R.31-4B FDD  | 85                  |
| 6    | 75376 (Note 3)  | R.31-4 FDD   | 85                  |
| 6A   | 75376 (Note 3)  | R.31-4 FDD   | 85                  |
| 6B   | 36696 (Note 2) for 10MHz CC<br>55056 for 15MHz CC   | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC                            | 85                  |
| 6C   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85                  |
| 6D   | 55056 for 15MHz CC<br>75376 (Note 3) for 20MHz CC   | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                             | 85                  |
| 6E   | 55056 (Note 5) for two 15MHz CCs  | R.31-4B FDD for two 15MHz CCs  | 85                  |
| 6F   | 55056 (Note 5) for 15MHz CC<br>18336 (Note 6) for 5MHz CC                                 | R.31-5 FDD for 15MHz CC<br>R.31-6 FDD for 5MHz CC                              | 85                  |
| 6G   | 75376 (Note 3) for 20MHz CC<br>18336 (Note 6) for 5MHz CC                                 | R.31-4 FDD for 20MHz CC<br>R.31-6 FDD for 5MHz CC                              | 85                  |
| 7    | 75376 (Note 3)  | R.31-4 FDD   | 85                  |
| 7A   | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                             | 85                  |
| 7B   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85                  |
| 7C   | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                             | 85                  |
| 7D   | 36696 (Note 2) for 10MHz CC<br>55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85                  |
| 7E   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85                  |
| 7F   | 36696 (Note 2) for 10MHz CC<br>55056 (Note 5) for 15MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC                            | 85                  |
| 7G   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC  | 85                  |
| 7H   | 18336 (Note 6) for 5MHz CC<br>55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC   | 85                  |
| 7I   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC                                 | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC                             | 85                  |
| 7J   | 18336 (Note 6) for 5MHz CC<br>75376 (Note 3) for 20MHz CC                                 | R.31-6 FDD for 5MHz CC<br>R.31-4 FDD for 20MHz CC                              | 85                  |
| 7K   | 36696 (Note 2) for 10MHz CC   | R.31-3A FDD for 10MHz CC   | 85                  |
| 7L   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC                                 | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC                             | 85                  |
| 8E   | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                             | 85                  |
| 8F   | 55056 (Note 5) for 15MHz CC   | R.31-5 FDD for 15MHz CC  | 85                  |

|  |   |  |    |
|--|---|--|----|
|  | 75376 (Note 3) for 20MHz CC   | R.31-4 FDD for 20MHz CC  |    |
| 8G   | 36696 (Note 2) for 10MHz CC<br>55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 8H   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 8I   | 18336 (Note 6) for 5MHz CC<br>75376 (Note 3) for 20MHz CC                                 | R.31-6 FDD for 5MHz CC<br>R.31-4 FDD for 20MHz CC                              | 85 |
| 8J   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC  | 85 |
| 8K   | 36696 (Note 2) for 10MHz CC   | R.31-3A FDD for 10MHz CC   | 85 |
| 8  | 75376 (Note 3)  | R.31-4 FDD   | 85 |
| 8A   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 8B   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 8C   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC  | 85 |
| 8D   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC  | 85 |
| 9  | 75376 (Note 3)  | R.31-4 FDD   | 85 |
| 9A   | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                             | 85 |
| 9B   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 9C   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 9D   | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC  | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC  | 85 |
| 9E   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 9F   | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC                                | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 |
| 10   | 75376 (Note 3)  | R.31-4 FDD   | 85 |
| 11   | 75376 (Note 3)  | R.31-4 FDD   | 85 |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: 35160 bits for sub-frame 5.</p> <p>Note 3: 71112 bits for sub-frame 5.</p> <p>Note 4: The TB success rate is defined as <math>TB\ success\ rate = 100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks.</p> <p>Note 5: 52752bits for sub-frame 5.</p> <p>Note 6: 15840bits for sub-frame 0.</p> |   |  |    |

**Table 8.7.1-4: Test points for sustained data rate (FRC 64QAM)**

| CA config      | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 1bis | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9,10 | Cat 11, 12    | DL Cat. 15 |
|----------------|--|--------|-----------|--------|--------|--------|----------|-----------|---------------|------------|
|                |  |        |           |        |        |        |          |           | DL Cat. 11,12 |            |
| Single carrier | 10   | 1      | 1A        | 2      | 3A     | 3A     | -        | -         | -             | -          |
|                | 15   | -      | -         | -      | 3C     | 4B     | -        | -         | -             | -          |
|                | 20   | -      | 1B        | -      | 3      | 4      | 6        | -         | -             | -          |
| CA with 2CCs   | 10+10  | -      | -         | -      | 3B     | 4A     | 4A       | 4A        | -             | -          |
|                | 10+15  | -      | -         | -      | 3B     | 4A     | 6B       | 6B        | -             | -          |
|                | 10+20  | -      | -         | -      | 3B     | 4A     | 6C       | 6C        | -             | -          |
|                | 15+15  | -      | -         | -      | 3B     | 4A     | 6E       | 6E        | -             | -          |
|                | 15+5   | -      | -         | -      | 3B     | 4A     | 6F       | 6F        | -             | -          |
|                | 20+5   | -      | -         | -      | 3      | 4      | 6G       | 6G        | -             | -          |
|                | 15+20  | -      | -         | -      | 3B     | 4A     | 6D       | 6D        | -             | -          |

|   |             |   |   |   |                     |                     |    |    |    |    |
|---|-------------|---|---|---|---------------------|---------------------|----|----|----|----|
|   | 20+20       | - | - | - | 3B or 3<br>(Note 4) | 4A or 4<br>(Note 4) | 6A | 6A | -  | -  |
| CA with 3CCs  | 3x20        | - | - | - | -                   | -                   | 6A | 7  | 7  | -  |
|   | 15+20+20    | - | - | - | -                   | -                   | 6A | 7A | 7A | -  |
|   | 10+20+20    | - | - | - | -                   | -                   | 6A | 7B | 7B | -  |
|   | 15+15+20    | - | - | - | -                   | -                   | 6D | 7C | 7C | -  |
|   | 10+15+20    | - | - | - | -                   | -                   | 6D | 7D | 7D | -  |
|   | 10+10+20    | - | - | - | -                   | -                   | 7E | 7E | 7E | -  |
|   | 10+15+15    | - | - | - | -                   | -                   | 7F | 7F | 7F | -  |
|   | 5+10+20     | - | - | - | -                   | -                   | 7G | 7G | 7G | -  |
|   | 5+15+20     | - | - | - | -                   | -                   | 7H | 7H | 7H | -  |
|   | 5+10+10     | - | - | - | -                   | -                   | 7I | 7I | 7I | -  |
|   | 5+5+20      | - | - | - | -                   | -                   | 7J | 7J | 7J | -  |
| CA with 4CCs  | 3x10        | - | - | - | -                   | -                   | 7K | 7K | 7K | -  |
|   | 5+5+10      | - | - | - | -                   | -                   | 7L | 7L | 7L | -  |
|   | 4x20        | - | - | - | -                   | -                   | -  | 7  | 8  | 8  |
|   | 20+20+20+10 | - | - | - | -                   | -                   | -  | 7  | 8A | 8A |
|   | 20+20+10+10 | - | - | - | -                   | -                   | -  | 8B | 8B | 8B |
|   | 20+20+10+5  | - | - | - | -                   | -                   | -  | 8C | 8C | 8C |
|   | 20+10+10+5  | - | - | - | -                   | -                   | -  | 8D | 8D | 8D |
|   | 15+3x20     | - | - | - | -                   | -                   | -  | 8E | 8E | 8E |
|   | 2x15+2x20   | - | - | - | -                   | -                   | -  | 8F | 8F | 8F |
|   | 10+15+2x20  | - | - | - | -                   | -                   | -  | 8G | 8G | 8G |
|   | 3x10+20     | - | - | - | -                   | -                   | -  | 8H | 8H | 8H |
| CA with 5CCs  | 2x5+2x20    | - | - | - | -                   | -                   | -  | 8I | 8I | 8I |
|   | 2x5+10+20   | - | - | - | -                   | -                   | -  | 8J | 8J | 8J |
|   | 4x10        | - | - | - | -                   | -                   | -  | 8K | 8K | 8K |
|   | 5x20        | - | - | - | -                   | -                   | -  | -  | 8  | 9  |
|   | 15+4x20     | - | - | - | -                   | -                   | -  | -  | -  | 10 |
|   | 10+4x20     | - | - | - | -                   | -                   | -  | -  | -  | 11 |
| CA with 6CCs  | 2x10+3x20   | - | - | - | -                   | -                   | -  | -  | -  | 12 |
|   | 5+10+3x20   | - | - | - | -                   | -                   | -  | -  | -  | 13 |
|   | 3x10+2x20   | - | - | - | -                   | -                   | -  | -  | -  | 14 |
| CA with 7CCs  | 6x20        | - | - | - | -                   | -                   | -  | 10 | 10 |    |
| CA with 7CCs  | 7x20        | - | - | - | -                   | -                   | -  | 11 | 11 |    |
| <p>Note 1: Void.</p> <p>Note 2: For non-CA UE, test is selected for maximum supported bandwidth.</p> <p>Note 3: Void.</p> <p>Note 4: If the intra-band contiguous CA is the only CA configuration supported by category 3 or 4 UE, the single carrier test is selected, i.e., Test 3 for UE category 3 and Test 4 for UE category 4. Otherwise, Test 3B applies for category 3 UE and Test 4A applies for category 4 UE.</p> <p>Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.</p> <p>Note 6: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.</p> |             |   |   |   |                     |                     |    |    |    |    |

Table 8.7.1-5: test parameters for sustained downlink data rate (FDD 256QAM)

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|---|-------------------------|
|      |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ |   |                         |
| 1    | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 2    | 2x15            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 2A   | 15+5            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |
| 3    | 10+15           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                     | OP.1 FDD                |

|     |             |   |       |    |    |    |   |     |             |
|-----|-------------|---|-------|----|----|----|---|-----|-------------|
| 3A  | 20+5        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 4   | 10+20       | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 6   | 15+20       | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 7   | 2x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 8   | 3x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 9   | 15+20+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 10  | 10+20+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 11  | 15+15+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 12  | 10+15+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 13  | 10+10+20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 14  | 10+15+15    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15  | 5+10+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15A | 5+15+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15B | 5+10+10     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15C | 5+5+20      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15D | 3x10        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 15E | 5+5+10      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 16  | 4x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 17  | 20+20+20+10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18  | 20+20+10+10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18A | 20+20+10+5  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18B | 20+10+10+5  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18C | 15+3x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18D | 2x15+2x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18E | 10+15+2x20  | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18F | 3x10+20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18G | 2x5+2x20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18H | 2x5+10+20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 18I | 4x10        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19  | 5x20        | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19A | 15+4x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19B | 10+4x20     | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19C | 2x10+3x20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |

|     |           |   |       |    |    |    |   |     |             |
|-----|-----------|---|-------|----|----|----|---|-----|-------------|
| 19D | 5+10+3x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19E | 3x10+2x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 19F | 4x10+20   | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 20  | 6x20      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |
| 21  | 7x20      | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1<br>FDD |

Note 1: For CA test cases, PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.1-6: Minimum requirement (FDD 256QAM)**

| Test | Measurement channel   | Reference value     |
|------|---|---------------------|
|      |   | TB success rate [%] |
| 1    | R.68 FDD  | 85                  |
| 2    | R.68-1 FDD  | 85                  |
| 2A   | R.68-1 FDD for 15MHz CC<br>R.68-3 FDD for 5MHz CC                           | 85                  |
| 3    | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC                          | 85                  |
| 3A   | R.68 FDD for 20MHz CC<br>R.68-3 FDD for 5MHz CC                             | 85                  |
| 4    | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 6    | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 7    | R.68 FDD  | 85                  |
| 8    | R.68 FDD  | 85                  |
| 9    | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 10   | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 11   | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 12   | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85                  |
| 13   | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 14   | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC                          | 85                  |
| 15   | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC  | 85                  |
| 15A  | R.68-3 FDD for 5MHz CC<br>R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC  | 85                  |
| 15B  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC                           | 85                  |
| 15C  | R.68-3 FDD for 5MHz CC<br>R.68 FDD for 20MHz CC                             | 85                  |
| 15D  | R.68-2 FDD for 10MHz CC   | 85                  |
| 15E  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC                           | 85                  |
| 16   | R.68 FDD  | 85                  |
| 17   | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 18   | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85                  |
| 18A  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC  | 85                  |
| 18B  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC                           | 85                  |



|  |   |    |
|--|---|----|
|  | R.68 FDD for 20MHz CC   |    |
| 18C  | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 18D  | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 18E  | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 18F  | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 18G  | R.68-3 FDD for 5MHz CC<br>R.68 FDD for 20MHz CC                             | 85 |
| 18H  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC  | 85 |
| 18I  | R.68-2 FDD for 10MHz CC   | 85 |
| 19   | R.68 FDD  | 85 |
| 19A  | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 19B  | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 19C  | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 19D  | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC  | 85 |
| 19E  | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 19F  | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC                            | 85 |
| 20   | R.68 FDD  | 85 |
| 21   | R.68 FDD  | 85 |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: The TB success rate is defined as <math>TB \text{ success rate} = 100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks.</p> |   |    |

**Table 8.7.1-7: Test points for sustained data rate (FRC 256QAM)**

| CA config      | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 11, 12    | DL Cat. 13 | DL Cat. 15 | DL Cat. 16 |  |  |
|----------------|--|----------------|------------|------------|------------|--|--|
|                |  | DL Cat. 11, 12 |            |            |            |  |  |
| Single carrier | 20   | -              | 1          | -          | -          |  |  |
| CA with 2CCs   | 2x15   | 2              | 2          | -          | -          |  |  |
|                | 15+5   | 2A             | 2A         | -          | -          |  |  |
|                | 10+15  | 3              | 3          | -          | -          |  |  |
|                | 20+5   | 3A             | 3A         | -          | -          |  |  |
|                | 10+20  | 4              | 4          | -          | -          |  |  |
|                | 15+20  | 6              | 6          | -          | -          |  |  |
| CA with 3CCs   | 20+20  | 7              | 7          | -          | -          |  |  |
|                | 3x20   | 8              | 7          | 8          | -          |  |  |
|                | 15+20+20   | 9              | 7          | 9          | -          |  |  |
|                | 10+20+20   | 10             | 7          | 10         | -          |  |  |
|                | 15+15+20   | 11             | 6          | 11         | -          |  |  |
|                | 10+15+20   | 12             | 6          | 12         | -          |  |  |
|                | 10+10+20   | 13             | 13         | 13         | -          |  |  |
|                | 10+15+15   | 14             | 14         | 14         | -          |  |  |
| 5+10+20        | 15   | 15             | 15         | -          |            |  |  |

|  |             |     |     |     |     |  |  |
|--|-------------|-----|-----|-----|-----|--|--|
|  | 5+15+20     | 15A | 15A | 15A | -   |  |  |
|  | 5+10+10     | 15B | 15B | 15B | -   |  |  |
|  | 5+5+20      | 15C | 15C | 15C |     |  |  |
|  | 3x10        | 15D | 15D | 15D |     |  |  |
|  | 5+5+10      | 15E | 15E | 15E |     |  |  |
| CA with 4CCs   | 4x20        | 8   | -   | 16  | 16  |  |  |
|  | 20+20+20+10 | 8   | -   | 17  | 17  |  |  |
|  | 20+20+10+10 | 18  | -   | 18  | 18  |  |  |
|  | 20+20+10+5  | 18A | -   | 18A | 18A |  |  |
|  | 20+10+10+5  | 18B | -   | 18B | 18B |  |  |
|  | 15+3x20     | 18C |     | 18C | 18C |  |  |
|  | 2x15+2x20   | 18D |     | 18D | 18D |  |  |
|  | 10+15+2x20  | 18E |     | 18E | 18E |  |  |
|  | 3x10+20     | 18F |     | 18F | 18F |  |  |
|  | 2x5+2x20    | 18G |     | 18G | 18G |  |  |
|  | 2x5+10+20   | 18H |     | 18H | 18H |  |  |
| 4x10   | 18I         |     | 18I | 18I |     |  |  |
| CA with 5CCs   | 5x20        | -   | -   | 16  | 19  |  |  |
|  | 15+4x20     |     |     |     | 20  |  |  |
|  | 10+4x20     |     |     |     | 21  |  |  |
|  | 2x10+3x20   |     |     |     | 22  |  |  |
|  | 5+10+3x20   |     |     |     | 23  |  |  |
|  | 3x10+2x20   |     |     |     | 24  |  |  |
|  | 4x10+20     |     |     |     | 25  |  |  |
| CA with 6CCs   | 6x20        | -   | -   | -   | 20  |  |  |
| CA with 7CCs   | 7x20        | -   | -   | -   | 21  |  |  |
| NOTE 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. |             |     |     |     |     |  |  |

### 8.7.2 TDD (single carrier and CA)

The parameters specified in Table 8.7.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.7.2-1: Common Test Parameters (TDD)**

| Parameter  | Unit         | Value   |                                |
|--|--------------|---|--------------------------------|
| Special subframe configuration (Note 1)                |              |   | 4                              |
| Cyclic prefix  |              |   | Normal                         |
| Cell ID  |              |   | 0                              |
| Inter-TTI Distance                                     |              |   | 1                              |
| Maximum number of HARQ transmission                    |              |   | 4                              |
| Redundancy version coding sequence                     |              |   | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols |   | 1                              |
| Cross carrier scheduling                               |              |   | Not configured                 |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied |                                |
| Note 1: as specified in Table 4.2-1 in TS 36.211 [4].  |              |   |                                |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.2-3, with the addition of the parameters in Table 8.7.2-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE

category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.2-4. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.2-6, with the addition of the parameters in Table 8.7.2-5 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.2-7. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.2-3 is not applicable.

For UE supporting 256QAM and category 9/10 and category 13, the requirements are specified in both Table 8.7.2-3 and Table 8.7.2-6, with the addition of the parameters in Table 8.7.2-2 and in Table 8.7.2-5 respectively. The downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.2-4 and in Table 8.7.2-7 for the category 9/10 and category 13, the TB success rate shall be sustained during at least 300 frames.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.2-2: test parameters for sustained downlink data rate (TDD 64QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          | $\hat{E}_s$ at antenna port (dBm/15 kHz) | ACK/NACK feedback mode | Symbols for unused PRBs |
|------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|--|------------------------|-------------------------|
|      |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ |  |                        |                         |
| 1    | 10              | 1                 | 1 x 2                 | N/A                         | 0                              | 0        | 0        | -85                                      | Bundling               | OP.6 TDD                |
| 1A   | 10              | 1                 | 1x1                   | N/A                         | 0                              | 0        | 0        | -85                                      | Bundling               | OP.6 TDD                |
| 1B   | 20              | 1                 | 1x1                   | N/A                         | 0                              | 0        | 0        | -85                                      | Bundling               | OP.6 TDD                |
| 2    | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | Bundling               | OP.1 TDD                |
| 3    | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | Bundling               | OP.1 TDD                |
| 3A   | 15              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | Multiplexing           | OP.2 TDD                |
| 4,6  | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | Multiplexing           | OP.1 TDD                |
| 6A   | 2x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | -<br>(Note 1)          | OP.1 TDD                |
| 6B   | 20+15           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 7    | 3x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 7A   | 15+20+20        | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 8    | 4x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 9    | 15+3x20         | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 10   | 5x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 11   | 15+4x20         | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 12   | 6x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |
| 13   | 7x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 2)               | OP.1 TDD                |

Note 1: PUCCH format 1b with channel selection is used to feedback ACK/NACK.  
Note 2: PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.2-3: Minimum requirement (TDD 64QAM)**

| Test | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel                                | Reference value     |
|------|---|--|---------------------|
|      |   |  | TB success rate [%] |
| 1    | 10296/0   | R.31-1 TDD   | 95                  |
| 1A   | 10296/0   | R.31-1 TDD   | 95                  |
| 1B   | 10296/0   | R.31-1A TDD  | 95                  |
| 2    | 25456/0   | R.31-2 TDD   | 95                  |
| 3    | 51024/0   | R.31-3 TDD   | 95                  |
| 3A   | 51024/0   | R.31-3A TDD  | 85                  |
| 4    | 75376/0 (Note 2)  | R.31-4 TDD   | 85                  |
| 6    | 75376/0 (Note 2)  | R.31-4 TDD   | 85                  |
| 6A   | 75376/0 (Note 2)  | R.31-4 TDD   | 85                  |
| 6B   | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 2)   | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85                  |
| 7    | 75376/0 (Note 2)  | R.31-4 TDD   | 85                  |
| 7A   | 55056/0 for 15MHz CC  | R.31-5 TDD for 15MHz CC                            | 85                  |

|   |   |  |    |
|---|---|--|----|
|   | 75376/0 for 20MHz CC (Note 2)                         | R.31-4 TDD for 20MHz CC                            |    |
| 8   | 75376/0 (Note 2)                                      | R.31-4 TDD   | 85 |
| 9   | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 2) | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85 |
| 10  | 75376/0 (Note 2)                                      | R.31-4 TDD   | 85 |
| 11  | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 2) | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85 |
| 12  | 75376/0 (Note 2)                                      | R.31-4 TDD   | 85 |
| 13  | 75376/0 (Note 2)                                      | R.31-4 TDD   | 85 |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: 71112 bits for sub-frame 5.</p> <p>Note 3: The TB success rate is defined as TB success rate = 100%*N<sub>DL_correct_rx</sub>/ (N<sub>DL_newtx</sub> + N<sub>DL_retx</sub>), where N<sub>DL_newtx</sub> is the number of newly transmitted DL transport blocks, N<sub>DL_retx</sub> is the number of retransmitted DL transport blocks, and N<sub>DL_correct_rx</sub> is the number of correctly received DL transport blocks.</p> |   |  |    |

**Table 8.7.2-4: Test points for sustained data rate (FRC 64QAM)**

| CA config   | Bandwidth/<br>Bandwidth combination (MHz) | Cat. 1 | Cat. 1bis | Cat. 2 | Cat. 3    | Cat. 4     | Cat. 6,7 | Cat. 9, 10 | Cat. 11, 12    | DL Cat. 15 |
|---|---|--------|-----------|--------|-----------|------------|----------|------------|----------------|------------|
|   |   |        |           |        |           |            |          |            | DL Cat. 11, 12 |            |
| Single carrier  | 10  | 1      | 1A        | 2      | -         | -          | -        | -          | -              | -          |
|   | 15  | -      | -         | -      | 3A        | 3A         | -        | -          | -              | -          |
|   | 20  | -      | 1B        | -      | 3         | 4          | 6        | -          | -              | -          |
| CA with 2CCs  | 20+20                                     | -      | -         | --     | 3(Note 4) | 4 (Note 4) | 6A       | 6A         | -              | -          |
|   | 15+20                                     | -      | -         | -      | 3(Note 4) | 4 (Note 4) | 6B       | 6B         | -              | -          |
| CA with 3 CCs   | 3x20                                      | -      | -         | -      | -         | -          | 6A       | 7          | 7              | -          |
|   | 15+20+20                                  | -      | -         | -      | -         | -          | 6A       | 7A         | 7A             | -          |
| CA with 4 CCs   | 4x20                                      | -      | -         | -      | -         | -          | -        | 7          | 8              | 8          |
|   | 15+3x20                                   | -      | -         | -      | -         | -          | -        | 7          | 9              | 9          |
| CA with 5 CCs   | 5x20                                      |        |           |        |           |            |          |            | 10             | 10         |
|   | 15+4x20                                   |        |           |        |           |            |          |            | 11             | 11         |
| CA with 6 CCs   | 6x20                                      |        |           |        |           |            |          |            | 12             | 12         |
| CA with 7 CCs   | 7x20                                      |        |           |        |           |            |          |            | 13             | 13         |
| <p>Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.</p> <p>Note 2: For non-CA UE, test is selected for maximum supported bandwidth.</p> <p>Note 3: Void.</p> <p>Note 4: If the intra-band contiguous CA is the only CA configuration supported by category 3 or 4 UE, single carrier test is selected.</p> <p>Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.</p> |   |        |           |        |           |            |          |            |                |            |

**Table 8.7.2-5: test parameters for sustained downlink data rate (TDD 256QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          | $\hat{E}_s$ at antenna port (dBm/15 kHz) | ACK/NACK feedback mode | Symbols for unused PRBs |
|------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|--|------------------------|-------------------------|
|      |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ |  |                        |                         |
| 1    | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | Bundling               | OP.1 TDD                |
| 2    | 15+20           | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 3    | 2x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 4    | 3x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 5    | 15+20+20        | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 6    | 4x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 7    | 15+3x20         | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |
| 8    | 5x20            | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | -85                                      | (Note 1)               | OP.1 TDD                |

|    |         |   |       |    |    |    |   |     |          |          |
|----|---------|---|-------|----|----|----|---|-----|----------|----------|
| 9  | 15+4x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 10 | 6x20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 11 | 7x20    | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |

Note 1: For CA test cases, PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.2-6: Minimum requirement (TDD 256QAM)**

| Test | Measurement channel                              | Reference value     |
|------|--|---------------------|
|      |  | TB success rate [%] |
| 1    | R.68 TDD   | 85                  |
| 2    | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85                  |
| 3    | R.68 TDD   | 85                  |
| 4    | R.68 TDD   | 85                  |
| 5    | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85                  |
| 6    | R.68 TDD   | 85                  |
| 7    | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85                  |
| 8    | R.68 TDD   | 85                  |
| 9    | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85                  |
| 10   | R.68 TDD   | 85                  |
| 11   | R.68 TDD   | 85                  |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.  
 Note 2: The TB success rate is defined as  $TB\ success\ rate = 100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks.

**Table 8.7.2-7: Test points for sustained data rate (FRC 256QAM)**

| CA config      | Bandwidth/<br>Bandwidth combination (MHz) | Cat. 11, 12    | DL Cat. 13 | DL Cat. 15 | DL Cat. 16 |  |  |
|----------------|---|----------------|------------|------------|------------|--|--|
|                |   | DL Cat. 11, 12 |            |            |            |  |  |
| Single carrier | 20  | -              | 1          | -          | -          |  |  |
| CA with 2CCs   | 15+20                                     | 2              | 2          | -          | -          |  |  |
|                | 2x20                                      | 3              | 3          | -          | -          |  |  |
| CA with 3 CCs  | 3x20                                      | 4              | 3          | 4          | -          |  |  |
|                | 15+20+20                                  | 5              | 3          | 5          | -          |  |  |
| CA with 4 CCs  | 4x20                                      | 4              | -          | 6          | 6          |  |  |
|                | 15+3x20                                   | 5              | -          | 7          | 7          |  |  |
| CA with 5 CCs  | 5x20                                      |                |            |            | 8          |  |  |
|                | 15+4x20                                   |                |            |            | 9          |  |  |
| CA with 6 CCs  | 6x20                                      |                |            |            | 10         |  |  |
| CA with 7 CCs  | 7x20                                      |                |            |            | 11         |  |  |

### 8.7.3 FDD (EPDCCH scheduling)

The parameters specified in Table 8.7.3-1 are valid for all FDD tests unless otherwise stated.

**Table 8.7.3-1: Common test parameters (FDD)**

| Parameter     | Unit | Value  |
|---------------|------|--------|
| Cyclic prefix |      | Normal |

|   |              |   |
|---|--------------|---|
| Cell ID   |              | 0   |
| Inter-TTI Distance  |              | 1   |
| Number of HARQ processes per component carrier  | Processes    | 8   |
| Maximum number of HARQ transmission   |              | 4   |
| Redundancy version coding sequence  |              | {0,0,1,2} for 64QAM   |
| Number of OFDM symbols for PDCCH per component carrier                                    | OFDM symbols | 1   |
| Cross carrier scheduling  |              | Not configured  |
| Number of EPDCCH sets   |              | 1   |
| EPDCCH transmission type  |              | Localized   |
| Number of PRB per EPDCCH set and EPDCCH PRB pair allocation                               |              | 2 PRB pairs<br>10MHz BW: Resource blocks $n_{PRB} = 48, 49$<br>15MHz BW: Resource blocks $n_{PRB} = 70, 71$<br>20MHz BW: Resource blocks $n_{PRB} = 98, 99$ |
| EPDCCH Starting Symbol  |              | Derived from CFI (i.e. default behaviour)   |
| ECCE Aggregation Level  |              | 2 ECCEs   |
| Number of EREGs per ECCE  |              | 4   |
| EPDCCH scheduling   |              | EPDCCH candidate is randomly assigned in each subframe  |
| EPDCCH precoder (Note 1)  |              | Fixed PMI 0   |
| EPDCCH monitoring SF pattern  |              | 1111111111 0000000000<br>1111111111 0000000000  |
| Timing advance  | $\mu$ s      | 100   |
| Propagation condition   |              | Static propagation condition<br>No external noise sources are applied   |
| Note 1: EPDCCH precoder parameters are defined for tests with 2 x 2 antenna configuration |              |   |

The requirements are specified in Table 8.7.3-3, with the addition of the parameters in Table 8.7.3-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.3-4. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.3-2: Test parameters for SDR test for PDSCH scheduled by EPDCCH (FDD)**

| Test   | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          |          | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|--------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|----------|---|-------------------------|
|        |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ | $\delta$ |   |                         |
| 1      | 10              | 1                 | 1 x 2                 | N/A                         | 0                              | 0        | 0        | 0        | -85                                     | OP.6 FDD                |
| 2      | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 FDD                |
| 3,4,6  | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 FDD                |
| 3A     | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 FDD                |
| 3C, 4B | 15              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 FDD                |

**Table 8.7.3-3: Minimum requirement (FDD)**

| Test | Measurement channel | Reference value |
|------|---------------------|-----------------|
|------|---------------------|-----------------|

|         | Number of bits of a DL-SCH transport block received within a TTI   |              | TB success rate [%] |
|---------|--|--------------|---------------------|
| 1       | 10296  | R.31E-1 FDD  | 95                  |
| 2       | 25456  | R.31E-2 FDD  | 95                  |
| 3       | 51024  | R.31E-3 FDD  | 95                  |
| 3A      | 36696 (Note 2)   | R.31E-3A FDD | 85                  |
| 3C      | 51024  | R.31E-3C FDD | 85                  |
| 4       | 75376 (Note 3)   | R.31E-4 FDD  | 85                  |
| 4B      | 55056 (Note 5)   | R.31E-4B FDD | 85                  |
| 6       | 75376 (Note 3)   | R.31E-4 FDD  | 85                  |
| Note 1: | For 2 layer transmissions, 2 transport blocks are received within a TTI.   |              |                     |
| Note 2: | 35160 bits for sub-frame 5.  |              |                     |
| Note 3: | 71112 bits for sub-frame 5.  |              |                     |
| Note 4: | The TB success rate is defined as TB success rate = $100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. |              |                     |
| Note 5: | 52752 bits for sub-frame 5.  |              |                     |

Table 8.7.3-4: Test points for sustained data rate (FRC)

| CA config   | Bandwidth (MHz) | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|---|-----------------|------------|------------|------------|------------|------------|------------|
| Single carrier  | 10              | 1          | 2          | 3A         | 3A         | -          | -          |
|   | 15              | -          | -          | 3C         | 4B         | -          | -          |
|   | 20              | -          | -          | 3          | 4          | 6          | 6          |
| Note 1: The test is selected for maximum supported bandwidth. |                 |            |            |            |            |            |            |

## 8.7.4 TDD (EPDCCH scheduling)

The parameters specified in Table 8.7.4-1 are valid for all TDD tests unless otherwise stated.

Table 8.7.4-1: Common test parameters (TDD)

| Parameter   | Unit         | Value   |
|---|--------------|---|
| Special subframe configuration (Note 1)                     |              | 4   |
| Cyclic prefix   |              | Normal  |
| Cell ID   |              | 0   |
| Inter-TTI Distance  |              | 1   |
| Maximum number of HARQ transmission                         |              | 4   |
| Redundancy version coding sequence                          |              | {0,0,1,2} for 64QAM   |
| Number of OFDM symbols for PDCCH per component carrier      | OFDM symbols | 1   |
| Cross carrier scheduling                                    |              | Not configured  |
| Number of EPDCCH sets                                       |              | 1   |
| EPDCCH transmission type                                    |              | Localized   |
| Number of PRB per EPDCCH set and EPDCCH PRB pair allocation |              | 2 PRB pairs<br>10MHz BW: Resource blocks $n_{PRB} = 48, 49$<br>15MHz BW: Resource blocks $n_{PRB} = 70, 71$<br>20MHz BW: Resource blocks $n_{PRB} = 98, 99$ |
| EPDCCH Starting Symbol                                      |              | Derived from CFI (i.e. default behaviour)   |
| ECCE Aggregation Level                                      |              | 2 ECCEs   |

|   |    |  |
|---|----|--|
| Number of EREGs per ECCE  |    | 4 for normal subframe and for special subframe   |
| EPDCCH scheduling   |    | EPDCCH candidate is randomly assigned in each subframe   |
| EPDCCH precoder (Note 2)  |    | Fixed PMI 0  |
| EPDCCH monitoring SF pattern  |    | UL-DL configuration 1: 1101111111<br>0000000000<br>UL-DL configuration 5: 1100111001<br>0000000000 |
| Timing advance  | μs | 100  |
| Propagation condition   |    | Static propagation condition<br>No external noise sources are applied                              |
| Note 1: As specified in Table 4.2-1 in TS 36.211 [4].                                     |    |  |
| Note 2: EPDCCH precoder parameters are defined for tests with 2 x 2 antenna configuration |    |  |

The requirements are specified in Table 8.7.4-3, with the addition of the parameters in Table 8.7.4-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.4-4. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.4-2: Test parameters for SDR test for PDSCH scheduled by EPDCCH (TDD)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) |          |          |          | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs | ACK/NACK feedback mode |
|------|-----------------|-------------------|-----------------------|-----------------------------|--------------------------------|----------|----------|----------|---|-------------------------|------------------------|
|      |                 |                   |                       |                             | $\rho_A$                       | $\rho_B$ | $\sigma$ | $\delta$ |   |                         |                        |
| 1    | 10              | 1                 | 1 x 2                 | N/A                         | 0                              | 0        | 0        | 0        | -85                                     | OP.6 TDD                | Bundling               |
| 2    | 10              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 TDD                | Bundling               |
| 3    | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 TDD                | Bundling               |
| 3A   | 15              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.2 TDD                | Multiplexing           |
| 4,6  | 20              | 3                 | 2 x 2                 | 10                          | -3                             | -3       | 0        | 3        | -85                                     | OP.1 TDD                | Multiplexing           |

**Table 8.7.4-3: Minimum requirement (TDD)**

| Test | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel | Reference value     |
|------|---|---------------------|---------------------|
|      |   |                     | TB success rate [%] |
| 1    | 10296/0   | R.31E-1 TDD         | 95                  |
| 2    | 25456/0   | R.31E-2 TDD         | 95                  |
| 3    | 51024/0   | R.31E-3 TDD         | 95                  |
| 3A   | 51024/0   | R.31E-3A TDD        | 85                  |
| 4    | 75376/0 (Note 2)  | R.31E-4 TDD         | 85                  |
| 6    | 75376/0 (Note 2)  | R.31E-4 TDD         | 85                  |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.  
 Note 2: 71112 bits for sub-frame 5.  
 Note 3: The TB success rate is defined as TB success rate = 100% \*  $N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks.

**Table 8.7.4-4: Test points for sustained data rate (FRC)**

| CA config | Bandwidth/ Bandwidth combination | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|-----------|----------------------------------|------------|------------|------------|------------|------------|------------|
|-----------|----------------------------------|------------|------------|------------|------------|------------|------------|



|                | (MHz) |   |   |    |    |   |   |
|----------------|-------|---|---|----|----|---|---|
| Single carrier | 10    | 1 | 2 | -  | -  | - | - |
|                | 15    | - | - | 3A | 3A | - | - |
|                | 20    | - | - | 3  | 4  | 6 | 6 |

Note 1: The test is selected for maximum supported bandwidth.

## 8.7.5 TDD FDD CA

The parameters specified in Table 8.7.5-1 are valid for all TDD FDD CA tests unless otherwise stated.

**Table 8.7.5-1: Common Test Parameters (TDD FDD CA)**

| Parameter  | Unit  | Value        |   |
|--|---|--------------|---|
| Uplink downlink configuration (Note 1) for TDD CC      |   |              | 1   |
| Special subframe configuration (Note 2) for TDD CC     |   |              | 4   |
| Downlink power allocation                              | $\rho_A$                                      | dB           | -3  |
|  | $\rho_B$                                      | dB           | -3  |
|  | $\sigma$                                      | dB           | 0   |
| Cyclic prefix  |   |              | Normal  |
| Cell ID  |   |              | 0   |
| Inter-TTI Distance                                     |   |              | 1   |
| Maximum number of HARQ processes per component carrier | FDD PCell                                     | Processes    | 8 for FDD and TDD CCs   |
|  | TDD PCell                                     | Processes    | 11 for FDD CC; 7 for TDD CC   |
| Maximum number of HARQ transmission                    |   |              | 4   |
| Redundancy version coding sequence                     |   |              | {0,0,1,2} for 64QAM, 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier |   | OFDM symbols | 1   |
| Cross carrier scheduling                               |   |              | Not configured  |
| Propagation condition                                  |   |              | Static propagation condition<br>No external noise sources are applied |
| Transmission mode                                      |   |              | TM3   |
| Codebook subset restriction                            |   |              | 10  |
| Antenna configuration                                  |   |              | 2 x 2   |
| $\hat{E}_s$ at antenna port (dBm/15kHz)                |   |              | -85   |
| Symbols for unused PRBs                                |   |              | OP.1 FDD for FDD CC,<br>OP.1 TDD for TDD CC                           |
| ACK/NACK feedback mode                                 |   |              | PUCCH format 3  |
| Downlink HARQ-ACK timing                               | FDD PCell                                     |              | As specified in Clause 7.3.3 in TS36.213 [6]                          |
|  | TDD PCell                                     |              | As specified in Clause 7.3.4 in TS36.213 [6]                          |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4]. |              |   |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4]. |              |   |

### 8.7.5.1 Minimum Requirement FDD PCell

For UE not supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.1-1 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.5.1-2. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.1-3 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category or UE DL category, and bandwidth combination with the maximum aggregated bandwidth as specified in Table 8.7.5.1-4. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.5.1-1 is not applicable.

The applicability of the requirements are specified in Clause 8.1.2.3B. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.5.1-1: test parameters for sustained downlink data rate (TDD FDD CA 64QAM)**

| Test number | Bandwidth (MHz) |         |        | Number of bits of a DL-SCH transport block received within a TTI (for normal/special subframe for TDD, except for subframe #5) |  | Measurement channel                                  |  | Reference value     |
|-------------|-----------------|---------|--------|--|--|--|--|---------------------|
|             | Total           | FDD CC  | TDD CC | FDD CC   | TDD CC                                       | FDD CC   | TDD CC   | TB success rate [%] |
| 1           | 2x20            | 20      | 20     | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |
| 2           | 10+20           | 10      | 20     | 36696  | 75376/0                                      | R.31-3A FDD  | R.31-4 TDD   | 85                  |
| 2A          | 15+20           | 15      | 20     | 55056  | 75376/0                                      | R.31-5 FDD   | R.31-4 TDD   | 85                  |
| 3           | 10+10           | 10      | 10     | 36696  | 36696/0                                      | R.31-3A FDD  | R.31-6 TDD   | 85                  |
| 4           | 3x20            | 20      | 2x20   | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |
| 5           | 15+20+20        | 15      | 2x20   | 55056  | 75376/0                                      | R.31-5 FDD   | R.31-4 TDD   | 85                  |
| 6           | 10+20+20        | 10      | 2x20   | 36696  | 75376/0                                      | R.31-3A FDD  | R.31-4 TDD   | 85                  |
| 7           | 3x20            | 2x20    | 20     | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |
| 8           | 20+20+15        | 20+15   | 20     | 75376 for 20MHz CC<br>55056 for 15MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC  | R.31-4 TDD   | 85                  |
| 9           | 20+20+10        | 20+10   | 20     | 75376 for 20MHz CC<br>36696 for 10MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-3A FDD for 10MHz CC | R.31-4 TDD   | 85                  |
| 9A          | 20+10+10        | 2x10    | 20     | 36696  | 75376/0                                      | R.31-3A  | R.31-4 TDD   | 85                  |
| 9B          | 10+15+20        | 10      | 15+20  | 36696  | 75376/0 for 20MHz CC<br>55056/0 for 15MHz CC | R.31-3A FDD  | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85                  |
| 9C          | 10+15+20        | 10+15   | 20     | 36696 for 10MHz CC<br>55056 for 15MHz CC   | 75376/0                                      | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC  | R.31-4 TDD   | 85                  |
| 10          | 4x20            | 20      | 3x20   | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |
| 11          | 4x20            | 2x20    | 2x20   | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |
| 12          | 3x20+15         | 20+15   | 2x20   | 75376 for 20MHz CC<br>55056 for 15MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC  | R.31-4 TDD   | 85                  |
| 13          | 2x15+2x20       | 2x15    | 2x20   | 55056  | 75376/0                                      | R.31-5 FDD   | R.31-4 TDD   | 85                  |
| 14          | 3x20+15         | 2x20+15 | 20     | 75376 for 20MHz CC<br>55056 for 15MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC  | R.31-4 TDD   | 85                  |
| 15          | 2x15+2x20       | 2x15+20 | 20     | 75376 for 20MHz CC<br>55056 for 15MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC  | R.31-4 TDD   | 85                  |
| 15A         | 3x20+10         | 2x20+10 | 20     | 75376 for 20MHz CC<br>36696 for 10MHz CC   | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-3A FDD for 10MHz CC | R.31-4 TDD   | 85                  |
| 15B         | 4x20            | 3x20    | 20     | 75376  | 75376/0                                      | R.31-4 FDD   | R.31-4 TDD   | 85                  |

|     |               |          |       |  |  |   |  |    |
|-----|---------------|----------|-------|--|--|---|--|----|
| 15C | 10+3x20       | 10       | 3x20  | 36696  | 75376/0                                      | R.31-3A FDD   | R.31-4 TDD   | 85 |
| 15D | 2x10+2x20     | 2x10     | 2x20  | 36696  | 75376/0                                      | R.31-3A FDD   | R.31-4 TDD   | 85 |
| 15E | 2x10+20+15    | 2x10     | 20+15 | 36696  | 75376/0 for 20MHz CC<br>55056/0 for 15MHz CC | R.31-3A FDD   | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85 |
| 15F | 10+3x20       | 10+20    | 2x20  | 75376 for 20MHz CC<br>36696 for 10MHz CC                       | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-3A FDD for 10MHz CC                            | R.31-4 TDD   | 85 |
| 15G | 10+15+2x20    | 10+15    | 2x20  | 36696 for 10MHz CC<br>55056 for 15MHz CC                       | 75376/0                                      | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC                             | R.31-4 TDD   | 85 |
| 15H | 10+15+2x20    | 10+15+20 | 20    | 36696 for 10MHz CC<br>55056 for 15MHz CC<br>75376 for 20MHz CC | 75376/0                                      | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC  | R.31-4 TDD   | 85 |
| 16  | 4x20+15       | 2x20+15  | 2x20  | 75376 for 20MHz CC<br>55056 for 15MHz CC                       | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC                             | R.31-4 TDD   | 85 |
| 17  | 2x15+3x20     | 2x15+20  | 2x20  | 75376 for 20MHz CC<br>55056 for 15MHz CC                       | 75376/0                                      | R.31-4 FDD for 20MHz CC,<br>R.31-5 FDD for 15MHz CC                             | R.31-4 TDD   | 85 |
| 18  | 4x20+20       | 4x20     | 20    | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 19  | 3x20+2x20     | 3x20     | 2x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 20  | 2x20+3x20     | 2x20     | 3x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 21  | 20+4x20       | 20       | 4x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 22  | 10+4x20       | 10       | 4x20  | 36696 for 10MHz CC   | 75376/0                                      | R.31-3A FDD for 10MHz CC  | R.31-4 TDD   | 85 |
| 23  | 10+20+3x20    | 10+20    | 3x20  | 36696 for 10MHz CC<br>75376 for 20MHz CC                       | 75376/0                                      | R.31-3A FDD for 10MHz CC,<br>R.31-4 FDD for 20MHz CC                            | R.31-4 TDD   | 85 |
| 24  | 2x10+3x20     | 2x10     | 3x20  | 36696 for 10MHz CC   | 75376/0                                      | R.31-3A FDD for 10MHz CC  | R.31-4 TDD   | 85 |
| 25  | 10+2x20+2x20  | 10+2x20  | 2x20  | 36696 for 10MHz CC<br>75376 for 20MHz CC                       | 75376/0                                      | R.31-3A FDD for 10MHz CC,<br>R.31-4 FDD for 20MHz CC                            | R.31-4 TDD   | 85 |
| 26  | 10+15+20+2x20 | 10+15+20 | 2x20  | 36696 for 10MHz CC<br>55056 for 15MHz CC<br>75376 for 20MHz CC | 75376/0                                      | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC, | R.31-4 TDD   | 85 |
| 27  | 20+5x20       | 20       | 5x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 28  | 2x20+4x20     | 2x20     | 4x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 29  | 20+6x20       | 20       | 6x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 30  | 2x20+5x20     | 2x20     | 5x20  | 75376  | 75376/0                                      | R.31-4 FDD  | R.31-4 TDD   | 85 |

Table 8.7.5.1-2: Test points for sustained data rate (FRC 64QAM)

| CA config       | Maximum supported Bandwidth/<br>Bandwidth combination (MHz) |        |        | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,<br>7    | Cat. 9,<br>10    | Cat 11,<br>12     | DL Cat.<br>15 |
|-----------------|---|--------|--------|--------|--------|--------|--------|-----------------|------------------|-------------------|---------------|
|                 | Total   | FDD CC | TDD CC |        |        |        |        | DL Cat.<br>6, 7 | DL Cat.<br>9, 10 | DL Cat.<br>11, 12 |               |
| CA with<br>2CCs | 2x20  | 20     | 20     | -      | -      | 3      | 3      | 1               | 1                | -                 | -             |
|                 | 10+20   | 10     | 20     | -      | -      | 3      | 3      | 2               | 2                | -                 | -             |
|                 | 15+20   | 15     | 20     | -      | -      | 3      | 3      | 2A              | 2A               | -                 | -             |

|               |  |         |       |   |   |   |    |    |        |     |     |
|---------------|--|---------|-------|---|---|---|----|----|--------|-----|-----|
|               | 10+10  | 10      | 10    | - | - | 3 | 3  | 3  | 3      | -   | -   |
| CA with 3CCs  | 3x20   | 20      | 2x20  | - | - | - | -  | 1  | 4      | 4   | -   |
|               | 15+20+20   | 15      | 2x20  | - | - | - | -  | 2A | 5      | 5   | -   |
|               | 10+20+20   | 10      | 2x20  | - | - | - | -  | 2  | 6      | 6   | -   |
|               | 3x20   | 2x20    | 20    | - | - | - | -  | 1  | 7      | 7   | -   |
|               | 20+20+15   | 20+15   | 20    | - | - | - | -  | 1  | 8      | 8   | -   |
|               | 20+20+10   | 20+10   | 20    | - | - | - | -  | 1  | 9      | 9   | -   |
|               | 20+10+10   | 2x10    | 20    | - | - | - | -  | 2  | 9A     | 9A  | -   |
|               | 10+15+20   | 10      | 15+20 |   |   |   |    | 2  | 9B     | 9B  |     |
| 10+15+20      | 10+15  | 20      |       |   |   |   | 2A | 9C | 9C     |     |     |
| CA with 4CCs  | 4x20   | 20      | 3x20  | - | - | - | -  | -  | 4      | 10  | 10  |
|               | 4x20   | 2x20    | 2x20  | - | - | - | -  | -  | 4 or 7 | 11  | 11  |
|               | 3x20+15  | 20+15   | 2x20  | - | - | - | -  | -  | 4      | 12  | 12  |
|               | 2x15+2x20  | 2x15    | 2x20  | - | - | - | -  | -  | 5      | 13  | 13  |
|               | 3x20+15  | 2x20+15 | 20    | - | - | - | -  | -  | 7      | 14  | 14  |
|               | 2x15+2x20  | 2x15+20 | 20    | - | - | - | -  | -  | 8      | 15  | 15  |
|               | 3x20+10  | 2x20+10 | 20    | - | - | - | -  | -  | 7      | 15A | 15A |
|               | 4x20   | 2x15+20 | 20    | - | - | - | -  | -  | 8      | 15B | 15B |
|               | 10+3x20  | 10      | 3x20  |   |   |   |    |    | 6      | 15C | 15C |
|               | 2x10+2x20  | 2x10    | 2x20  |   |   |   |    |    | 6      | 15D | 15D |
|               | 2x10+20+15   | 2x10    | 20+15 |   |   |   |    |    | 9A     | 15E | 15E |
|               | 10+3x20  | 10+20   | 2x20  |   |   |   |    |    | 4      | 15F | 15F |
| 10+15+2x20    | 10+15  | 2x20    |       |   |   |   |    | 5  | 15G    | 15G |     |
| 10+15+2x20    | 10+15+20   | 20      |       |   |   |   |    | 8  | 15H    | 15H |     |
| CA with 5 CCs | 4x20+15  | 2x20+15 | 2x20  | - | - | - | -  | -  | -      | 11  | 16  |
|               | 2x15+3x20  | 2x15+20 | 2x20  | - | - | - | -  | -  | -      | 12  | 17  |
|               | 4x20+20  | 4x20    | 20    |   |   |   |    |    |        |     | 18  |
|               | 3x20+2x20  | 3x20    | 2x20  |   |   |   |    |    |        |     | 19  |
|               | 2x20+3x20  | 2x20    | 3x20  |   |   |   |    |    |        |     | 20  |
|               | 20+4x20  | 20      | 4x20  |   |   |   |    |    |        |     | 21  |
|               | 10+4x20  | 10      | 4x20  |   |   |   |    |    |        |     | 22  |
|               | 10+20+3x20   | 10+20   | 3x20  |   |   |   |    |    |        |     | 23  |
|               | 2x10+3x20  | 2x10    | 3x20  |   |   |   |    |    |        |     | 24  |
|               | 10+2x20+2x20   | 10+2x20 | 2x20  |   |   |   |    |    |        |     | 25  |
| 10+15+20+2x20 | 10+15+20   | 2x20    |       |   |   |   |    |    |        | 26  |     |
| CA with 6 CCs | 20+5x20  | 20      | 5x20  |   |   |   |    |    |        |     | 27  |
|               | 2x20+4x20  | 2x20    | 4x20  |   |   |   |    |    |        |     | 28  |
| CA with 7 CCs | 20+6x20  | 20      | 6x20  |   |   |   |    |    |        |     | 29  |
|               | 2x20+5x20  | 2x20    | 5x20  |   |   |   |    |    |        |     | 30  |
| Note 1:       | Void.  |         |       |   |   |   |    |    |        |     |     |
| Note 2:       | Void.  |         |       |   |   |   |    |    |        |     |     |
| Note 3:       | If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. |         |       |   |   |   |    |    |        |     |     |

Table 8.7.5.1-3: Minimum requirement (TDD FDD CA 256QAM)

| Test number | Bandwidth (MHz) |        |        | Measurement channel    |          | Reference value     |
|-------------|-----------------|--------|--------|------------------------|----------|---------------------|
|             | Total           | FDD CC | TDD CC | FDD CC                 | TDD CC   | TB success rate [%] |
| 1           | 2x20            | 20     | 20     | R.68 FDD               | R.68 TDD | 85                  |
| 2           | 10+20           | 10     | 20     | R.68-2 FDD             | R.68 TDD | 85                  |
| 3           | 15+20           | 15     | 20     | R.68-1 FDD             | R.68 TDD | 85                  |
| 4           | 3x20            | 20     | 2x20   | R.68 FDD               | R.68 TDD | 85                  |
| 5           | 15+20+20        | 15     | 2x20   | R.68-1 FDD             | R.68 TDD | 85                  |
| 6           | 10+20+20        | 10     | 2x20   | R.68-2 FDD             | R.68TDD  | 85                  |
| 7           | 3x20            | 2x20   | 20     | R.68 FDD               | R.68 TDD | 85                  |
| 8           | 20+20+15        | 20+15  | 20     | R.68 FDD for 20MHz CC, | R.68 TDD | 85                  |

|     |            |          |       |   |  |    |
|-----|------------|----------|-------|---|--|----|
|     |            |          |       | R.68-1 FDD for 15MHz CC   |  |    |
| 9   | 20+20+10   | 20+10    | 20    | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD   | 85 |
| 9A  | 20+10+10   | 2x10     | 20    | R.68-2 FDD  | R.68 TDD   | 85 |
| 9B  | 10+15+20   | 10       | 15+20 | R.68-2 FDD  | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85 |
| 9C  | 10+15+20   | 10+15    | 20    | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC                        | R.68 TDD   | 85 |
| 10  | 4x20       | 20       | 3x20  | R.68 FDD  | R.68TDD  | 85 |
| 11  | 4x20       | 2x20     | 2x20  | R.68 FDD  | R.68 TDD   | 85 |
| 12  | 3x20+15    | 20+15    | 2x20  | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 13  | 2x15+2x20  | 2x15     | 2x20  | R.68-1 FDD  | R.68 TDD   | 85 |
| 14  | 3x20+15    | 2x20+15  | 20    | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 15  | 2x15+2x20  | 2x15+20  | 20    | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 15A | 3x20+10    | 2x20+10  | 20    | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD   | 85 |
| 15B | 4x20       | 3x20     | 20    | R.68 FDD  | R.68TDD  | 85 |
| 15C | 10+3x20    | 10       | 3x20  | R.68-2 FDD  | R.68TDD  | 85 |
| 15D | 2x10+2x20  | 2x10     | 2x20  | R.68-2 FDD  | R.68TDD  | 85 |
| 15E | 2x10+20+15 | 2x10     | 20+15 | R.68-2 FDD  | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85 |
| 15F | 10+3x20    | 10+20    | 2x20  | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD   | 85 |
| 15G | 10+15+2x20 | 10+15    | 2x20  | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC                        | R.68 TDD   | 85 |
| 15H | 10+15+2x20 | 10+15+20 | 20    | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC, R.68 FDD for 20MHz CC | R.68 TDD   | 85 |
| 16  | 4x20+15    | 2x20+15  | 2x20  | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 17  | 2x15+3x20  | 2x15+20  | 2x20  | R.68 FDD for 20MHz CC,  | R.68 TDD   | 85 |

|    |               |          |      |   |          |    |
|----|---------------|----------|------|---|----------|----|
|    |               |          |      | R.68-1 FDD for 15MHz CC   |          |    |
| 18 | 4x20+20       | 4x20     | 20   | R.68 FDD  | R.68TDD  | 85 |
| 19 | 3x20+2x20     | 3x20     | 2x20 | R.68 FDD  | R.68 TDD | 85 |
| 20 | 2x20+3x20     | 2x20     | 3x20 | R.68 FDD  | R.68TDD  | 85 |
| 21 | 20+4x20       | 20       | 4x20 | R.68 FDD  | R.68 TDD | 85 |
| 22 | 10+4x20       | 10       | 4x20 | R.68-2 FDD  | R.68 TDD | 85 |
| 23 | 10+20+3x20    | 10+20    | 3x20 | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD | 85 |
| 24 | 2x10+3x20     | 2x10     | 3x20 | R.68-2 FDD  | R.68 TDD | 85 |
| 25 | 10+2x20+2x20  | 10+2x20  | 2x20 | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD | 85 |
| 26 | 10+15+20+2x20 | 10+15+20 | 2x20 | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC, R.68 FDD for 20MHz CC | R.68 TDD | 85 |
| 27 | 20+5x20       | 20       | 5x20 | R.68 FDD  | R.68 TDD | 85 |
| 28 | 2x20+4x20     | 2x20     | 4x20 | R.68 FDD  | R.68 TDD | 85 |
| 29 | 20+6x20       | 20       | 6x20 | R.68 FDD  | R.68 TDD | 85 |
| 30 | 2x20+5x20     | 2x20     | 5x20 | R.68 FDD  | R.68 TDD | 85 |

Table 8.7.5.1-4: Test points for sustained data rate (FRC 256QAM)

| CA config    | Maximum supported Bandwidth/ Bandwidth combination (MHz) |         |        | Cat. 11, 12<br>DL Cat. 11, 12 | DL Cat. 13 | DL Cat. 15 | DL Cat. 16 |  |  |
|--------------|--|---------|--------|-------------------------------|------------|------------|------------|--|--|
|              | Total  | FDD CC  | TDD CC |                               |            |            |            |  |  |
| CA with 2CCs | 2x20   | 20      | 20     | 1                             | 1          | -          | -          |  |  |
|              | 10+20  | 10      | 20     | 2                             | 2          |            |            |  |  |
|              | 15+20  | 15      | 20     | 3                             | 3          | -          | -          |  |  |
| CA with 3CCs | 3x20   | 20      | 2x20   | 4                             | 1          | 4          | -          |  |  |
|              | 15+20+20   | 15      | 2x20   | 5                             | 3          | 5          | -          |  |  |
|              | 10+20+20   | 10      | 2x20   | 6                             | 2          | 6          | -          |  |  |
|              | 3x20   | 2x20    | 20     | 7                             | 1          | 7          | -          |  |  |
|              | 20+20+15   | 20+15   | 20     | 8                             | 1          | 8          | -          |  |  |
|              | 20+20+10   | 20+10   | 20     | 9                             | 1          | 9          | -          |  |  |
|              | 20+10+10   | 2x10    | 20     | 9A                            | 2          | 9A         |            |  |  |
|              | 10+15+20   | 10      | 15+20  | 9B                            | 2          | 9B         |            |  |  |
| 10+15+20     | 10+15  | 20      | 9C     | 3                             | 9C         |            |            |  |  |
| CA with 4CCs | 4x20   | 20      | 3x20   | 4                             | -          | 10         | 10         |  |  |
|              | 4x20   | 2x20    | 2x20   | 4 or 7                        | -          | 11         | 11         |  |  |
|              | 3x20+15  | 20+15   | 2x20   | 8                             | -          | 12         | 12         |  |  |
|              | 2x15+2x20  | 2x15    | 2x20   | 5                             | -          | 13         | 13         |  |  |
|              | 3x20+15  | 2x20+15 | 20     | 7                             | -          | 14         | 14         |  |  |
|              | 2x15+2x20  | 2x15+20 | 20     | 8                             | -          | 15         | 15         |  |  |
|              | 3x20+10  | 2x20+10 | 20     | 7                             | -          | 15A        | 15A        |  |  |
|              | 4x20   | 2x15+20 | 20     | 8                             | -          | 15B        | 15B        |  |  |
|              | 10+3x20  | 10      | 3x20   | 6                             | -          | 15C        | 15C        |  |  |
|              | 2x10+2x20  | 2x10    | 2x20   | 6                             | -          | 15D        | 15D        |  |  |
|              | 2x10+20+15   | 2x10    | 20+15  | 9A                            | -          | 15E        | 15E        |  |  |
|              | 10+3x20  | 10+20   | 2x20   | 4                             | -          | 15F        | 15F        |  |  |
|              | 10+15+2x20   | 10+15   | 2x20   | 5                             | -          | 15G        | 15G        |  |  |
| 10+15+2x20   | 10+15+20   | 20      | 8      | -                             | 15H        | 15H        |            |  |  |

|  |              |         |      |   |   |          |    |  |  |
|--|--------------|---------|------|---|---|----------|----|--|--|
| CA with 5CCs   | 4x20+15      | 2x20+15 | 2x20 | - | - | 14 or 12 | 16 |  |  |
|  | 2x15+3x20    | 2x15+20 | 2x20 | - | - | 15 or 12 | 17 |  |  |
|  | 4x20+20      | 4x20    | 20   |   |   |          | 18 |  |  |
|  | 3x20+2x20    | 3x20    | 2x20 |   |   |          | 19 |  |  |
|  | 2x20+3x20    | 2x20    | 3x20 |   |   |          | 20 |  |  |
|  | 20+4x20      | 20      | 4x20 |   |   |          | 21 |  |  |
|  | 10+4x20      | 10      | 4x20 |   |   |          | 22 |  |  |
|  | 10+20+3x20   | 10+20   | 3x20 |   |   |          | 23 |  |  |
|  | 2x10+3x20    | 2x10    | 3x20 |   |   |          | 24 |  |  |
|  | 10+2x20+2x20 | 10+2x20 | 2x20 |   |   |          | 25 |  |  |
| 10+15+20+2x20  | 10+15+20     | 2x20    |      |   |   | 26       |    |  |  |
| CA with 6CCs   | 20+5x20      | 20      | 5x20 |   |   |          | 27 |  |  |
|  | 2x20+4x20    | 2x20    | 4x20 |   |   |          | 28 |  |  |
| CA with 7CCs   | 20+6x20      | 20      | 6x20 |   |   |          | 29 |  |  |
|  | 2x20+5x20    | 2x20    | 5x20 |   |   |          | 30 |  |  |
| Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. |              |         |      |   |   |          |    |  |  |

### 8.7.5.2 Minimum Requirement TDD PCell

For UE not supporting 256QAM, the requirements for TDD FDD CA with TDD PCell are specified in Table 8.7.5.2-1 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.5.2-2. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.2-3 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category or UE DL category, and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.5.2-4. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.5.2-1 is not applicable.

The applicability of their requirements are specified in Clause 8.1.2.3B. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.5.2-1: test parameters for sustained downlink data rate (TDD FDD CA 64QAM)**

| Test number | Bandwidth (MHz) |        |        | Number of bits of a DL-SCH transport block received within a TTI (for normal/special subframe for TDD, except for subframe #5) |         | Measurement channel                              |            | Reference value     |
|-------------|-----------------|--------|--------|--|---------|--|------------|---------------------|
|             | Total           | FDD CC | TDD CC | FDD CC   | TDD CC  | FDD CC   | TDD CC     | TB success rate [%] |
| 1           | 2x20            | 20     | 20     | 75376  | 75376/0 | R.31-4 FDD                                       | R.31-4 TDD | 85                  |
| 2           | 10+20           | 10     | 20     | 36696  | 75376/0 | R.31-3A FDD                                      | R.31-4 TDD | 85                  |
| 2A          | 15+20           | 15     | 20     | 55056  | 75376/0 | R.31-5 FDD                                       | R.31-4 TDD | 85                  |
| 3           | 10+10           | 10     | 10     | 36696  | 36696/0 | R.31-3A FDD                                      | R.31-6 TDD | 85                  |
| 4           | 3x20            | 20     | 2x20   | 75376  | 75376/0 | R.31-4 FDD                                       | R.31-4 TDD | 85                  |
| 5           | 15+20+20        | 15     | 2x20   | 55056  | 75376/0 | R.31-5 FDD                                       | R.31-4 TDD | 85                  |
| 6           | 10+20+20        | 10     | 2x20   | 36696  | 75376/0 | R.31-3A FDD                                      | R.31-4 TDD | 85                  |
| 7           | 3x20            | 2x20   | 20     | 75376  | 75376/0 | R.31-4 FDD                                       | R.31-4 TDD | 85                  |
| 8           | 20+20+15        | 20+15  | 20     | 75376 for 20MHz CC<br>55056 for 15MHz CC   | 75376/0 | R.31-4 FDD for 20MHz CC, R.31-5 FDD for 15MHz CC | R.31-4 TDD | 85                  |

|     |            |          |       |   |  |   |  |    |
|-----|------------|----------|-------|---|--|---|--|----|
| 9   | 20+20+10   | 20+10    | 20    | 75376 for<br>20MHz CC<br>36696 for<br>10MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-3A<br>FDD for<br>10MHz CC                           | R.31-4 TDD   | 85 |
| 9A  | 20+10+10   | 2x10     | 20    | 36696   | 75376/0  | R.31-3A   | R.31-4 TDD   | 85 |
| 9B  | 10+15+20   | 10       | 15+20 | 36696   | 75376/0<br>for 20MHz<br>CC<br>55056/0<br>for 15MHz<br>CC | R.31-3A FDD   | R.31-5 TDD<br>for 15MHz<br>CC<br>R.31-4 TDD<br>for 20MHz<br>CC | 85 |
| 9C  | 10+15+20   | 10+15    | 20    | 36696 for<br>10MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-3A FDD<br>for 10MHz CC<br>R.31-5 FDD<br>for 15MHz CC                               | R.31-4 TDD   | 85 |
| 10  | 4x20       | 20       | 3x20  | 75376   | 75376/0  | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 11  | 4x20       | 2x20     | 2x20  | 75376   | 75376/0  | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 12  | 3x20+15    | 20+15    | 2x20  | 75376 for<br>20MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-5<br>FDD for<br>15MHz CC                            | R.31-4 TDD   | 85 |
| 13  | 2x15+2x20  | 2x15     | 2x20  | 55056   | 75376/0  | R.31-5 FDD  | R.31-4 TDD   | 85 |
| 14  | 3x20+15    | 2x20+15  | 20    | 75376 for<br>20MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-5<br>FDD for<br>15MHz CC                            | R.31-4 TDD   | 85 |
| 15  | 2x15+2x20  | 2x15+20  | 20    | 75376 for<br>20MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-5<br>FDD for<br>15MHz CC                            | R.31-4 TDD   | 85 |
| 15A | 3x20+10    | 2x20+10  | 20    | 75376 for<br>20MHz CC<br>36696 for<br>10MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-3A<br>FDD for<br>10MHz CC                           | R.31-4 TDD   | 85 |
| 15B | 4x20       | 3x20     | 20    | 75376   | 75376/0  | R.31-4 FDD  | R.31-4 TDD   | 85 |
| 15C | 10+3x20    | 10       | 3x20  | 36696   | 75376/0  | R.31-3A FDD   | R.31-4 TDD   | 85 |
| 15D | 2x10+2x20  | 2x10     | 2x20  | 36696   | 75376/0  | R.31-3A FDD   | R.31-4 TDD   | 85 |
| 15E | 2x10+20+15 | 2x10     | 20+15 | 36696   | 75376/0<br>for 20MHz<br>CC<br>55056/0<br>for 15MHz<br>CC | R.31-3A FDD   | R.31-5 TDD<br>for 15MHz<br>CC<br>R.31-4 TDD<br>for 20MHz<br>CC | 85 |
| 15F | 10+3x20    | 10+20    | 2x20  | 75376 for<br>20MHz CC<br>36696 for<br>10MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-3A<br>FDD for<br>10MHz CC                           | R.31-4 TDD   | 85 |
| 15G | 10+15+2x20 | 10+15    | 2x20  | 36696 for<br>10MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-3A FDD<br>for 10MHz CC<br>R.31-5 FDD<br>for 15MHz CC                               | R.31-4 TDD   | 85 |
| 15H | 10+15+2x20 | 10+15+20 | 20    | 36696 for<br>10MHz CC<br>55056 for<br>15MHz CC<br>75376 for<br>20MHz CC | 75376/0  | R.31-3A FDD<br>for 10MHz CC<br>R.31-5 FDD<br>for 15MHz CC<br>R.31-4 FDD<br>for 20MHz CC | R.31-4 TDD   | 85 |
| 16  | 4x20+15    | 2x20+15  | 2x20  | 75376 for<br>20MHz CC<br>55056 for<br>15MHz CC                          | 75376/0  | R.31-4 FDD<br>for 20MHz<br>CC, R.31-5   | R.31-4 TDD   | 85 |



|    |               |          |      |  |         |  |            |    |
|----|---------------|----------|------|--|---------|--|------------|----|
|    |               |          |      |  |         | FDD for 15MHz CC   |            |    |
| 17 | 2x15+3x20     | 2x15+20  | 2x20 | 75376 for 20MHz CC<br>55056 for 15MHz CC                       | 75376/0 | R.31-4 FDD for 20MHz CC, R.31-5 FDD for 15MHz CC                           | R.31-4 TDD | 85 |
| 18 | 4x20+20       | 4x20     | 20   | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 19 | 3x20+2x20     | 3x20     | 2x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 20 | 2x20+3x20     | 2x20     | 3x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 21 | 20+4x20       | 20       | 4x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 22 | 10+4x20       | 10       | 4x20 | 36696  | 75376/0 | R.31-3A FDD  | R.31-4 TDD | 85 |
| 23 | 10+20+3x20    | 10+20    | 3x20 | 75376 for 20MHz CC<br>36696 for 10MHz CC                       | 75376/0 | R.31-4 FDD for 20MHz CC, R.31-3A FDD for 10MHz CC                          | R.31-4 TDD | 85 |
| 24 | 2x10+3x20     | 2x10     | 3x20 | 36696  | 75376/0 | R.31-3A FDD  | R.31-4 TDD | 85 |
| 25 | 10+2x20+2x20  | 10+2x20  | 2x20 | 75376 for 20MHz CC<br>36696 for 10MHz CC                       | 75376/0 | R.31-4 FDD for 20MHz CC, R.31-3A FDD for 10MHz CC                          | R.31-4 TDD | 85 |
| 26 | 10+15+20+2x20 | 10+15+20 | 2x20 | 75376 for 20MHz CC<br>55056 for 15MHz CC<br>36696 for 10MHz CC | 75376/0 | R.31-4 FDD for 20MHz CC, R.31-5 FDD for 15MHz CC, R.31-3A FDD for 10MHz CC | R.31-4 TDD | 85 |
| 27 | 20+5x20       | 20       | 5x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 28 | 2x20+4x20     | 2x20     | 4x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 29 | 20+6x20       | 20       | 6x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |
| 30 | 2x20+5x20     | 2x20     | 5x20 | 75376  | 75376/0 | R.31-4 FDD   | R.31-4 TDD | 85 |

Table 8.7.5.2-2: Test points for sustained data rate (FRC 64QAM)

| CA config    | Maximum supported Bandwidth/<br>Bandwidth combination (MHz) |         |        | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6, 7    | Cat. 9,10     | Cat 11, 12     | DL Cat. 15 |
|--------------|---|---------|--------|--------|--------|--------|--------|--------------|---------------|----------------|------------|
|              | Total   | FDD CC  | TDD CC |        |        |        |        | DL Cat. 6, 7 | DL Cat. 9, 10 | DL Cat. 11, 12 |            |
| CA with 2CCs | 2x20  | 20      | 20     | -      | -      | 3      | 3      | 1            | 1             | -              | -          |
|              | 10+20   | 10      | 20     | -      | -      | 3      | 3      | 2            | 2             | -              | -          |
|              | 15+20   | 15      | 20     | -      | -      | 3      | 3      | 2A           | 2A            | -              | -          |
|              | 10+10   | 10      | 10     | -      | -      | 3      | 3      | 3            | 3             | -              | -          |
| CA with 3CCs | 3x20  | 20      | 2x20   | -      | -      | -      | -      | 1            | 4             | 4              | -          |
|              | 15+20+20  | 15      | 2x20   | -      | -      | -      | -      | 2A           | 5             | 5              | -          |
|              | 10+20+20  | 10      | 2x20   | -      | -      | -      | -      | 2            | 6             | 6              | -          |
|              | 3x20  | 2x20    | 20     | -      | -      | -      | -      | 1            | 7             | 7              | -          |
|              | 20+20+15  | 20+15   | 20     | -      | -      | -      | -      | 1            | 8             | 8              | -          |
|              | 20+20+10  | 20+10   | 20     | -      | -      | -      | -      | 1            | 9             | 9              | -          |
|              | 20+10+10  | 2x10    | 20     | -      | -      | -      | -      | 2            | 9A            | 9A             | -          |
|              | 10+15+20  | 10      | 15+20  | -      | -      | -      | -      | 2            | 9B            | 9B             | -          |
| 10+15+20     | 10+15   | 20      | -      | -      | -      | -      | 2A     | 9C           | 9C            | -              |            |
| CA with 4CCs | 4x20  | 20      | 3x20   | -      | -      | -      | -      | -            | 4             | 10             | 10         |
|              | 4x20  | 2x20    | 2x20   | -      | -      | -      | -      | -            | 4 or 7        | 11             | 11         |
|              | 3x20+15   | 20+15   | 2x20   | -      | -      | -      | -      | -            | 4             | 12             | 12         |
|              | 2x15+2x20   | 2x15    | 2x20   | -      | -      | -      | -      | -            | 5             | 13             | 13         |
|              | 3x20+15   | 2x20+15 | 20     | -      | -      | -      | -      | -            | 7             | 14             | 14         |
|              | 2x15+2x20   | 2x15+20 | 20     | -      | -      | -      | -      | -            | 8             | 15             | 15         |
|              | 3x20+10   | 2x20+10 | 20     | -      | -      | -      | -      | -            | 7             | 15A            | 15A        |
|              | 4x20  | 2x15+20 | 20     | -      | -      | -      | -      | -            | 8             | 15B            | 15B        |
|              | 10+3x20   | 10      | 3x20   | -      | -      | -      | -      | -            | 6             | 15C            | 15C        |
| 2x10+2x20    | 2x10  | 2x20    | -      | -      | -      | -      | -      | 6            | 15D           | 15D            |            |

|               |  |          |       |   |   |   |   |   |    |     |     |
|---------------|--|----------|-------|---|---|---|---|---|----|-----|-----|
|               | 2x10+20+15   | 2x10     | 20+15 |   |   |   |   |   | 9A | 15E | 15E |
|               | 10+3x20  | 10+20    | 2x20  |   |   |   |   |   | 4  | 15F | 15F |
|               | 10+15+2x20   | 10+15    | 2x20  |   |   |   |   |   | 5  | 15G | 15G |
|               | 10+15+2x20   | 10+15+20 | 20    |   |   |   |   |   | 8  | 15H | 15H |
| CA with 5 CCs | 4x20+15  | 2x20+15  | 2x20  | - | - | - | - | - | -  | 11  | 16  |
|               | 2x15+3x20  | 2x15+20  | 2x20  | - | - | - | - | - | -  | 12  | 17  |
|               | 4x20+20  | 4x20     | 20    |   |   |   |   |   |    |     | 18  |
|               | 3x20+2x20  | 3x20     | 2x20  |   |   |   |   |   |    |     | 19  |
|               | 2x20+3x20  | 2x20     | 3x20  |   |   |   |   |   |    |     | 20  |
|               | 20+4x20  | 20       | 4x20  |   |   |   |   |   |    |     | 21  |
|               | 10+4x20  | 10       | 4x20  |   |   |   |   |   |    |     | 22  |
|               | 10+20+3x20   | 10+20    | 3x20  |   |   |   |   |   |    |     | 23  |
|               | 2x10+3x20  | 2x10     | 3x20  |   |   |   |   |   |    |     | 24  |
| 10+2x20+2x20  | 10+2x20  | 2x20     |       |   |   |   |   |   |    | 25  |     |
| 10+15+20+2x20 | 10+15+20   | 2x20     |       |   |   |   |   |   |    | 26  |     |
| CA with 6 CCs | 20+5x20  | 20       | 5x20  |   |   |   |   |   |    | 27  | 27  |
|               | 2x20+4x20  | 2x20     | 4x20  |   |   |   |   |   |    | 28  | 28  |
| CA with 7 CCs | 20+6x20  | 20       | 6x20  |   |   |   |   |   |    | 29  | 29  |
|               | 2x20+5x20  | 2x20     | 5x20  |   |   |   |   |   |    | 30  | 30  |
| Note 1:       | Void.  |          |       |   |   |   |   |   |    |     |     |
| Note 2:       | Void.  |          |       |   |   |   |   |   |    |     |     |
| Note 3:       | If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. |          |       |   |   |   |   |   |    |     |     |

Table 8.7.5.2-3: Minimum requirement (TDD FDD CA 256QAM)

| Test number | Bandwidth (MHz) |        |        | Measurement channel                              |  | Reference value     |
|-------------|-----------------|--------|--------|--|--|---------------------|
|             | Total           | FDD CC | TDD CC | FDD CC   | TDD CC   | TB success rate [%] |
| 1           | 2x20            | 20     | 20     | R.68 FDD   | R.68 TDD   | 85                  |
| 2           | 10+20           | 10     | 20     | R.68-2 FDD                                       | R.68 TDD   | 85                  |
| 3           | 15+20           | 15     | 20     | R.68-1 FDD                                       | R.68 TDD   | 85                  |
| 4           | 3x20            | 20     | 2x20   | R.68 FDD   | R.68 TDD   | 85                  |
| 5           | 15+20+20        | 15     | 2x20   | R.68-1 FDD                                       | R.68 TDD   | 85                  |
| 6           | 10+20+20        | 10     | 2x20   | R.68-2 FDD                                       | R.68TDD  | 85                  |
| 7           | 3x20            | 2x20   | 20     | R.68 FDD   | R.68 TDD   | 85                  |
| 8           | 20+20+15        | 20+15  | 20     | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC   | R.68 TDD   | 85                  |
| 9           | 20+20+10        | 20+10  | 20     | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC   | R.68 TDD   | 85                  |
| 9A          | 20+10+10        | 2x10   | 20     | R.68-2 FDD                                       | R.68 TDD   | 85                  |
| 9B          | 10+15+20        | 10     | 15+20  | R.68-2 FDD                                       | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85                  |
| 9C          | 10+15+20        | 10+15  | 20     | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC | R.68 TDD   | 85                  |
| 10          | 4x20            | 20     | 3x20   | R.68 FDD   | R.68TDD  | 85                  |
| 11          | 4x20            | 2x20   | 2x20   | R.68 FDD   | R.68 TDD   | 85                  |
| 12          | 3x20+15         | 20+15  | 2x20   | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC   | R.68 TDD   | 85                  |

|     |               |          |       |   |  |    |
|-----|---------------|----------|-------|---|--|----|
| 13  | 2x15+2x20     | 2x15     | 2x20  | R.68-1 FDD  | R.68 TDD   | 85 |
| 14  | 3x20+15       | 2x20+15  | 20    | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 15  | 2x15+2x20     | 2x15+20  | 20    | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 15A | 3x20+10       | 2x20+10  | 20    | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD   | 85 |
| 15B | 4x20          | 3x20     | 20    | R.68 FDD  | R.68TDD  | 85 |
| 15C | 10+3x20       | 10       | 3x20  | R.68-2 FDD  | R.68TDD  | 85 |
| 15D | 2x10+2x20     | 2x10     | 2x20  | R.68-2 FDD  | R.68TDD  | 85 |
| 15E | 2x10+20+15    | 2x10     | 20+15 | R.68-2 FDD  | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85 |
| 15F | 10+3x20       | 10+20    | 2x20  | R.68 FDD for 20MHz CC, R.68-2 FDD for 10MHz CC                          | R.68 TDD   | 85 |
| 15G | 10+15+2x20    | 10+15    | 2x20  | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC                        | R.68 TDD   | 85 |
| 15H | 10+15+2x20    | 10+15+20 | 20    | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC, R.68 FDD for 20MHz CC | R.68 TDD   | 85 |
| 16  | 4x20+15       | 2x20+15  | 2x20  | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 17  | 2x15+3x20     | 2x15+20  | 2x20  | R.68 FDD for 20MHz CC, R.68-1 FDD for 15MHz CC                          | R.68 TDD   | 85 |
| 18  | 4x20+20       | 4x20     | 20    | R.68 FDD  | R.68 TDD   | 85 |
| 19  | 3x20+2x20     | 3x20     | 2x20  | R.68 FDD  | R.68 TDD   | 85 |
| 20  | 2x20+3x20     | 2x20     | 3x20  | R.68 FDD  | R.68 TDD   | 85 |
| 21  | 20+4x20       | 20       | 4x20  | R.68 FDD  | R.68 TDD   | 85 |
| 22  | 10+4x20       | 10       | 4x20  | R.68-2 FDD  | R.68 TDD   | 85 |
| 23  | 10+20+3x20    | 10+20    | 3x20  | R.68-2 FDD for 10MHz CC, R.68 FDD for 20MHz CC                          | R.68 TDD   | 85 |
| 24  | 2x10+3x20     | 2x10     | 3x20  | R.68-2 FDD  | R.68 TDD   | 85 |
| 25  | 10+2x20+2x20  | 10+2x20  | 2x20  | R.68-2 FDD for 10MHz CC, R.68 FDD for 20MHz CC                          | R.68 TDD   | 85 |
| 26  | 10+15+20+2x20 | 10+15+20 | 2x20  | R.68-2 FDD for 10MHz CC, R.68-1 FDD for 15MHz CC, R.68 FDD for 20MHz CC | R.68 TDD   | 85 |
| 27  | 20+5x20       | 20       | 5x20  | R.68 FDD  | R.68 TDD   | 85 |
| 28  | 2x20+4x20     | 2x20     | 4x20  | R.68 FDD  | R.68 TDD   | 85 |
| 29  | 20+6x20       | 20       | 6x20  | R.68 FDD  | R.68 TDD   | 85 |
| 30  | 2x20+5x20     | 2x20     | 5x20  | R.68 FDD  | R.68 TDD   | 85 |

**Table 8.7.5.2-4: Test points for sustained data rate (FRC 256QAM)**

| CA config     | Maximum supported Bandwidth/<br>Bandwidth combination (MHz) |         |        | Cat. 11,<br>12    | DL Cat.<br>13 | DL Cat.<br>15 | DL Cat.<br>16 |  |  |
|---------------|---|---------|--------|-------------------|---------------|---------------|---------------|--|--|
|               | Total   | FDD CC  | TDD CC | DL Cat.<br>11, 12 |               |               |               |  |  |
| CA with 2CCs  | 2x20  | 20      | 20     | 1                 | 1             | -             | -             |  |  |
|               | 10+20   | 10      | 20     | 2                 | 2             |               |               |  |  |
|               | 15+20   | 15      | 20     | 3                 | 3             | -             | -             |  |  |
| CA with 3CCs  | 3x20  | 20      | 2x20   | 4                 | 1             | 4             | -             |  |  |
|               | 15+20+20  | 15      | 2x20   | 5                 | 3             | 5             | -             |  |  |
|               | 10+20+20  | 10      | 2x20   | 6                 | 2             | 6             | -             |  |  |
|               | 3x20  | 2x20    | 20     | 7                 | 1             | 7             | -             |  |  |
|               | 20+20+15  | 20+15   | 20     | 8                 | 1             | 8             | -             |  |  |
|               | 20+20+10  | 20+10   | 20     | 9                 | 1             | 9             | -             |  |  |
|               | 20+10+10  | 2x10    | 20     | 9A                | 2             | 9A            |               |  |  |
|               | 10+15+20  | 10      | 15+20  | 9B                | 2             | 9B            |               |  |  |
| 10+15+20      | 10+15   | 20      | 9C     | 3                 | 9C            |               |               |  |  |
| CA with 4CCs  | 4x20  | 20      | 3x20   | 4                 | -             | 10            | 10            |  |  |
|               | 4x20  | 2x20    | 2x20   | 4 or 7            | -             | 11            | 11            |  |  |
|               | 3x20+15   | 20+15   | 2x20   | 8                 | -             | 12            | 12            |  |  |
|               | 2x15+2x20   | 2x15    | 2x20   | 5                 | -             | 13            | 13            |  |  |
|               | 3x20+15   | 2x20+15 | 20     | 7                 | -             | 14            | 14            |  |  |
|               | 2x15+2x20   | 2x15+20 | 20     | 8                 | -             | 15            | 15            |  |  |
|               | 3x20+10   | 2x20+10 | 20     | 7                 | -             | 15A           | 15A           |  |  |
|               | 4x20  | 2x15+20 | 20     | 8                 | -             | 15B           | 15B           |  |  |
|               | 10+3x20   | 10      | 3x20   | 6                 |               | 15C           | 15C           |  |  |
|               | 2x10+2x20   | 2x10    | 2x20   | 6                 |               | 15D           | 15D           |  |  |
|               | 2x10+20+15  | 2x10    | 20+15  | 9A                |               | 15E           | 15E           |  |  |
|               | 10+3x20   | 10+20   | 2x20   | 4                 |               | 15F           | 15F           |  |  |
| 10+15+2x20    | 10+15   | 2x20    | 5      |                   | 15G           | 15G           |               |  |  |
| 10+15+2x20    | 10+15+20  | 20      | 8      |                   | 15H           | 15H           |               |  |  |
| CA with 5CCs  | 4x20+15   | 2x20+15 | 2x20   | -                 | -             | 14 or 12      | 16            |  |  |
|               | 2x15+3x20   | 2x15+20 | 2x20   | -                 | -             | 15 or 12      | 17            |  |  |
|               | 4x20+20   | 4x20    | 20     |                   |               |               | 18            |  |  |
|               | 3x20+2x20   | 3x20    | 2x20   |                   |               |               | 19            |  |  |
|               | 2x20+3x20   | 2x20    | 3x20   |                   |               |               | 20            |  |  |
|               | 20+4x20   | 20      | 4x20   |                   |               |               | 21            |  |  |
|               | 10+4x20   | 10      | 4x20   |                   |               |               | 22            |  |  |
|               | 10+20+3x20  | 10+20   | 3x20   |                   |               |               | 23            |  |  |
|               | 2x10+3x20   | 2x10    | 3x20   |                   |               |               | 24            |  |  |
|               | 10+2x20+2x20  | 10+2x20 | 2x20   |                   |               |               | 25            |  |  |
| 10+15+20+2x20 | 10+15+20  | 2x20    |        |                   |               | 26            |               |  |  |
| CA with 6CCs  | 20+5x20   | 20      | 5x20   |                   |               |               | 27            |  |  |
|               | 2x20+4x20   | 2x20    | 4x20   |                   |               |               | 28            |  |  |
| CA with 7CCs  | 20+6x20   | 20      | 6x20   |                   |               |               | 29            |  |  |
|               | 2x20+5x20   | 2x20    | 5x20   |                   |               |               | 30            |  |  |

Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.

### 8.7.6 FDD (DC)

The parameters specified in Table 8.7.6-1 are valid for all FDD DC tests unless otherwise stated.

**Table 8.7.6-1: Common Test Parameters (FDD)**

| Parameter | Unit | Value |
|-----------|------|-------|
|-----------|------|-------|

|  |              |  |    |
|--|--------------|--|----|
| Cyclic prefix  |              | Normal   |    |
| Cell ID  |              | 0  |    |
| Inter-TTI Distance   |              | 1  |    |
| Number of HARQ processes per component carrier   | Processes    | 8  |    |
| Maximum number of HARQ transmission  |              | 4  |    |
| Redundancy version coding sequence   |              | {0,0,1,2} for 64QAM and 256QAM   |    |
| Number of OFDM symbols for PDCCH per component carrier                                       | OFDM symbols | 1  |    |
| Cross carrier scheduling   |              | Not configured   |    |
| Propagation condition  |              | Static propagation condition<br>No external noise sources are applied  |    |
| Transmission mode  |              | TM3  |    |
| Codebook subset restriction  |              | 10   |    |
| Antenna configuration  |              | 2x2  |    |
| $\hat{E}_s$ at antenna port (dBm/15kHz)  |              | -85  |    |
| Symbols for unused PRBs  |              | OP.1 FDD   |    |
| ACK/NACK feedback mode   |              | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |    |
| Time offset between MCG CC and SCG CC  | $\mu$ s      | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |    |
| Downlink power allocation  | $\rho_A$     | dB   | -3 |
|  | $\rho_B$     | dB   | -3 |
|  | $\sigma$     | dB   | 0  |
| Note 1: Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].         |              |  |    |
| Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |              |  |    |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.6-2, with the addition of the parameters in Table 8.7.6-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.6-3. The TB success rate across CGs shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.6-4, with the addition of the parameters in Table 8.7.6-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.6-5. The TB success rate across CGs shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.6-2 are not applicable.

The applicability of their requirements are specified in Clause 8.1.2.3A.

**Table 8.7.6-2: Minimum requirement (DC 64QAM)**

| Test number | Bandwidth combination (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel      | Reference value TB success rate(%) |                                 |     |
|-------------|-----------------------------|--|--------------------------|------------------------------------|---------------------------------|-----|
|             |                             |  |                          | DRB type of Split bearer (Note 2)  | DRB type of SCG bearer (Note 3) |     |
|             |                             |  |                          |                                    | MCG                             | SCG |
| 1           | 2x10                        | 25456  | R.31-2 FDD               | 95                                 | 95                              | 95  |
| 2           | 2x10                        | 36696 (Note 4)   | R.31-3A FDD              | 85                                 | 85                              | 85  |
| 3           | 10+20                       | 36696 (Note 4) for 10MHz CC                                      | R.31-3A FDD for 10MHz CC | 85                                 | 85                              | 85  |

|  |          |   |   |    |    |    |
|--|----------|---|---|----|----|----|
|  |          | 75376 (Note 5) for 20MHz CC   | R.31-4 FDD for 20MHz CC   |    |    |    |
| 4  | 2x15     | 55056 (Note 6)  | R.31-4B FDD   | 85 | 85 | 85 |
| 5  | 15+20    | 55056 for 15MHz CC<br>75376 (Note 5) for 20MHz CC   | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 | 85 | 85 |
| 6  | 2x20     | 75376 (Note 5)  | R.31-4 FDD  | 85 | 85 | 85 |
| 6A   | 10+15    | 36696 (Note 4) for 10MHz CC<br>55056 (Note 6) for 15MHz CC                                | R.31-2 FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC                            | 85 | 85 | 85 |
| 7  | 15+5     | 55056 for 15MHz CC<br>18336 for 5MHz CC   | R.31-5 FDD for 15MHz CC<br>R.31-6 FDD for 5MHz CC                             | 85 | 85 | 85 |
| 8  | 15+20+20 | 55056 for 15MHz CC<br>75376 (Note 5) for 20MHz CC   | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 | 85 | 85 |
| 9  | 15+15+20 | 55056 for 15MHz CC<br>75376 (Note 5) for 20MHz CC   | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 | 85 | 85 |
| 10   | 10+10+20 | 36696 (Note 4) for 10MHz CC<br>75376 (Note 5) for 20MHz CC                                | R.31-2 FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 | 85 | 85 |
| 11   | 10+15+15 | 36696 (Note 4) for 10MHz CC<br>55056 (Note 6) for 15MHz CC                                | R.31-2 FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC                            | 85 | 85 | 85 |
| 12   | 10+15+20 | 36696 (Note 4) for 10MHz CC<br>55056 (Note 6) for 15MHz CC<br>75376 (Note 5) for 20MHz CC | R.31-2 FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 | 85 | 85 |
| 13   | 10+20+20 | 36696 (Note 4) for 10MHz CC<br>75376 (Note 5) for 20MHz CC                                | R.31-2 FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC                            | 85 | 85 | 85 |
| 14   | 3x20     | 75376 (Note 5)  | R.31-4 FDD  | 85 | 85 | 85 |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.</p> <p>Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.</p> <p>Note 4: 35160 bits for sub-frame 5.</p> <p>Note 5: 71112 bits for sub-frame 5.</p> <p>Note 6: 52752 bits for sub-frame 5.</p> |          |   |   |    |    |    |

**Table 8.7.6-3: Test points for sustained data rate (FRC DC 64QAM)**

| DC config | Maximum supported | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9, 10 | Cat. 11, 12 |
|-----------|-------------------|--------|--------|-----------|------------|-------------|
|-----------|-------------------|--------|--------|-----------|------------|-------------|

|               | Bandwidth combination (MHz) |   |   |    |    | DL Cat. 11,12 |  |
|---------------|-----------------------------|---|---|----|----|---------------|--|
| DC with 2CCs  | 2x10                        | 1 | 2 | 2  | 2  | -             |  |
|               | 10+20                       | 1 | 2 | 3  | 3  | -             |  |
|               | 2x15                        | 1 | 2 | 4  | 4  | -             |  |
|               | 15+20                       | 1 | 2 | 5  | 5  | -             |  |
|               | 2x20                        | 1 | 2 | 6  | 6  | -             |  |
|               | 10+15                       | 1 | 2 | 6A | 6A | -             |  |
|               | 15+5                        | 7 | 7 | 7  | 7  | -             |  |
| DC with 3 CCs | 15+20+20                    | - | - | 8  | 8  | 8             |  |
|               | 15+15+20                    | - | - | 9  | 9  | 9             |  |
|               | 10+10+20                    | - | - | 10 | 10 | 10            |  |
|               | 10+15+15                    | - | - | 11 | 11 | 11            |  |
|               | 10+15+20                    | - | - | 12 | 12 | 12            |  |
|               | 10+20+20                    | - | - | 13 | 13 | 13            |  |
|               | 20+20+20                    | - | - | 14 | 14 | 14            |  |

Table 8.7.6-4: Minimum requirement (DC 256QAM)

| Test number | Bandwidth combination (MHz) | Measurement channel                                | Reference value TB success rate (%) |                                 |     |
|-------------|-----------------------------|--|-------------------------------------|---------------------------------|-----|
|             |                             |  | DRB type of Split bearer (Note 2)   | DRB type of SCG bearer (Note 3) |     |
|             |                             |  |                                     | MCG                             | SCG |
| 1           | 2x10                        | R.68-2 FDD   | 85                                  | 85                              | 85  |
| 2           | 10+20                       | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC   | 85                                  | 85                              | 85  |
| 3           | 2x15                        | R.68-1 FDD   | 85                                  | 85                              | 85  |
| 4           | 15+20                       | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC   | 85                                  | 85                              | 85  |
| 5           | 2x20                        | R.68 FDD   | 85                                  | 85                              | 85  |
| 6           | 15+5                        | R.68-1 FDD for 15MHz CC<br>R.68-3 FDD for 5MHz CC  | 85                                  | 85                              | 85  |
| 6A          | 10+15                       | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC | 85                                  | 85                              | 85  |
| 7           | 15+20+20                    | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC   | 85                                  | 85                              | 85  |
| 8           | 15+15+20                    | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC   | 85                                  | 85                              | 85  |
| 9           | 10+10+20                    | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC   | 85                                  | 85                              | 85  |
| 10          | 10+15+15                    | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC | 85                                  | 85                              | 85  |
| 11          | 10+15+20                    | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC | 85                                  | 85                              | 85  |

|   |          |  |    |    |    |
|---|----------|--|----|----|----|
|   |          | R.68 FDD for 20MHz CC                            |    |    |    |
| 12  | 10+20+20 | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 | 85 | 85 |
| 13  | 20+20+20 | R.68 FDD   | 85 | 85 | 85 |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \times N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.</p> <p>Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \times N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.</p> |          |  |    |    |    |

**Table 8.7.6-5: Test points for sustained data rate (FRC DC 256QAM)**

| DC config    | Maximum supported Bandwidth combination (MHz) | Cat. 11, 12   | DL Cat. 13 | DL Cat.15 |  |  |  |
|--------------|---|---------------|------------|-----------|--|--|--|
|              |   | DL Cat. 11,12 |            |           |  |  |  |
| DC with 2CCs | 2x10  | 1             | 1          |           |  |  |  |
|              | 10+20   | 2             | 2          |           |  |  |  |
|              | 2x15  | 3             | 3          |           |  |  |  |
|              | 15+20   | 4             | 4          |           |  |  |  |
|              | 2x20  | 5             | 5          |           |  |  |  |
|              | 10+15   | 6A            | 6A         | -         |  |  |  |
| DC with 3CCs | 15+5  | 6             | 6          |           |  |  |  |
|              | 15+20+20                                      | 7             | 5          |           |  |  |  |
|              | 15+15+20                                      | 8             | 4          | 8         |  |  |  |
|              | 10+10+20                                      | 9             | 2          | 9         |  |  |  |
|              | 10+15+15                                      | 10            | 3          | 10        |  |  |  |
|              | 10+15+20                                      | 11            | 4          | 11        |  |  |  |
|              | 10+20+20                                      | 12            | 5          | 12        |  |  |  |
| 20+20+20     | 13  | 5             | 13         |           |  |  |  |

### 8.7.7 TDD (DC)

The parameters specified in Table 8.7.7-1 are valid for all TDD DC tests unless otherwise stated.

**Table 8.7.7-1: Common Test Parameters (TDD)**

| Parameter                                      | Unit      | Value      |
|--|-----------|------------|
| Uplink downlink configuration                  |           | 2 (Note 2) |
| Special subframe configuration                 |           | 4          |
| Cyclic prefix                                  |           | Normal     |
| Cell ID  |           | 0          |
| Inter-TTI Distance                             |           | 1          |
| Number of HARQ processes per component carrier | Processes | 7          |



|  |              |  |    |
|--|--------------|--|----|
| Maximum number of HARQ transmission  |              | 4  |    |
| Redundancy version coding sequence   |              | {0,0,1,2} for 64QAM and 256QAM   |    |
| Number of OFDM symbols for PDCCH per component carrier                                       | OFDM symbols | 1  |    |
| Cross carrier scheduling   |              | Not configured   |    |
| Propagation condition  |              | Static propagation condition<br>No external noise sources are applied  |    |
| Transmission mode  |              | TM3  |    |
| Codebook subset restriction  |              | 10   |    |
| Antenna configuration  |              | 2x2  |    |
| $\hat{E}_s$ at antenna port (dBm/15kHz)  |              | -85  |    |
| Symbols for unused PRBs  |              | OP.1 TDD   |    |
| ACK/NACK feedback mode   |              | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |    |
| Time offset between MCG CC and SCG CC  | $\mu$ s      | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |    |
| Downlink power allocation  | $\rho_A$     | dB   | -3 |
|  | $\rho_B$     | dB   | -3 |
|  | $\sigma$     | dB   | 0  |
| Note 1: Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].         |              |  |    |
| Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |              |  |    |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.7-2, with the addition of the parameters in Table 8.7.7-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.7-3. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.7-4, with the addition of the parameters in Table 8.7.7-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.7-5. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.7-2 are not applicable.

The applicability of their requirements are specified in Clause 8.1.2.3A.

**Table 8.7.7-2: Minimum requirement (DC 64QAM)**

| Test number  | Bandwidth combination (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel                                | Reference value TB success rate across CGs(%) |                                 |     |
|--|-----------------------------|--|--|---|---------------------------------|-----|
|  |                             |  |  | DRB type of Split bearer (Note 2)             | DRB type of SCG bearer (Note 3) |     |
|  |                             |  |  |   | MCG                             | SCG |
| 1  | 2x20                        | 75376/0 (Note 4)   | R.31-4A TDD  | 85  | 85                              | 85  |
| 2  | 3x20                        | 75376/0 (Note 4)   | R.31-4A TDD  | 85  | 85                              | 85  |
| 3  | 4x20                        | 75376/0 (Note 4)   | R.31-4A TDD  | 85  | 85                              | 85  |
| 4  | 15+3x20                     | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 4)            | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85  | 85                              | 85  |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.   |                             |  |  |   |                                 |     |
| Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100% * $N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL |                             |  |  |   |                                 |     |

transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.

Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate =  $100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.

Note 4: 71112 bits for sub-frame 5.

**Table 8.7.7-3: Test points for sustained data rate (FRC DC 64QAM)**

| DC config    | Maximum supported Bandwidth combination (MHz) | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9, 10 | Cat. 11, 12    | DL Cat.15 |
|--------------|---|--------|--------|-----------|------------|----------------|-----------|
|              |   |        |        |           |            | DL Cat. 11, 12 |           |
| DC with 2CCs | 2x20  | -      | -      | 1         | 1          | -              | -         |
| DC with 3CCs | 3x20  | -      | -      | 1         | 2          | 2              | -         |
| DC with 4CCs | 4x20  | -      | -      | -         | 2          | 3              | 3         |
|              | 15+3x20                                       | -      | -      | -         | 2          | 4              | 4         |

**Table 8.7.7-4: Minimum requirement (DC 256QAM)**

| Test number   | Bandwidth combination (MHz) | Measurement channel | Reference value TB success rate (%) |                                 |     |
|---|-----------------------------|---------------------|-------------------------------------|---------------------------------|-----|
|   |                             |                     | DRB type of Split bearer (Note 2)   | DRB type of SCG bearer (Note 3) |     |
|   |                             |                     |                                     | MCG                             | SCG |
| 1   | 2x20                        | R.68-3 TDD          | 85                                  | 85                              | 85  |
| <p>Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.</p> <p>Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.</p> <p>Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = <math>100\% \cdot N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})</math>, where <math>N_{DL\_newtx}</math> is the number of newly transmitted DL transport blocks, <math>N_{DL\_retx}</math> is the number of retransmitted DL transport blocks, and <math>N_{DL\_correct\_rx}</math> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.</p> |                             |                     |                                     |                                 |     |

**Table 8.7.7-5: Test points for sustained data rate (FRC DC 256QAM)**

| DC config    | Maximum supported Bandwidth combination (MHz) | Cat. 11, 12    | DL Cat. 13 | DL Cat. 15 | DL Cat. 16 |  |  |
|--------------|---|----------------|------------|------------|------------|--|--|
|              |   | DL Cat. 11, 12 |            |            |            |  |  |
| DC with 2CCs | 2x20  | 1              | 1          | -          | -          |  |  |
| DC with 3CCs | 3x20  | 2              | 1          | 2          | -          |  |  |
| DC with 4CCs | 4x20  | 2              | -          | 3          | 3          |  |  |
|              | 15+3x20                                       | 2              | -          | 4          | 4          |  |  |

## 8.7.8 TDD FDD (DC)

The parameters specified in Table 8.7.8-1 are valid for all TDD FDD DC tests unless otherwise stated.

**Table 8.7.8-1: Common Test Parameters (TDD FDD DC)**

| Parameter  | Unit         | Value |  |
|--|--------------|-------|--|
| Uplink downlink configuration for TDD CC   |              |       | 2 (Note 2)   |
| Special subframe configuration for TDD CC  |              |       | 4  |
| Cyclic prefix  |              |       | Normal   |
| Cell ID  |              |       | 0  |
| Inter-TTI Distance   |              |       | 1  |
| Number of HARQ processes per component carrier   | Processes    |       | 8 for FDD CC; 7 for TDD CC   |
| Maximum number of HARQ transmission  |              |       | 4  |
| Redundancy version coding sequence   |              |       | {0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier                                       | OFDM symbols |       | 1  |
| Cross carrier scheduling   |              |       | Not configured   |
| Propagation condition  |              |       | Static propagation condition<br>No external noise sources are applied  |
| Transmission mode  |              |       | TM3  |
| Codebook subset restriction  |              |       | 10   |
| Antenna configuration  |              |       | 2x2  |
| $\hat{E}_s$ at antenna port (dBm/15kHz)  |              |       | -85  |
| Symbols for unused PRBs  |              |       | OP.1 TDD for TDD CC; OP.1 FDD for FDD CC   |
| ACK/NACK feedback mode   |              |       | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |
| Time offset between MCG CC and SCG CC  | $\mu$ s      |       | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |
| Downlink power allocation  | $\rho_A$     | dB    | -3   |
|  | $\rho_B$     | dB    | -3   |
|  | $\sigma$     | dB    | 0  |
| Note 1: Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].         |              |       |  |
| Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |              |       |  |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.8-2, with the addition of the parameters in Table 8.7.8-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.8-3. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.8-4, with the addition of the parameters in Table 8.7.7-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.8-5. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.8-2 are not applicable.

The applicability of their requirements are specified in Clause 8.1.2.3A.

**Table 8.7.8-2: Minimum requirement (TDD FDD DC 64QAM)**

| Test number | Bandwidth (MHz)   |        |        | Number of bits of a DL-SCH transport block received within a TTI (for normal/special subframe for TDD, except for subframe #5) |                  | Measurement channel |             | Reference value<br>TB success rate across CGs(%) |                                 |     |
|-------------|---|--------|--------|--|------------------|---------------------|-------------|--|---------------------------------|-----|
|             |   |        |        |  |                  |                     |             | DRB type of Split bearer (Note 2)                | DRB type of SCG bearer (Note 3) |     |
|             | Total   | FDD CC | TDD CC | FDD CC   | TDD CC           | FDD CC              | TDD CC      |  | MCG                             | SCG |
| 1           | 2x20  | 20     | 20     | 75376 (Note 4)   | 75376/0 (Note 4) | R.31-4 FDD          | R.31-4A TDD | 85   | 85                              | 85  |
| Note 1:     | For 2 layer transmissions, 2 transport blocks are received within a TTI.  |        |        |  |                  |                     |             |  |                                 |     |
| Note 2:     | For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100% * N <sub>DL_correct_rx</sub> / (N <sub>DL_newtx</sub> + N <sub>DL_retx</sub> ), where N <sub>DL_newtx</sub> is the number of newly transmitted DL transport blocks, N <sub>DL_retx</sub> is the number of retransmitted DL transport blocks, and N <sub>DL_correct_rx</sub> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception. |        |        |  |                  |                     |             |  |                                 |     |
| Note 3:     | For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100% * N <sub>DL_correct_rx</sub> / (N <sub>DL_newtx</sub> + N <sub>DL_retx</sub> ), where N <sub>DL_newtx</sub> is the number of newly transmitted DL transport blocks, N <sub>DL_retx</sub> is the number of retransmitted DL transport blocks, and N <sub>DL_correct_rx</sub> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.   |        |        |  |                  |                     |             |  |                                 |     |
| Note 4:     | 71112 bits for sub-frame 5.   |        |        |  |                  |                     |             |  |                                 |     |

**Table 8.7.8-3: Test points for sustained data rate (FRC TDD FDD DC 64QAM)**

| CA config    | Maximum supported Bandwidth/ Bandwidth combination (MHz) |        |        | Cat. 6, 7 | Cat. 9,10 |  |
|--------------|--|--------|--------|-----------|-----------|--|
|              | Total  | FDD CC | TDD CC |           |           |  |
| DC with 2CCs | 2x20   | 20     | 20     | 1         | 1         |  |

**Table 8.7.8-4: Minimum requirement (TDD FDD DC 256QAM)**

| Test number | Bandwidth (MHz)   |        |        | Measurement channel |            | Reference value<br>TB success rate across CGs(%) |                                 |     |
|-------------|---|--------|--------|---------------------|------------|--|---------------------------------|-----|
|             |   |        |        |                     |            | DRB type of Split bearer (Note 2)                | DRB type of SCG bearer (Note 3) |     |
|             | Total   | FDD CC | TDD CC | FDD CC              | TDD CC     |  | MCG                             | SCG |
| 1           | 2x20  | 20     | 20     | R.68 FDD            | R.68-3 TDD | 85   | 85                              | 85  |
| Note 1:     | For 2 layer transmissions, 2 transport blocks are received within a TTI.  |        |        |                     |            |  |                                 |     |
| Note 2:     | For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100% * N <sub>DL_correct_rx</sub> / (N <sub>DL_newtx</sub> + N <sub>DL_retx</sub> ), where N <sub>DL_newtx</sub> is the number of newly transmitted DL transport blocks, N <sub>DL_retx</sub> is the number of retransmitted DL transport blocks, and N <sub>DL_correct_rx</sub> is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception. |        |        |                     |            |  |                                 |     |
| Note 3:     | For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100% * N <sub>DL_correct_rx</sub> / (N <sub>DL_newtx</sub> + N <sub>DL_retx</sub> ), where N <sub>DL_newtx</sub> is the number of newly transmitted DL transport blocks, N <sub>DL_retx</sub> is the number of retransmitted DL transport blocks, and N <sub>DL_correct_rx</sub> is the number of correctly received DL transport blocks. All the above numbers of transmitted,   |        |        |                     |            |  |                                 |     |

retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC transmission or reception, separately.

**Table 8.7.8-5: Test points for sustained data rate (FRC TDD FDD DC 256QAM)**

| CA config    | Maximum supported Bandwidth/<br>Bandwidth combination (MHz) |        |        | Cat. 11,<br>12    | DL Cat.<br>13 |  |  |  |  |
|--------------|---|--------|--------|-------------------|---------------|--|--|--|--|
|              | Total   | FDD CC | TDD CC | DL Cat.<br>11, 12 |               |  |  |  |  |
| DC with 2CCs | 2x20  | 20     | 20     | 1                 | 1             |  |  |  |  |
|              |   |        |        |                   |               |  |  |  |  |

Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.

## 8.7.9 FDD (4 Rx)

The parameters specified in Table 8.7.9-1 are valid for all FDD tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.9-1: Common Test Parameters (FDD)**

| Parameter  | Unit         | Value   |
|--|--------------|---|
| Transmission mode                                      |              | 3   |
| Cyclic prefix  |              | Normal  |
| Cell ID  |              | 0   |
| Inter-TTI Distance                                     |              | 1   |
| Number of HARQ processes per component carrier         | Processes    | 8   |
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  |
|  | 4 layer CC   | 1000  |
| Downlink power allocation                              | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs                                |              | OP.1 FDD  |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.9-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.9-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.9-2: Per-CC FRC for SDR test (FDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.31-6 FDD        |
|            | 10        | R.31-3A FDD       |
|            | 15        | R.31-5 FDD        |
|            | 20        | R.31-4 FDD        |
| 4 layer    | 5         | R.31-10 FDD       |
|            | 10        | R.31-7 FDD        |
|            | 15        | R.31-8 FDD        |
|            | 20        | R.31-9 FDD        |

**Table 8.7.9-3: Per-CC FRC for SDR test (FDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.68-3 FDD        |
|            | 10        | R.68-2 FDD        |
|            | 15        | R.68-1 FDD        |
|            | 20        | R.68 FDD          |
| 4 layer    | 5         | R.68-7 FDD        |
|            | 10        | R.68-4 FDD        |
|            | 15        | R.68-5 FDD        |
|            | 20        | R.68-6 FDD        |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.
- The procedure applies also for single carrier using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

**Table 8.7.9-4: Void**

**Table 8.7.9-5: Void**

## 8.7.10 TDD (4 Rx)

The parameters specified in Table 8.7.10-1 are valid for all TDD tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.10-1: Common Test Parameters (TDD)**

| Parameter  | Unit         | Value   |
|--|--------------|---|
| Transmission mode                                      |              | 3   |
| Special subframe configuration (Note 1)                |              | 4   |
| Cyclic prefix  |              | Normal  |
| Cell ID  |              | 0   |
| Inter-TTI Distance                                     |              | 1   |
| Number of HARQ processes per component carrier         | Processes    | 8   |
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |
| Symbols for unused PRBs                                |              | OP.1 TDD  |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  |
|  | 4 layer CC   | 1000  |
| Downlink power allocation                              | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs                                |              | OP.1 TDD  |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.10-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.10-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% * N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.10-2: Per-CC FRC for SDR test(TDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.31-6 TDD        |
|            | 15        | R.31-5 TDD        |
|            | 20        | R.31-4 TDD        |
| 4 layer    | 10        | R.31-7 TDD        |
|            | 15        | R.31-8 TDD        |
|            | 20        | R.31-9 TDD        |

**Table 8.7.10-3: Per-CC FRC for SDR test (TDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.68-2 TDD        |
|            | 15        | R.68-1 TDD        |
|            | 20        | R.68 TDD          |
| 4 layer    | 10        | R.68-5 TDD        |
|            | 15        | R.68-6 TDD        |
|            | 20        | R.68-7 TDD        |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.
- The procedure applies also for single carrier using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

**Table 8.7.10-4: Void****Table 8.7.10-5: Void**

### 8.7.11 TDD FDD CA (4 Rx)

The parameters specified in Table 8.7.11-1 are valid for all TDD FDD CA tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.11-1: Common Test Parameters (TDD FDD CA)**

| Parameter  | Unit         | FDD CC                         | TDD CC                         |
|--|--------------|--------------------------------|--------------------------------|
| Transmission mode                                      |              | 3                              | 3                              |
| Uplink downlink configuration (Note 1)                 |              | N/A                            | 1                              |
| Special subframe configuration (Note 2)                |              | N/A                            | 4                              |
| Cyclic prefix  |              | Normal                         | Normal                         |
| Cell ID  |              | 0                              | 0                              |
| Inter-TTI Distance                                     |              | 1                              | 1                              |
| Number of HARQ processes per component carrier         | Processes    | 8                              | 8                              |
| Maximum number of HARQ transmission                    |              | 4                              | 4                              |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1                              | 1                              |
| Cross carrier scheduling                               |              | Not configured                 | Not configured                 |



| Propagation condition                                 |            | Static propagation condition<br>No external noise sources are<br>applied | Static propagation condition<br>No external noise sources are<br>applied |
|---|------------|--|--|
| $\hat{E}_s$ at antenna port                           | dBm/15kHz  | -85  | -85  |
| Antenna configuration                                 | 2 layer CC | 2x2 or 2x4   | 2x2 or 2x4   |
|   | 4 layer CC | 4x4  | 4x4  |
| Codebook subset<br>restriction                        | 2 layer CC | 10   | 10   |
|   | 4 layer CC | 1000   | 1000   |
| Downlink power<br>allocation                          | 2 layer CC | $\rho_A = -3\text{dB}, \rho_B = -3\text{dB}, \sigma = 0\text{dB}$        | $\rho_A = -3\text{dB}, \rho_B = -3\text{dB}, \sigma = 0\text{dB}$        |
|   | 4 layer CC | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$        | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$        |
| Symbols for unused<br>PRBs                            |            | OP.1 FDD   | OP.1 TDD   |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. |            |  |  |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. |            |  |  |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.11-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.11-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% \cdot N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.11-2: Per-CC FRC for SDR test (TDD-FDD 64QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.31-6 FDD            | N/A                   |
|            | 10        | R.31-3A FDD           | R.31-6 TDD            |
|            | 15        | R.31-5 FDD            | R.31-5 TDD            |
|            | 20        | R.31-4 FDD            | R.31-4 TDD            |
| 4 layer    | 5         | R.31-10 FDD           | N/A                   |
|            | 10        | R.31-7 FDD            | R.31-7 TDD            |
|            | 15        | R.31-8 FDD            | R.31-8 TDD            |
|            | 20        | R.31-9 FDD            | R.31-9 TDD            |

**Table 8.7.11-3: Per-CC FRC for SDR test (TDD-FDD 256QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.68-3 FDD            | N/A                   |
|            | 10        | R.68-2 FDD            | R.68-2 TDD            |
|            | 15        | R.68-1 FDD            | R.68-1 TDD            |
|            | 20        | R.68 FDD              | R.68 TDD              |
| 4 layer    | 5         | R.68-7 FDD            | N/A                   |
|            | 10        | R.68-4 FDD            | R.68-5 TDD            |
|            | 15        | R.68-5 FDD            | R.68-6 TDD            |
|            | 20        | R.68-6 FDD            | R.68-7 TDD            |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

### 8.7.11.1 Void

**Table 8.7.11.1-1: Void**

**Table 8.7.11.1-2: Void**

**Table 8.7.11.1-3: Void**

**Table 8.7.11.1-4:Void**

## 8.7.12 LAA

### 8.7.12.1 FDD CA in licensed bands

The parameters specified in Table 8.7.12.1-1 are valid for all LAA CA SDR tests unless otherwise stated.

**Table 8.7.12.1-1: Common Test Parameters**

| Parameter  | Unit         | FDD CC  | LAA CC |
|--|--------------|---|--------|
| Transmission mode                                      |              | 3   |        |
| Cyclic prefix  |              | Normal  |        |
| Cell ID  |              | 0   | 0      |
| Inter-TTI Distance                                     |              | 1   |        |
| Number of HARQ processes per component carrier         | Processes    | 8   |        |
| Maximum number of HARQ transmission                    |              | 4   |        |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM  |        |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |        |
| Cross carrier scheduling                               |              | Not configured  |        |
| Propagation condition                                  |              | Static propagation condition (B.1)<br>No external noise sources are applied |        |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |        |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |        |
|  | 4 layer CC   | 4x4   |        |
| Codebook subset restriction                            | 2 layer CC   | 10  |        |
|  | 4 layer CC   | 1000  |        |
| Downlink power allocation                              | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$     |        |

|                         |            |   |          |
|-------------------------|------------|---|----------|
|                         | 4 layer CC | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$ |          |
| Symbols for unused PRBs |            | OP.1 FDD  | OP.1 FS3 |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.1-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.1-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

For LAA SCell, per-CC separate FRCs are defined for different UE capability for endingDwPTS and secondSlotStartingPosition.

The TB success rate is defined as  $100\% * N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.12.1-2: Per-CC FRC for SDR test (64QAM)**

| MIMO layer | Bandwidth (MHz) | FDD         | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|-------------|-------------------------------|---|--|
| 2 layer    | 5               | R.31-6 FDD  | N/A                           | N/A   | N/A  |
|            | 10              | R.31-3A FDD | N/A                           | N/A   | N/A  |
|            | 15              | R.31-5 FDD  | N/A                           | NA  | NA   |
|            | 20              | R.31-4 FDD  | R.6 FS3                       | R.7 FS3   | R.5 FS3  |
| 4 layer    | 5               | R.31-10 FDD | N/A                           | N/A   | N/A  |
|            | 10              | R.31-7 FDD  | N/A                           | N/A   | N/A  |
|            | 15              | R.31-8 FDD  | N/A                           | N/A   | N/A  |
|            | 20              | R.31-9 FDD  | R.9 FS3                       | R.10 FS3  | R.8 FS3  |

**Table 8.7.12.1-3: Per-CC FRC for SDR test (256QAM)**

| MIMO layer | Bandwidth (MHz) | FDD        | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|------------|-------------------------------|---|--|
| 2 layer    | 5               | R.68-3 FDD | N/A                           | N/A   | N/A  |
|            | 10              | R.68-2 FDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-1 FDD | N/A                           | NA  | NA   |
|            | 20              | R.68 FDD   | R.12 FS3                      | R.13 FS3  | R.11 FS3   |
| 4 layer    | 5               | R.68-7 FDD | N/A                           | N/A   | N/A  |
|            | 10              | R.68-4 FDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-5 FDD | N/A                           | N/A   | N/A  |
|            | 20              | R.68-6 FDD | R.15 FS3                      | R.16 FS3  | R.14 FS3   |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC following the equation that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

### 8.7.12.2 TDD CA in licensed bands

The parameters specified in Table 8.7.12.2-1 are valid for all LAA CA SDR tests unless otherwise stated.

**Table 8.7.12.2-1: Common Test Parameters**

| Parameter  | Unit  | TDD CC  | LAA CC   |
|--|---|---|----------|
| Transmission mode                                      |   | 3   |          |
| Uplink downlink configuration (Note 1)                 |   | 1   | N/A      |
| Special subframe configuration (Note 2)                |   | 4   | N/A      |
| Cyclic prefix  |   | Normal  |          |
| Cell ID  |   | 0   | 0        |
| Inter-TTI Distance                                     |   | 1   |          |
| Number of HARQ processes per component carrier         | Processes                                     | 8   |          |
| Maximum number of HARQ transmission                    |   | 4   |          |
| Redundancy version coding sequence                     |   | {0,0,1,2} for 64QAM and 256QAM  |          |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols                                  | 1   |          |
| Cross carrier scheduling                               |   | Not configured  |          |
| Propagation condition                                  |   | Static propagation condition (B.1)<br>No external noise sources are applied |          |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz                                     | -85   |          |
| Antenna configuration                                  | 2 layer CC                                    | 2x2 or 2x4  |          |
|  | 4 layer CC                                    | 4x4   |          |
| Codebook subset restriction                            | 2 layer CC                                    | 10  |          |
|  | 4 layer CC                                    | 1000  |          |
| Downlink power allocation                              | 2 layer CC                                    | $\rho_A = -3\text{dB}, \rho_B = -3\text{dB}, \sigma = 0\text{dB}$           |          |
|  | 4 layer CC                                    | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$           |          |
| Symbols for unused PRBs                                |   | OP.1 TDD  | OP.1 FS3 |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4]. |   |          |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4]. |   |          |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.2-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.2-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

For LAA SCell, per-CC separate FRCs are defined for different UE capability for endingDwPTS and secondSlotStartingPosition.

The TB success rate is defined as  $100\% * N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

Table 8.7.12.2-2: Per-CC FRC for SDR test (64QAM)

| MIMO layer | Bandwidth (MHz) | FDD        | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|------------|-------------------------------|---|--|
| 2 layer    | 5               | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.31-6 TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.31-5 TDD | N/A                           | NA  | NA   |
|            | 20              | R.31-4 TDD | R.6 FS3                       | R.7 FS3   | R.5 FS3  |
| 4 layer    | 5               | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.31-7 TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.31-8 TDD | N/A                           | N/A   | N/A  |
|            | 20              | R.31-9 TDD | R.9 FS3                       | R.10 FS3  | R.8 FS3  |

Table 8.7.12.2-3: Per-CC FRC for SDR test (256QAM)

| MIMO layer | Bandwidth (MHz) | FDD        | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|------------|-------------------------------|---|--|
| 2 layer    | 5               | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.68-2 TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-1 TDD | N/A                           | NA  | NA   |
|            | 20              | R.68 TDD   | R.12 FS3                      | R.13 FS3  | R.11 FS3   |
| 4 layer    | 5               | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.68-4 TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-5 TDD | N/A                           | N/A   | N/A  |
|            | 20              | R.68-6 TDD | R.15 FS3                      | R.16 FS3  | R.14 FS3   |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC following the equation that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

### 8.7.12.3 TDD-FDD CA in licensed bands

The parameters specified in Table 8.7.12.3-1 are valid for all LAA CA SDR tests unless otherwise stated.

Table 8.7.12.3-1: Common Test Parameters

| Parameter                               | Unit | FDD CC | TDD CC | LAA CC |
|---|------|--------|--------|--------|
| Transmission mode                       |      |        | 3      |        |
| Uplink downlink configuration (Note 1)  |      | N/A    | 1      | N/A    |
| Special subframe configuration (Note 2) |      | N/A    | 4      | N/A    |
| Cyclic prefix                           |      |        | Normal |        |
| Cell ID                                 |      | 0      | 0      | 0      |

|  |   |   |          |          |
|--|---|---|----------|----------|
| Inter-TTI Distance                                     |   | 1   |          |          |
| Number of HARQ processes per component carrier         | Processes                                     | 8   |          |          |
| Maximum number of HARQ transmission                    |   | 4   |          |          |
| Redundancy version coding sequence                     |   | {0,0,1,2} for 64QAM and 256QAM  |          |          |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols                                  | 1   |          |          |
| Cross carrier scheduling                               |   | Not configured  |          |          |
| Propagation condition                                  |   | Static propagation condition (B.1)<br>No external noise sources are applied |          |          |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz                                     | -85   |          |          |
| Antenna configuration                                  | 2 layer CC                                    | 2x2 or 2x4  |          |          |
|  | 4 layer CC                                    | 4x4   |          |          |
| Codebook subset restriction                            | 2 layer CC                                    | 10  |          |          |
|  | 4 layer CC                                    | 1000  |          |          |
| Downlink power allocation                              | 2 layer CC                                    | $\rho_A = -3\text{dB}, \rho_B = -3\text{dB}, \sigma = 0\text{dB}$           |          |          |
|  | 4 layer CC                                    | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$           |          |          |
| Symbols for unused PRBs                                |   | OP.1 FDD  | OP.1 TDD | OP.1 FS3 |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4]. |   |          |          |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4]. |   |          |          |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.3-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.12.3-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

For LAA SCell, per-CC separate FRCs are defined for different UE capability for endingDwPTS and secondSlotStartingPosition.

The TB success rate is defined as  $100\% \cdot N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.12.3-2: Per-CC FRC for SDR test (64QAM)**

| MIMO layer | Bandwidth (MHz) | FDD         | TDD        | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|-------------|------------|-------------------------------|---|--|
| 2 layer    | 5               | R.31-6 FDD  | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.31-3A FDD | R.31-6 TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.31-5 FDD  | R.31-5 TDD | N/A                           | NA  | NA   |
|            | 20              | R.31-4 FDD  | R.31-4 TDD | R.6 FS3                       | R.7 FS3   | R.5 FS3  |
| 4 layer    | 5               | R.31-10 FDD | N/A        | N/A                           | N/A   | N/A  |
|            | 10              | R.31-7 FDD  | R.31-7 TDD | N/A                           | N/A   | N/A  |

|  |    |               |               |         |          |         |
|--|----|---------------|---------------|---------|----------|---------|
|  | 15 | R.31-8<br>FDD | R.31-8<br>TDD | N/A     | N/A      | N/A     |
|  | 20 | R.31-9<br>FDD | R.31-9<br>TDD | R.9 FS3 | R.10 FS3 | R.8 FS3 |

**Table 8.7.12.3-3: Per-CC FRC for SDR test (256QAM)**

| MIMO layer | Bandwidth (MHz) | FDD           | TDD           | LAA supporting end partial SF | LAA supporting initial partial SF but not supporting end partial SF | LAA not supporting both initial and end partial SF |
|------------|-----------------|---------------|---------------|-------------------------------|---|--|
| 2 layer    | 5               | R.68-3<br>FDD | N/A           | N/A                           | N/A   | N/A  |
|            | 10              | R.68-2<br>FDD | R.68-2<br>TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-1<br>FDD | R.68-1<br>TDD | N/A                           | NA  | NA   |
|            | 20              | R.68 FDD      | R.68 TDD      | R.12 FS3                      | R.13 FS3  | R.11 FS3   |
| 4 layer    | 5               | R.68-7<br>FDD | N/A           | N/A                           | N/A   | N/A  |
|            | 10              | R.68-4<br>FDD | R.68-4<br>TDD | N/A                           | N/A   | N/A  |
|            | 15              | R.68-5<br>FDD | R.68-5<br>TDD | N/A                           | N/A   | N/A  |
|            | 20              | R.68-6<br>FDD | R.68-6<br>TDD | R.15 FS3                      | R.16 FS3  | R.14 FS3   |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one CA bandwidth combination among all supported CA configurations with bandwidth combination and MIMO layer on each CC following the equation that leads to largest equivalent aggregated bandwidth among all CA bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {CA configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

### 8.7.13 FDD DC (4 Rx)

The parameters specified in Table 8.7.13-1 are valid for all FDD tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.13-1: Common Test Parameters (FDD)**

| Parameter                                      | Unit      | Value  |
|--|-----------|--------|
| Transmission mode                              |           | 3      |
| Cyclic prefix                                  |           | Normal |
| Cell ID  |           | 0      |
| Inter-TTI Distance                             |           | 1      |
| Number of HARQ processes per component carrier | Processes | 8      |
| Maximum number of HARQ transmission            |           | 4      |

|  |               |  |
|--|---------------|--|
| Redundancy version coding sequence   |               | {0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier   | OFDM symbols  | 1  |
| Cross carrier scheduling   |               | Not configured   |
| Propagation condition  |               | Static propagation condition<br>No external noise sources are applied  |
| $\hat{E}_s$ at antenna port  | dBm/15kHz     | -85  |
| Antenna configuration  | 2 layer CC    | 2x2 or 2x4   |
|  | 4 layer CC    | 4x4  |
| Codebook subset restriction  | 2 layer CC    | 10   |
|  | 4 layer CC    | 1000   |
| Downlink power allocation  | 2 layer CC    | $\rho_A = -3\text{dB}, \rho_B = -3\text{dB}, \sigma = 0\text{dB}$  |
|  | 4 layer CC    | $\rho_A = -6\text{dB}, \rho_B = -6\text{dB}, \sigma = 3\text{dB}$  |
| Symbols for unused PRBs  |               | OP.1 FDD   |
| ACK/NACK feedback mode   |               | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |
| Time offset between MCG CC and SCG CC  | $\mu\text{s}$ | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |
| Note 1: Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].<br>Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |               |  |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.13-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.13-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% \cdot N_{\text{DL\_correct\_rx}} / (N_{\text{DL\_newtx}} + N_{\text{DL\_retx}})$ , where  $N_{\text{DL\_newtx}}$  is the number of newly transmitted DL transport blocks,  $N_{\text{DL\_retx}}$  is the number of retransmitted DL transport blocks, and  $N_{\text{DL\_correct\_rx}}$  is the number of correctly received DL transport blocks. The TB success rate across CGs shall be sustained during at least 300 frames.

**Table 8.7.13-2: Per-CC FRC for SDR test (FDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.31-6 FDD        |
|            | 10        | R.31-3A FDD       |
|            | 15        | R.31-5 FDD        |
|            | 20        | R.31-4 FDD        |
| 4 layer    | 5         | R.31-10 FDD       |
|            | 10        | R.31-7 FDD        |
|            | 15        | R.31-8 FDD        |
|            | 20        | R.31-9 FDD        |

**Table 8.7.13-3: Per-CC FRC for SDR test (FDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.68-3 FDD        |
|            | 10        | R.68-2 FDD        |
|            | 15        | R.68-1 FDD        |



|         |    |            |
|---------|----|------------|
|         | 20 | R.68 FDD   |
| 4 layer | 5  | R.68-7 FDD |
|         | 10 | R.68-4 FDD |
|         | 15 | R.68-5 FDD |
|         | 20 | R.68-6 FDD |

DC configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one DC bandwidth combination among all supported DC configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all DC bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {DC configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

### 8.7.14 TDD DC (4 Rx)

The parameters specified in Table 8.7.14-1 are valid for all TDD tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.14-1: Common Test Parameters (TDD)**

| Parameter  | Unit         | Value   |
|--|--------------|---|
| Transmission mode                                      |              | 3   |
| Special subframe configuration                         |              | 4   |
| Cyclic prefix  |              | Normal  |
| Cell ID  |              | 0   |
| Inter-TTI Distance                                     |              | 1   |
| Number of HARQ processes per component carrier         | Processes    | 8   |
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM and 256QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  |
|  | 4 layer CC   | 1000  |
| Downlin power allocation                               | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |

|                                       |  |  |
|---------------------------------------|--|--|
| Symbols for unused PRBs               |  | OP.1 TDD   |
| ACK/NACK feedback mode                |  | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |
| Time offset between MCG CC and SCG CC | $\mu\text{s}$  | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |
| Note 1:                               | Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].         |  |
| Note 2:                               | If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |  |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.14-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.14-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate across CGs shall be sustained during at least 300 frames.

**Table 8.7.14-2: Per-CC FRC for SDR test (TDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.31-6 TDD        |
|            | 15        | R.31-5 TDD        |
|            | 20        | R.31-4 TDD        |
| 4 layer    | 10        | R.31-7 TDD        |
|            | 15        | R.31-8 TDD        |
|            | 20        | R.31-9 TDD        |

**Table 8.7.14-3: Per-CC FRC for SDR test (TDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.68-2 TDD        |
|            | 15        | R.68-1 TDD        |
|            | 20        | R.68 TDD          |
| 4 layer    | 10        | R.68-5 TDD        |
|            | 15        | R.68-6 TDD        |
|            | 20        | R.68-7 TDD        |

DC configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one DC bandwidth combination among all supported DC configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all DC bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {DC configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

## 8.7.15 TDD FDD DC (4 Rx)

The parameters specified in Table 8.7.15-1 are valid for all TDD FDD tests for 4Rx capable UEs unless otherwise stated.

**Table 8.7.15-1: Common Test Parameters (TDD FDD)**

| Parameter  | Unit          | FDD CC   | TDD CC  |
|--|---------------|--|---|
| Transmission mode  |               | 3  | 3   |
| Uplink downlink configuration (Note 1)   |               | N/A  | 1   |
| Special subframe configuration (Note 2)  |               | N/A  | 4   |
| Cyclic prefix  |               | Normal   | Normal  |
| Cell ID  |               | 0  | 0   |
| Inter-TTI Distance   |               | 1  | 1   |
| Number of HARQ processes per component carrier   | Processes     | 8  | 8   |
| Maximum number of HARQ transmission  |               | 4  | 4   |
| Redundancy version coding sequence   |               | {0,0,1,2} for 64QAM and 256QAM   | {0,0,1,2} for 64QAM and 256QAM  |
| Number of OFDM symbols for PDCCH per component carrier                                       | OFDM symbols  | 1  | 1   |
| Cross carrier scheduling   |               | Not configured   | Not configured  |
| Propagation condition  |               | Static propagation condition<br>No external noise sources are applied  | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port  | dBm/15kHz     | -85  | -85   |
| Antenna configuration  | 2 layer CC    | 2x2 or 2x4   | 2x2 or 2x4  |
|  | 4 layer CC    | 4x4  | 4x4   |
| Codebook subset restriction  | 2 layer CC    | 10   | 10  |
|  | 4 layer CC    | 1000   | 1000  |
| Downlink power allocation  | 2 layer CC    | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$  | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC    | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$  | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs  |               | OP.1 FDD   | OP.1 TDD  |
| ACK/NACK feedback mode   |               | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG   |   |
| Time offset between MCG CC and SCG CC  | $\mu\text{s}$ | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 1) |   |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].  |               |  |   |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4].  |               |  |   |
| Note 3: Asynchronous and synchronous dual connectivity are defined in TS36.300 [11].         |               |  |   |
| Note 4: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. |               |  |   |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.15-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.15-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate across CGs shall be sustained during at least 300 frames.

**Table 8.7.15-2: Per-CC FRC for SDR test (TDD-FDD 64QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.31-6 FDD            | N/A                   |
|            | 10        | R.31-3A FDD           | R.31-6 TDD            |
|            | 15        | R.31-5 FDD            | R.31-5 TDD            |
|            | 20        | R.31-4 FDD            | R.31-4 TDD            |
| 4 layer    | 5         | R.31-10 FDD           | N/A                   |
|            | 10        | R.31-7 FDD            | R.31-7 TDD            |
|            | 15        | R.31-8 FDD            | R.31-8 TDD            |
|            | 20        | R.31-9 FDD            | R.31-9 TDD            |

**Table 8.7.15-3: Per-CC FRC for SDR test (TDD-FDD 256QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.68-3 FDD            | N/A                   |
|            | 10        | R.68-2 FDD            | R.68-2 TDD            |
|            | 15        | R.68-1 FDD            | R.68-1 TDD            |
|            | 20        | R.68 FDD              | R.68 TDD              |
| 4 layer    | 5         | R.68-7 FDD            | N/A                   |
|            | 10        | R.68-4 FDD            | R.68-5 TDD            |
|            | 15        | R.68-5 FDD            | R.68-6 TDD            |
|            | 20        | R.68-6 FDD            | R.68-7 TDD            |

DC configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select one DC bandwidth combination among all supported DC configurations with bandwidth combination and MIMO layer on each CC that leads to largest equivalent aggregated bandwidth among all DC bandwidth combinations supported by UE. Equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} R_i B_i$$

where  $N$  is number of CCs,  $R_i \in \{2,4\}$  and  $B_i \in \{5,10,15,20\}$  is MIMO layer and bandwidth of CC  $i$ .

- When there are multiple sets of {DC configuration, bandwidth combination, MIMO layer} with same largest aggregated bandwidth, select one among sets with largest number of 4 layer CCs.

## 8.7.16 FDD (1024QAM and up to 4Rx supported)

The common parameters are specified in Table 8.7.16-1 for UE which is capable of supporting 1024QAM.

Table 8.7.16-1: Common Test Parameters (FDD)

| Parameter          | Unit | Value  |
|--------------------|------|--------|
| Transmission mode  |      | 3      |
| Cyclic prefix      |      | Normal |
| Cell ID            |      | 0      |
| Inter-TTI Distance |      | 1      |

|  |              |   |
|--|--------------|---|
| Number of HARQ processes per component carrier         | Processes    | 8   |
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM, 256QAM and 1024QAM                                 |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  |
|  | 4 layer CC   | 1000  |
| Downlin power allocation                               | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs                                |              | OP.1 FDD  |

The UE capability for 1024QAM is signalled per band or per band combination, hence the SDR tests with the mixed modulation orders and the mixed receiver antenna numbers across CC-s are specified.

For UE not supporting CA and supporting 1024QAM, the TB success rate shall be higher than 85% when PDSCH is scheduled with FRC in Table 8.7.16-4 according the UE capability. The maximum supported channel bandwidth and MIMO layer are configured during the test.

For UE supporting CA and supporting 1024QAM at least on one CC for a supported CA configuration, the SDR requirements are specified as follows:

- If UE is capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.16-3 for the transmission with 256QAM and Table 8.7.16-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.
- If UE is not capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.16-2 for the transmission with 64QAM and Table 8.7.16-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.

For UE supporting 1024 QAM, the SDR requirement with 64QAM and 256QAM only is not applicable.

The CA configuration or band for single carrier, bandwidth combination or bandwidth for single carrier, modulation order on each CC and MIMO layer on each CC are determined by the following procedure.

- Among all the supported CA configurations which support 1024QAM at least on one CC, select one set of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC}, which leads to the largest equivalent aggregated bandwidth. The equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} M_i R_i B_i$$

Where  $N$  is the number of CCs,  $R_i \in \{2,4\}$  represents the MIMO layer,  $B_i \in \{5,10,15,20\}$  represents the bandwidths on each CC,  $[M_i \in \{0.75,1,1.25\}]$  is the scaling factor according to the supported modulation order on each CC, where  $M_i = 0.75$  is used if the maximum modulation order of CC  $i$  is 64QAM,  $M_i = 1$  is used if the

maximum modulation order of CC  $i$  is 256QAM, and  $M_i = 1.25$  is used if the maximum modulation order of CC  $i$  is 1024QAM.]

- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth, select one among the sets with the largest number of CCs supporting 1024QAM.
- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth with the same number of CCs supporting 1024QAM, select one among the sets with the largest number of CCs supporting 4 layer.
- The procedure applies also for the single carrier operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

The TB success rate for single carrier or on each CC for CA is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.16-2: Per-CC FRC for SDR test (FDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.31-6 FDD        |
|            | 10        | R.31-3A FDD       |
|            | 15        | R.31-5 FDD        |
|            | 20        | R.31-4 FDD        |
| 4 layer    | 5         | R.31-10 FDD       |
|            | 10        | R.31-7 FDD        |
|            | 15        | R.31-8 FDD        |
|            | 20        | R.31-9 FDD        |

**Table 8.7.16-3: Per-CC FRC for SDR test (FDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.68-3 FDD        |
|            | 10        | R.68-2 FDD        |
|            | 15        | R.68-1 FDD        |
|            | 20        | R.68 FDD          |
| 4 layer    | 5         | R.68-7 FDD        |
|            | 10        | R.68-4 FDD        |
|            | 15        | R.68-5 FDD        |
|            | 20        | R.68-6 FDD        |

**Table 8.7.16-4: Per-CC FRC for SDR test (FDD 1024QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 5         | R.105-3 FDD       |
|            | 10        | R.105-2 FDD       |
|            | 15        | R.105-1 FDD       |
|            | 20        | R.105 FDD         |
| 4 layer    | 5         | R.105-7 FDD       |
|            | 10        | R.105-6 FDD       |
|            | 15        | R.105-5 FDD       |
|            | 20        | R.105-4 FDD       |

### 8.7.17 TDD (1024QAM and up to 4 Rx supported)

The common parameters are specified in Table 8.7.17-1 for UE which is capable of supporting 1024QAM.

Table 8.7.17-1: Common Test Parameters (TDD)

| Parameter  | Unit         | Value   |
|--|--------------|---|
| Transmission mode                                      |              | 3   |
| Uplink downlink configuration                          |              | 1   |
| Special subframe configuration (Note 1)                |              | 4   |
| Cyclic prefix  |              | Normal  |
| Cell ID  |              | 0   |
| Inter-TTI Distance                                     |              | 1   |
| Number of HARQ processes per component carrier         | Processes    | 7   |
| Maximum number of HARQ transmission                    |              | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM, 256QAM, and 1024QAM                                |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   |
| Cross carrier scheduling                               |              | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   |
| Symbols for unused PRBs                                |              | OP.1 TDD  |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  |
|  | 4 layer CC   | 1000  |
| Downlin power allocation                               | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs                                |              | OP.1 TDD  |

The UE capability for 1024QAM is signalled per band or per band combination, hence the SDR tests with the mixed modulation orders and the mixed receiver antenna numbers across CC-s are specified.

For UE not supporting CA and supporting 1024QAM, the TB success rate shall be higher than 85% when PDSCH is scheduled with FRC in Table 8.7.17-4 according the UE capability. The maximum supported channel bandwidth and MIMO layer are configured during the test.

For UE supporting CA and supporting 1024QAM at least on one CC for a supported CA configuration, the SDR requirements are specified as follows:

- If UE is capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.17-3 for the transmission with 256QAM and Table 8.7.17-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.
- If UE is not capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.17-2 for the transmission with 64QAM and Table 8.7.17-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.

For UE supporting 1024 QAM, the SDR requirement with 64QAM and 256QAM only is not applicable.

The CA configuration or band for single carrier, bandwidth combination or bandwidth for single carrier, modulation order on each CC and MIMO layer on each CC are determined by the following procedure.

- Among all the supported CA configurations which support 1024QAM at least on one CC, select one set of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on

each CC}, which leads to the largest equivalent aggregated bandwidth. The equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} M_i R_i B_i$$

Where  $N$  is the number of CCs,  $R_i \in \{2,4\}$  represents the MIMO layer,  $B_i \in \{10,15,20\}$  represents the bandwidths on each CC,  $[M_i \in \{0.75,1,1.25\}]$  is the scaling factor according to the supported modulation order on each CC, where  $M_i = 0.75$  is used if the maximum modulation order of CC  $i$  is 64QAM,  $M_i = 1$  is used if the maximum modulation order of CC  $i$  is 256QAM, and  $M_i = 1.25$  is used if the maximum modulation order of CC  $i$  is 1024QAM.]

- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth, select one among the sets with the largest number of CCs supporting 1024QAM.
- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth with the same number of CCs supporting 1024QAM, select one among the sets with the largest number of CCs supporting 4 layer.
- The procedure applies also for the single carrier operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

The TB success rate for single carrier or on each CC for CA is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.17-2: Per-CC FRC for SDR test(TDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.31-6 TDD        |
|            | 15        | R.31-5 TDD        |
|            | 20        | R.31-4 TDD        |
| 4 layer    | 10        | R.31-7 TDD        |
|            | 15        | R.31-8 TDD        |
|            | 20        | R.31-9 TDD        |

**Table 8.7.17-3: Per-CC FRC for SDR test (TDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.68-2 TDD        |
|            | 15        | R.68-1 TDD        |
|            | 20        | R.68 TDD          |
| 4 layer    | 10        | R.68-5 TDD        |
|            | 15        | R.68-6 TDD        |
|            | 20        | R.68-7 TDD        |

**Table 8.7.17-4: Per-CC FRC for SDR test (TDD 1024QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.105-2 TDD       |
|            | 15        | R.105-1 TDD       |
|            | 20        | R.105 TDD         |
| 4 layer    | 10        | R.105-5 TDD       |
|            | 15        | R.105-4 TDD       |
|            | 20        | R.105-3 TDD       |



## 8.7.18 TDD FDD CA (1024QAM and up to 4 Rx supported)

The common parameters are specified in Table 8.7.18-1 for UE which is capable of supporting 1024QAM.

**Table 8.7.18-1: Common Test Parameters (TDD FDD CA)**

| Parameter  | Unit         | FDD CC  | TDD CC  |
|--|--------------|---|---|
| Transmission mode                                      |              | 3   | 3   |
| Uplink downlink configuration (Note 1)                 |              | N/A   | 1   |
| Special subframe configuration (Note 2)                |              | N/A   | 4   |
| Cyclic prefix  |              | Normal  | Normal  |
| Cell ID  |              | 0   | 0   |
| Inter-TTI Distance                                     |              | 1   | 1   |
| Number of HARQ processes per component carrier         | Processes    | 8   | 7   |
| Maximum number of HARQ transmission                    |              | 4   | 4   |
| Redundancy version coding sequence                     |              | {0,0,1,2} for 64QAM, 256QAM and 1024QAM                                 | {0,0,1,2} for 64QAM, 256QAM, and 1024QAM                                |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1   | 1   |
| Cross carrier scheduling                               |              | Not configured  | Not configured  |
| Propagation condition                                  |              | Static propagation condition<br>No external noise sources are applied   | Static propagation condition<br>No external noise sources are applied   |
| $\hat{E}_s$ at antenna port                            | dBm/15kHz    | -85   | -85   |
| Antenna configuration                                  | 2 layer CC   | 2x2 or 2x4  | 2x2 or 2x4  |
|  | 4 layer CC   | 4x4   | 4x4   |
| Codebook subset restriction                            | 2 layer CC   | 10  | 10  |
|  | 4 layer CC   | 1000  | 1000  |
| Downlink power allocation                              | 2 layer CC   | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ | $\rho_A = -3\text{dB}$ , $\rho_B = -3\text{dB}$ , $\sigma = 0\text{dB}$ |
|  | 4 layer CC   | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ | $\rho_A = -6\text{dB}$ , $\rho_B = -6\text{dB}$ , $\sigma = 3\text{dB}$ |
| Symbols for unused PRBs                                |              | OP.1 FDD  | OP.1 TDD  |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].  |              |   |   |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4].  |              |   |   |

The UE capability for 1024QAM is signalled per band or per band combination, hence the SDR tests with the mixed modulation orders and the mixed receiver antenna numbers across CC-s are specified.

For UE not supporting CA and supporting 1024QAM, the TB success rate shall be higher than 85% when PDSCH is scheduled with FRC in Table 8.7.18-4 according to the UE capability. The maximum supported channel bandwidth and MIMO layer are configured during the test.

For UE supporting CA and supporting 1024QAM at least on one CC for a supported CA configuration, the SDR requirements are specified as follows:

- If UE is capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.18-3 for the transmission with 256QAM and Table 8.7.18-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.

- If UE is not capable of supporting 256QAM, the TB success rate shall be higher than 85% on each CC when PDSCH-s are scheduled with FRC-s in Table 8.7.18-2 for the transmission with 64QAM and Table 8.7.18-4 for the transmission with 1024QAM according to the reported capability of supported modulation order for the determined CA configuration.

For UE supporting 1024 QAM, the SDR requirement with 64QAM and 256QAM only is not applicable.

The CA configuration or band for single carrier, bandwidth combination or bandwidth for single carrier, modulation order on each CC and MIMO layer on each CC are determined by the following procedure.

- Among all the supported CA configurations which support 1024QAM at least on one CC, select one set of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC}, which leads to the largest equivalent aggregated bandwidth. The equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} M_i R_i B_i$$

Where  $N$  is the number of CCs,  $R_i \in \{2,4\}$  represents the MIMO layer,  $B_i \in \{5,10,15,20\}$  represents the bandwidths on each FDD CC and  $B_i \in \{10,15,20\}$  represents the bandwidths on each FDD CC,

[ $M_i \in \{0.75,1,1.25\}$  is the scaling factor according to the supported modulation order on each CC, where  $M_i = 0.75$  is used if the maximum modulation order of CC  $i$  is 64QAM,  $M_i = 1$  is used if the maximum modulation order of CC  $i$  is 256QAM, and  $M_i = 1.25$  is used if the maximum modulation order of CC  $i$  is 1024QAM.]

- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth, select one among the sets with the largest number of CCs supporting 1024QAM.
- When there are multiple sets of {CA configuration or a band, bandwidth combination or bandwidth, modulation order on each CC, MIMO layer on each CC} which can reach the same equivalent aggregated bandwidth with the same number of CCs supporting 1024QAM, select one among the sets with the largest number of CCs supporting 4 layer.
- The procedure applies also for the single carrier operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

The TB success rate for single carrier or on each CC for CA is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.18-2: Per-CC FRC for SDR test (TDD-FDD 64QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.31-6 FDD            | N/A                   |
|            | 10        | R.31-3A FDD           | R.31-6 TDD            |
|            | 15        | R.31-5 FDD            | R.31-5 TDD            |
|            | 20        | R.31-4 FDD            | R.31-4 TDD            |
| 4 layer    | 5         | R.31-10 FDD           | N/A                   |
|            | 10        | R.31-7 FDD            | R.31-7 TDD            |
|            | 15        | R.31-8 FDD            | R.31-8 TDD            |
|            | 20        | R.31-9 FDD            | R.31-9 TDD            |

**Table 8.7.18-3: Per-CC FRC for SDR test (TDD-FDD 256QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.68-3 FDD            | N/A                   |
|            | 10        | R.68-2 FDD            | R.68-2 TDD            |
|            | 15        | R.68-1 FDD            | R.68-1 TDD            |
|            | 20        | R.68 FDD              | R.68 TDD              |
| 4 layer    | 5         | R.68-7 FDD            | N/A                   |
|            | 10        | R.68-4 FDD            | R.68-5 TDD            |

|  |    |            |            |
|--|----|------------|------------|
|  | 15 | R.68-5 FDD | R.68-6 TDD |
|  | 20 | R.68-6 FDD | R.68-7 TDD |

**Table 8.7.18-4: Per-CC FRC for SDR test (TDD-FDD 1024QAM)**

| MIMO layer | Bandwidth | FDD Reference channel | TDD Reference channel |
|------------|-----------|-----------------------|-----------------------|
| 2 layer    | 5         | R.105-3 FDD           | N/A                   |
|            | 10        | R.105-2 FDD           | R.105-2 TDD           |
|            | 15        | R.105-1 FDD           | R.105-1 TDD           |
|            | 20        | R.105 FDD             | R.105 TDD             |
| 4 layer    | 5         | R.105-7 FDD           | N/A                   |
|            | 10        | R.105-6 FDD           | R.105-5 TDD           |
|            | 15        | R.105-5 FDD           | R.105-4 TDD           |
|            | 20        | R.105-4 FDD           | R.105-3 TDD           |

### 8.7.19 TDD (8 Rx)

The parameters specified in Table 8.7.19-1 are valid for all TDD tests for 8Rx capable UEs unless otherwise stated. For 2/4 layer carrier configurations, please refer to Table 8.7.10-1. 8 layer carrier configuration is specified in Table 8.7.19-1.

**Table 8.7.19-1: Common Test Parameters for 8 Layer (TDD)**

| Parameter  | Unit                  | Test 1  |            |
|--|-----------------------|---|------------|
| Downlink power allocation  | $\rho_A$              | dB  | 0          |
|  | $\rho_B$              | dB  | 0 (Note 1) |
|  | $\sigma$              | dB  | -3         |
| Uplink downlink configuration  |                       | 1   |            |
| Special subframe configuration   |                       | 4   |            |
| Cell-specific reference signals  |                       | Antenna ports 0,1   |            |
| CSI reference signals  |                       | Antenna ports 15,...,22   |            |
| Beamforming model  |                       | Annex B.4.3(Note 3, 4)  |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | Subframes             | 5 / 4   |            |
| CSI reference signal configuration   |                       | 3   |            |
| Zero-power CSI-RS configuration<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap | Subframes<br>/ bitmap | 4 /<br>0010000000000000   |            |
| $N_{oc}$ at antenna port   | dBm/15kHz             | -98   |            |
| Symbols for unused PRBs  |                       | OP.1 TDD  |            |
| Cyclic prefix  |                       | Normal  |            |
| Cell ID  |                       | 0   |            |
| Inter-TTI Distance   |                       | 1   |            |
| Number of HARQ processes per component carrier   | Processes             | 7   |            |
| Maximum number of HARQ transmission  |                       | 4   |            |
| Redundancy version coding sequence   |                       | {0,0,1,2} for 64QAM and 256QAM  |            |
| Number of allocated resource blocks (Note 2)   | PRB                   | 50  |            |
| Number of OFDM symbols for PDCCH per component carrier                                 | OFDM symbols          | 1   |            |
| Propagation condition  |                       | Static propagation condition<br>No external noise sources are applied |            |
| Simultaneous transmission  |                       | No  |            |
| PDSCH transmission mode  |                       | 9   |            |
| Precoding granularity  |                       | 50  |            |
| PMI delay  |                       | 10 or 11  |            |
| Reporting interval   |                       | 1 or 4  |            |
| Reporting mode   |                       | PUSCH 3-1   |            |
| alternativeCodeBookEnabledFor4TX-r12   |                       | False   |            |

|                                  |   |   |
|----------------------------------|---|---|
| CodeBookSubsetRestriction bitmap |   | 0x0000 0000 0000 0010 0000<br>0000 0000 |
| Note 1:                          | $P_B = 1$ .   |   |
| Note 2:                          | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.  |   |
| Note 3:                          | The precoder in clause B.4.3 follows UE recommended PMI.  |   |
| Note 4:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |   |

For UE not supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.19-2 with the downlink physical channel setup according to Annex C.3.2.

For UE supporting 256QAM, the TB success rate shall be higher than 85% when PDSCH are scheduled with FRC in Table 8.7.19-3 with the downlink physical channel setup according to Annex C.3.2. For UE supporting 256QAM, the requirement with 64QAM is not applicable.

The TB success rate is defined as  $100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$ , where  $N_{DL\_newtx}$  is the number of newly transmitted DL transport blocks,  $N_{DL\_retx}$  is the number of retransmitted DL transport blocks, and  $N_{DL\_correct\_rx}$  is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.19-2: Per-CC FRC for SDR test (TDD 64QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.31-6 TDD        |
|            | 15        | R.31-5 TDD        |
|            | 20        | R.31-4 TDD        |
| 4 layer    | 10        | R.31-7 TDD        |
|            | 15        | R.31-8 TDD        |
|            | 20        | R.31-9 TDD        |
| 8 layer    | 10        | R.31-10 TDD       |
|            | 15        | R.31-11 TDD       |
|            | 20        | R.31-12 TDD       |

**Table 8.7.19-3: Per-CC FRC for SDR test (TDD 256QAM)**

| MIMO layer | Bandwidth | Reference channel |
|------------|-----------|-------------------|
| 2 layer    | 10        | R.68-2 TDD        |
|            | 15        | R.68-1 TDD        |
|            | 20        | R.68 TDD          |
| 4 layer    | 10        | R.68-5 TDD        |
|            | 15        | R.68-6 TDD        |
|            | 20        | R.68-7 TDD        |
| 8 layer    | 10        | R.68-8 TDD        |
|            | 15        | R.68-9 TDD        |
|            | 20        | R.68-10 TDD       |

CA configuration, bandwidth combination and MIMO layer on each CC is determined by following procedure.

- Select the set(s) of {CA configuration, bandwidth combination, MIMO layer} among all the supported CA configurations that leads to the largest equivalent aggregated bandwidth which does not cause the transport block bits within a TTI to exceed the capability of the category of UE under test when the defined reference channel applies on each CC. The equivalent aggregated bandwidth is defined as

$$B_{agg} = \sum_{i=0}^{N-1} a(R_i) R_i B_i$$

Where  $N$  is the number of CCs,  $R_i \in \{2,4,8\}$  and  $B_i \in \{5,10,15,20\}$  are MIMO layer and bandwidth of CC  $i$ . And  $a(R_i)=1$  for  $R_i = 2,4$  and  $a(R_i)=0.75$  for  $R_i = 8$

- The procedure applies also for single carrier using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

## 8.8 Demodulation of EPDCCH

The receiver characteristics of the EPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). For the distributed transmission tests in 8.8.1, EPDCCH and PCFICH are tested jointly, i.e. a miss detection of PCFICH implies a miss detection of EPDCCH. For other tests, EPDCCH and PCFICH are not tested jointly.

### 8.8.1 Distributed Transmission

#### 8.8.1.1 FDD

The parameters specified in Table 8.8.1.1-1 are valid for all FDD distributed EPDCCH tests unless otherwise stated.

**Table 8.8.1.1-1: Test Parameters for Distributed EPDCCH**

| Parameter  |          | Unit       | Value                   |
|--|----------|------------|-------------------------|
| Number of PDCCH symbols  |          | symbols    | 2 (Note 1)              |
| PHICH duration   |          |            | Normal                  |
| Unused RE-s and PRB-s  |          |            | OCNG                    |
| Cell ID  |          |            | 0                       |
| Downlink power allocation  | $\rho_A$ | dB         | -3                      |
|  | $\rho_B$ | dB         | -3                      |
|  | $\sigma$ | dB         | 0                       |
|  | $\delta$ | dB         | 3                       |
| $N_{oc}$ at antenna port   |          | dBm/15 kHz | -98                     |
| Cyclic prefix  |          |            | Normal                  |
| Subframe Configuration   |          |            | Non-MBSFN               |
| Precoder Update Granularity  |          | PRB        | 1                       |
|  |          | ms         | 1                       |
| Beamforming Pre-Coder  |          |            | Annex B. 4.4            |
| Cell Specific Reference Signal   |          |            | Port 0 and 1            |
| Number of EPDCCH Sets Configured   |          |            | 2 (Note 2)              |
| Number of PRB per EPDCCH Set   |          |            | 4 (1 <sup>st</sup> Set) |
|  |          |            | 8 (2 <sup>nd</sup> Set) |
| EPDCCH Subframe Monitoring   |          |            | NA                      |
| PDSCH TM   |          |            | TM3                     |
| DCI Format   |          |            | 2A                      |
| Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured.<br>Note 2: The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured. |          |            |                         |

For the parameters specified in Table 8.8.1.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.1.1-2. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.1.1-2: Minimum performance Distributed EPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55 FDD          | OP.7 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | 2.60     |
| 2           | 10 MHz    | 16 ECCE           | R.56 FDD          | OP.7 FDD     | EVA70                 | 2 x 2 Low                                    | 1               | -3.20    |

8.8.1.1.1 Void

**Table 8.8.1.1.1-1: Void**

8.8.1.2 TDD

The parameters specified in Table 8.8.1.2-1 are valid for all TDD distributed EPDCCH tests unless otherwise stated.

**Table 8.8.1.2-1: Test Parameters for Distributed EPDCCH**

| Parameter                        | Unit   | Value                   |    |
|----------------------------------|--|-------------------------|----|
| Number of PDCCH symbols          | symbols  | 2 (Note 1)              |    |
| PHICH duration                   |  | Normal                  |    |
| Unused RE-s and PRB-s            |  | OCNG                    |    |
| Cell ID                          |  | 0                       |    |
| Downlink power allocation        | $\rho_A$   | dB                      | -3 |
|                                  | $\rho_B$   | dB                      | -3 |
|                                  | $\sigma$   | dB                      | 0  |
|                                  | $\delta$   | dB                      | 3  |
| $N_{oc}$ at antenna port         | dBm/15 kHz   | -98                     |    |
| Cyclic prefix                    |  | Normal                  |    |
| Subframe Configuration           |  | Non-MBSFN               |    |
| Precoder Update Granularity      | PRB  | 1                       |    |
|                                  | ms   | 1                       |    |
| Beamforming Pre-Coder            |  | Annex B. 4.4            |    |
| Cell Specific Reference Signal   |  | Port 0 and 1            |    |
| Number of EPDCCH Sets Configured |  | 2 (Note 2)              |    |
| Number of PRB per EPDCCH Set     |  | 4 (1 <sup>st</sup> Set) |    |
|                                  |  | 8 (2 <sup>nd</sup> Set) |    |
| EPDCCH Subframe Monitoring       |  | NA                      |    |
| PDSCH TM                         |  | TM3                     |    |
| DCI Format                       |  | 2A                      |    |
| TDD UL/DL Configuration          |  | 0                       |    |
| TDD Special Subframe             |  | 1 (Note 3)              |    |
| Note 1:                          | The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured.   |                         |    |
| Note 2:                          | The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured. |                         |    |
| Note 3:                          | Demodulation performance is averaged over normal and special subframe.   |                         |    |

For the parameters specified in Table 8.8.1.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.1.2-2. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.8.1.2-2: Minimum performance Distributed EPDCCH

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55 TDD          | OP.7 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | 2.80     |
| 2           | 10 MHz    | 16 ECCE           | R.56 TDD          | OP.7 TDD     | EVA70                 | 2 x 2 Low                                    | 1               | -3.10    |

8.8.1.2.1 Void

Table 8.8.1.2.1-1: Void

## 8.8.2 Localized Transmission with TM9

## 8.8.2.1 FDD

The parameters specified in Table 8.8.2.1-1 are valid for all FDD TM9 localized ePDCCH tests unless otherwise stated.

Table 8.8.2.1-1: Test Parameters for Localized EPDCCH with TM9

| Parameter   | Unit  | Value   |    |
|---|---|---|----|
| Number of PDCCH symbols   | symbols   | 1 (Note 1)  |    |
| EPDCCH starting symbol  | symbols   | 2 (Note 1)  |    |
| PHICH duration  |   | Normal  |    |
| Unused RE-s and PRB-s   |   | OCNG  |    |
| Cell ID   |   | 0   |    |
| Downlink power allocation   | $\rho_A$  | dB  | 0  |
|   | $\rho_B$  | dB  | 0  |
|   | $\sigma$  | dB  | -3 |
|   | $\delta$  | dB  | 0  |
| $N_{oc}$ at antenna port  | dBm/15 kHz  | -98   |    |
| Cyclic prefix   |   | Normal  |    |
| Subframe Configuration  |   | Non-MBSFN   |    |
| Precoder Update Granularity   | PRB   | 1   |    |
|   | ms  | 1   |    |
| Beamforming Pre-Coder   |   | Annex B.4.5   |    |
| Cell Specific Reference Signal                                      |   | Port 0 and 1  |    |
| CSI-RS Reference Signal   |   | Port 15 and 16                                      |    |
| CSI-RS reference signal resource configuration                      |   | 0   |    |
| CSI reference signal subframe configuration $l_{CSI-RS}$            |   | 2   |    |
| ZP-CSI-RS configuration bitmap                                      |   | 0000010000000000                                    |    |
| ZP-CSI-RS subframe configuration $l_{ZP-CSI-RS}$                    |   | 2   |    |
| Number of EPDCCH Sets   |   | 2 (Note 2)  |    |
| EPDCCH Subframe Monitoring pattern <i>subframePatternConfig-r11</i> |   | 111111110 111111101 111111011<br>111110111 (Note 3) |    |
| PDSCH TM  |   | TM9   |    |
| Note 1:   | The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . However, CFI is set to 1.  |   |    |
| Note 2:   | The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests. |   |    |
| Note 3:   | EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by <i>subframePatternConfig-r11</i> . Legacy PDCCH is not scheduled.                |   |    |

For the parameters specified in Table 8.8.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.2.1-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.2.1-2: Minimum performance Localized EPDCCH with TM9**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 FDD          | OP.7 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | 12.2     |
| 2           | 10 MHz    | 8 ECCE            | R.58 FDD          | OP.7 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | 2.5      |

8.8.2.1.1 Void

**Table 8.8.2.1.1-1: Void**

8.8.2.1.2 Void

**Table 8.8.2.1.2-1: Void**

**Table 8.8.2.1.2-2: Void**

**Table 8.8.2.1.2-3: Void**

8.8.2.2 TDD

The parameters specified in Table 8.8.2.2-1 are valid for all TDD TM9 localized ePDCCH tests unless otherwise stated.

**Table 8.8.2.2-1: Test Parameters for Localized EPDCCH with TM9**

| Parameter                   |          | Unit       | Value      |
|-----------------------------|----------|------------|------------|
| Number of PDCCH symbols     |          | symbols    | 1 (Note 1) |
| EPDCCH starting symbol      |          | symbols    | 2 (Note 1) |
| PHICH duration              |          |            | Normal     |
| Unused RE-s and PRB-s       |          |            | OCNG       |
| Cell ID                     |          |            | 0          |
| Downlink power allocation   | $\rho_A$ | dB         | 0          |
|                             | $\rho_B$ | dB         | 0          |
|                             | $\sigma$ | dB         | -3         |
|                             | $\delta$ | dB         | 0          |
| $N_{oc}$ at antenna port    |          | dBm/15 kHz | -98        |
| Cyclic prefix               |          |            | Normal     |
| Subframe Configuration      |          |            | Non-MBSFN  |
| Precoder Update Granularity |          | PRB        | 1          |



|   |   |   |
|---|---|---|
|   | ms  | 1   |
| Beamforming Pre-Coder   |   | Annex B.4.5   |
| Cell Specific Reference Signal                                      |   | Port 0 and 1  |
| CSI-RS Reference Signal   |   | Port 15 and 16  |
| CSI-RS reference signal resource configuration                      |   | 0   |
| CSI reference signal subframe configuration $I_{CSI-RS}$            |   | 0   |
| ZP-CSI-RS configuration bitmap                                      |   | 0000010000000000  |
| ZP-CSI-RS subframe configuration $I_{ZP-CSI-RS}$                    |   | 0   |
| Number of EPDCCH Sets   |   | 2 (Note 2)  |
| EPDCCH Subframe Monitoring pattern <i>subframePatternConfig-r11</i> |   | 1100011000 1100010000 1100011000<br>1100001000 1100011000 1000011000<br>1100011000 (Note 3) |
| PDSCH TM  |   | TM9   |
| TDD UL/DL Configuration   |   | 0   |
| TDD Special Subframe  |   | 1 (Note 4)  |
| Note 1:   | The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . However, CFI is set to 1.  |   |
| Note 2:   | The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests. |   |
| Note 3:   | EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by <i>subframePatternConfig-r11</i> . Legacy PDCCH is not scheduled.                |   |
| Note 4:   | Demodulation performance is averaged over normal and special subframe.  |   |

For the parameters specified in Table 8.8.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.2.2.2-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.2.2-2: Minimum performance Localized EPDCCH with TM9**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 TDD          | OP.7 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | 12.8     |
| 2           | 10 MHz    | 8 ECCE            | R.58 TDD          | OP.7 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | 2.0      |

8.8.2.2.1 Void

**Table 8.8.2.2.1-1: Void**

8.8.2.2.2 Void

**Table 8.8.2.2.2-1: Void**

**Table 8.8.2.2.2-2: Void**

Table 8.8.2.2.2-3: Void

## 8.8.3 Localized transmission with TM10 Type B quasi co-location type

## 8.8.3.1 FDD

For the parameters specified in Table 8.8.3.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified values in Table 8.8.3.1-2. In Table 8.8.3.1-1, transmission point 1 (TP 1) is the serving cell. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.8.3.1-1: Test Parameters for Localized Transmission TM10 Type B quasi co-location type

| Parameter                                     |  | Unit   | Test 1                             |   | Test 2  |                 |
|---|--|--|------------------------------------|---|---|-----------------|
|   |  |  | TP 1                               | TP 2  | TP 1  | TP 2            |
| PHICH duration                                |  |  | Normal                             |   |   |                 |
| Downlink power allocation                     | $\rho_A$   | dB   | 0                                  |   |   |                 |
|   | $\rho_B$   | dB   | 0                                  |   |   |                 |
|   | $\sigma$   | dB   | -3                                 |   |   |                 |
|   | $\delta$   | dB   | 0                                  |   |   |                 |
| $\hat{E}_s/N_{oc}$                            | dB   | 0dB power imbalance is considered between TP 1 and TP 2, | Reference value in Table 8.8.3.1-2 | Reference value in Table 8.8.3.1-2                              | Reference value in Table 8.8.3.1-2                              |                 |
| $N_{oc}$ at antenna port                      | dBm/15kHz  | -98  |                                    |   |   |                 |
| Bandwidth                                     | MHz  | 10   | 10                                 | 10  | 10  |                 |
| Number of configured EPDCCH Sets              |  | 2 (Note 1)   |                                    | 2 (Note1)   |   |                 |
| EPDCCH-PRB-Set ID (setConfigId)               |  | 0  | 1                                  | 0   | 1   |                 |
| Transmission type of EPDCCH-PRB-set           |  | Localized  | Localized                          | Localized   | Localized   |                 |
| Number of PRB pair per EPDCCH-PRB-set         | PRB  | 8  | 8                                  | 8   | 8   |                 |
| EPDCCH beamforming model                      |  | Annex B.4.5  | Annex B.4.5                        | Annex B.4.5   | Annex B.4.5   |                 |
| PDSCH transmission mode                       |  | TM10   | TM10                               | TM10  | TM10  |                 |
| PDSCH transmission scheduling                 |  | Blanked in all the subframes                             | Transmit in all the subframes      | Probability of occurrence of PDSCH transmission is 30% (Note 3) | Probability of occurrence of PDSCH transmission is 70% (Note 3) |                 |
| Non-zero power CSI reference signal (NZPId=1) | CSI reference signal configuration                       |  | N/A                                | 0   | N/A   | 0               |
|   | CSI reference signal subframe configuration $l_{CSI-RS}$ |  | N/A                                | 2   | N/A   | 2               |
| Non-zero power CSI reference signal (NZPId=2) | CSI reference signal configuration                       |  | N/A                                | N/A   | 10  | N/A             |
|   | CSI reference signal subframe configuration $l_{CSI-RS}$ |  | N/A                                | N/A   | 2   | N/A             |
| Zero power CSI reference signal               | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap)       | Bitmap   | N/A                                | 000001000000000   | N/A   | 100001000000000 |

|   |  |               |                            |                            |                            |                            |
|---|--|---------------|----------------------------|----------------------------|----------------------------|----------------------------|
| (ZPId=1)  | CSI-RS subframe configuration $l_{\text{CSI-RS}}$  |               | N/A                        | 2                          | N/A                        | 2                          |
| Zero power CSI reference signal (ZPId=2)  | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap) | Bitmap        | N/A                        | N/A                        | 1000010000000000           | N/A                        |
|   | CSI-RS subframe configuration $l_{\text{CSI-RS}}$  |               | N/A                        | N/A                        | 2                          | N/A                        |
| PQI set 0 (Note 4)  | Non-Zero power CSI RS Identity (NZPId)             |               | N/A                        | 1                          | N/A                        | 1                          |
|   | Zero power CSI RS Identity (ZPId)                  |               | N/A                        | 1                          | N/A                        | 1                          |
| PQI set 1 (Note 4)  | Non-Zero power CSI RS Identity (NZPId)             |               | N/A                        | N/A                        | 2                          | N/A                        |
|   | Zero power CSI RS Identity (ZPId)                  |               | N/A                        | N/A                        | 2                          | N/A                        |
| Number of PDCCH symbols   |  | Symbols       | 1 (Note 2)                 |                            |                            |                            |
| EPDCCH starting position  |  |               | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) |
| Subframe configuration  |  |               | Non-MBSFN                  | Non-MBSFN                  | Non-MBSFN                  | Non-MBSFN                  |
| Time offset between TPs   |  | $\mu\text{s}$ | N/A                        | 2                          | N/A                        | 2                          |
| Frequency shift between TPs   |  | Hz            | N/A                        | 200                        | N/A                        | 200                        |
| Cell ID   |  |               | 0                          | 126                        | 0                          | 126                        |
| <p>Note 1: Resource blocks <math>n_{\text{PRB}} = 0, 7, 14, 21, 28, 35, 42, 49</math> are allocated for both the first set and the second set.</p> <p>Note 2: The starting OFDM symbol for EPDCCH is determined from the higher layer signalling pdsch-Start-r11. And CFI is set to 1.</p> <p>Note 3: The TP from which PDSCH is transmitted shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TP 1 and TP 2 are specified.</p> <p>Note 4: For PQI set 0, PDSCH and EPDCCH are transmitted from TP 2. For PQI set 1, PDSCH and EPDCCH are transmitted from TP1. EPDCCH and PDSCH are transmitted from same TP.</p> |  |               |                            |                            |                            |                            |

Table 8.8.3.1-2: Minimum Performance

| Test number | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 2 ECCE            | R.59 FDD          | OP.7 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | 13.4     |
| 2           | 2 ECCE            | R.59 FDD          | OP.7 FDD     | EVA5                  | 2 x 2 Low                                    | 1               | 13.4     |

### 8.8.3.2 TDD

For the parameters specified in Table 8.8.3.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified values in Table 8.8.3.2-2. In Table 8.8.3.2-1, transmission point 1 (TP1) is the serving cell. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.8.3.2-1: Test Parameters for Localized Transmission TM10 Type B quasi co-location type

| Parameter                 | Unit     | Test 1 |      | Test 2 |      |
|---------------------------|----------|--------|------|--------|------|
|                           |          | TP 1   | TP 2 | TP 1   | TP 2 |
| PHICH duration            |          | Normal |      |        |      |
| Downlink power allocation | $\rho_A$ | 0      |      |        |      |
|                           | $\rho_B$ | 0      |      |        |      |
|                           | $\sigma$ | -3     |      |        |      |

|   |  |           |  |                                    |   |   |
|---|--|-----------|--|------------------------------------|---|---|
|   | $\delta$   | dB        | 0  |                                    |   |   |
| $\hat{E}_s/N_{oc}$                            |  | dB        | 0dB power imbalance is considered between TP 1 and TP 2, | Reference value in Table 8.8.3.2-2 | Reference value in Table 8.8.3.2-2                              | Reference value in Table 8.8.3.2-2                              |
| $N_{oc}$ at antenna port                      |  | dBm/15kHz | -98  |                                    |   |   |
| Bandwidth                                     |  | MHz       | 10   | 10                                 | 10  | 10  |
| Number of EPDCCH Sets                         |  |           | 2 (Note 1)   |                                    | 2 (Note1)   |   |
| EPDCCH-PRB-Set ID (setConfigId)               |  |           | 0  | 1                                  | 0   | 1   |
| Transmission type of EPDCCH-PRB-set           |  |           | Localized  | Localized                          | Localized   | Localized   |
| Number of PRB pair per EPDCCH-PRB-set         |  | PRB       | 8  | 8                                  | 8   | 8   |
| EPDCCH beamforming model                      |  |           | Annex B.4.5  | Annex B.4.5                        | Annex B.4.5   | Annex B.4.5   |
| PDSCH transmission mode                       |  |           | TM10   | TM10                               | TM10  | TM10  |
| PDSCH transmission scheduling                 |  |           | Blanked in all the subframes                             | Transmit in all the subframes      | Probability of occurrence of PDSCH transmission is 30% (Note 3) | Probability of occurrence of PDSCH transmission is 70% (Note 3) |
| CSI reference signal configurations           |  |           | Antenna ports 15,16                                      | Antenna ports 15,16                | Antenna ports 15,16   | Antenna ports 15,16   |
| Non-zero power CSI reference signal (NZPId=1) | CSI reference signal configuration                       |           | N/A  | 0                                  | N/A   | 0   |
|   | CSI reference signal subframe configuration $l_{CSI-RS}$ |           | N/A  | 0                                  | N/A   | 0   |
| Non-zero power CSI reference signal (NZPId=2) | CSI reference signal configuration                       |           | N/A  | N/A                                | 10  | N/A   |
|   | CSI reference signal subframe configuration $l_{CSI-RS}$ |           | N/A  | N/A                                | 0   | N/A   |
| Zero power CSI reference signal (ZPId=1)      | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap)       | Bitmap    | N/A  | 000001000000000                    | N/A   | 100001000000000   |
|   | CSI-RS subframe configuration $l_{CSI-RS}$               |           | N/A  | 0                                  | N/A   | 0   |
| Zero power CSI reference signal (ZPId=2)      | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap)       | Bitmap    | N/A  | N/A                                | 100001000000000   | N/A   |
|   | CSI-RS subframe configuration $l_{CSI-RS}$               |           | N/A  | N/A                                | 0   | N/A   |
| PQI set 0 (Note 4)                            | Non-Zero power CSI RS Identity (NZPId)                   |           | N/A  | 1                                  | N/A   | 1   |
|   | Zero power CSI RS Identity (ZPId)                        |           | N/A  | 1                                  | N/A   | 1   |
| PQI set 1 (Note 4)                            | Non-Zero power CSI RS Identity (NZPId)                   |           | N/A  | N/A                                | 2   | N/A   |

|                             |  |                            |                            |                            |                            |     |
|-----------------------------|--|----------------------------|----------------------------|----------------------------|----------------------------|-----|
|                             | Zero power CSI RS Identity (ZPId)  |                            | N/A                        | N/A                        | 2                          | N/A |
| Number of PDCCH symbols     | Symbols  | 1 (Note 2)                 |                            |                            |                            |     |
| EPDCCH starting position    |  | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) |     |
| Subframe configuration      |  | Non-MBSFN                  | Non-MBSFN                  | Non-MBSFN                  | Non-MBSFN                  |     |
| Time offset between TPs     | $\mu\text{s}$  | N/A                        | 2                          | N/A                        | 2                          |     |
| Frequency shift between TPs | Hz   | N/A                        | 200                        | N/A                        | 200                        |     |
| Cell ID                     |  | 0                          | 126                        | 0                          | 126                        |     |
| TDD UL/DL configuration     |  | 0                          |                            |                            |                            |     |
| TDD special subframe        |  | 1                          |                            |                            |                            |     |
| Note 1:                     | Resource blocks $n_{\text{PRB}} = 0, 7, 14, 21, 28, 35, 42, 49$ are allocated for both the first set and the second set.   |                            |                            |                            |                            |     |
| Note 2:                     | The starting OFDM symbol for EPDCCH is determined from the higher layer signalling pdsch-Start-r11. And CFI is set to 1.   |                            |                            |                            |                            |     |
| Note 3:                     | The TP from which PDSCH is transmitted shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TP 1 and TP 2 are specified. |                            |                            |                            |                            |     |
| Note 4:                     | For PQI set 0, PDSCH and EPDCCH are transmitted from TP 2. For PQI set 1, PDSCH and EPDCCH are transmitted from TP1. EPDCCH and PDSCH are transmitted from same TP.                      |                            |                            |                            |                            |     |

Table 8.8.3.2-2: Minimum Performance

| Test number | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 2 ECCE            | R.59 TDD          | OP.7 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | 13.6     |
| 2           | 2 ECCE            | R.59 TDD          | OP.7 TDD     | EVA5                  | 2 x 2 Low                                    | 1               | 13.6     |

## 8.8.4 Enhanced Downlink Control Channel Performance Requirements Type A - Localized Transmission with CRS Interference Model

### 8.8.4.1 FDD

For the parameters specified in Table 8.8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.4.1-2. The purpose of this test is to verify the localized EPDCCH performance, when the EPDCCH transmission in the serving cell is interfered by the CRS of the interfering cells, applying the CRS interference model defined in clause B.6.5. In Table 8.8.4.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical setup is in accordance with Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.8.4.1-1: Test Parameters for EPDCCH

| Parameter                       |          | Unit      | Cell 1            | Cell 2            | Cell 3            |
|---------------------------------|----------|-----------|-------------------|-------------------|-------------------|
| Number of PDCCH symbols         |          | symbols   | 1 (Note 1)        | 2                 | 2                 |
| EPDCCH starting symbol          |          | symbols   | 2 (Note 1)        | N/A               | N/A               |
| PHICH duration                  |          |           | Normal            | Normal            | Normal            |
| Unused RE-s and PRB-s           |          |           | OCNG              | N/A               | N/A               |
| Cell ID                         |          |           | 0                 | 1                 | 6                 |
| Downlink power allocation       | $\rho_A$ | dB        | 0                 | -3                | -3                |
|                                 | $\rho_B$ | dB        | 0                 | -3                | -3                |
|                                 | $\sigma$ | dB        | -3                | 0                 | 0                 |
|                                 | $\delta$ | dB        | 0                 | 0                 | 0                 |
| Cell-specific reference signals |          |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port        |          | dBm/15kHz |                   | -98               |                   |
| $\bar{E}_s/N_{oc}$              |          | dB        | N/A               | 13.91             | 3.34              |
| BW <sub>Channel</sub>           |          | MHz       | 10                | 10                | 10                |
| Cyclic Prefix                   |          |           | Normal            | Normal            | Normal            |

|   |               |                                 |                                 |                                 |
|---|---------------|---------------------------------|---------------------------------|---------------------------------|
| Subframe Configuration  |               | Non-MBSFN                       | Non-MBSFN                       | Non-MBSFN                       |
| EPDCCH Precoder Update Granularity  | PRB           | 1                               | N/A                             | N/A                             |
|   | ms            | 1                               | N/A                             | N/A                             |
| EPDCCH Beamforming Pre-Coder  |               | Annex B. 4.5                    | N/A                             | N/A                             |
| CSI-RS Reference Signal   |               | Port 15 and 16                  | N/A                             | N/A                             |
| CSI-RS reference signal resource configuration  |               | 0                               | N/A                             | N/A                             |
| CSI reference signal subframe configuration $l_{\text{CSI-RS}}$   |               | 2                               | N/A                             | N/A                             |
| ZP-CSI-RS configuration bitmap  |               | 000001000000<br>0000            | N/A                             | N/A                             |
| ZP-CSI-RS subframe configuration $l_{\text{ZP-CSI-RS}}$   |               | 2                               | N/A                             | N/A                             |
| Number of EPDCCH Sets   |               | 1                               | N/A                             | N/A                             |
| EPDCCH Set type   |               | Localized                       | N/A                             | N/A                             |
| Number of PRB per EPDCCH Set  |               | 8                               | N/A                             | N/A                             |
| EPDCCH Set PRBs   |               | 0, 7, 14, 21,<br>28, 35, 42, 49 | N/A                             | N/A                             |
| PDSCH TM  |               | TM9                             | N/A                             | N/A                             |
| Interference model  |               | N/A                             | As specified in<br>clause B.6.5 | As specified in<br>clause B.6.5 |
| Time offset to cell 1   | $\mu\text{s}$ | N/A                             | 2                               | 3                               |
| Frequency offset to cell 1  | Hz            | N/A                             | 200                             | 300                             |
| Note 1: The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . CFI is set to 1. |               |                                 |                                 |                                 |
| Note 2: EPDCCH is scheduled in every subframe. EPDCCH Subframe Monitoring pattern is not configured.      |               |                                 |                                 |                                 |

**Table 8.8.4.1-2: Minimum performance for EPDCCH for enhanced downlink control channel performance requirements Type A**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 FDD          | OP.7 FDD     | EPA5                  | 2 x 2 Low                                    | 1               | 13.4     |

### 8.8.4.2 TDD

For the parameters specified in Table 8.8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.4.2-2. The purpose of this test is to verify the localized EPDCCH performance, when the EPDCCH transmission in the serving cell is interfered by the CRS of the interfering cells, applying the CRS interference model defined in clause B.6.5. In Table 8.8.4.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical setup is in accordance with Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.8.4.2-1: Test Parameters for EPDCCH**

| Parameter                       |          | Unit      | Cell 1               | Cell 2               | Cell 3               |
|---------------------------------|----------|-----------|----------------------|----------------------|----------------------|
| Number of PDCCH symbols         |          | symbols   | 1 (Note 1)           | 2                    | 2                    |
| EPDCCH starting symbol          |          | symbols   | 2 (Note 1)           | N/A                  | N/A                  |
| PHICH duration                  |          |           | Normal               | Normal               | Normal               |
| Unused RE-s and PRB-s           |          |           | OCNG                 | N/A                  | N/A                  |
| Cell ID                         |          |           | 0                    | 1                    | 6                    |
| Downlink power allocation       | $\rho_A$ | dB        | 0                    | -3                   | -3                   |
|                                 | $\rho_B$ | dB        | 0                    | -3                   | -3                   |
|                                 | $\sigma$ | dB        | -3                   | 0                    | 0                    |
|                                 | $\delta$ | dB        | 0                    | 0                    | 0                    |
| Cell-specific reference signals |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1 | Antenna ports<br>0,1 |
| $N_{oc}$ at antenna port        |          | dBm/15kHz | -98                  |                      |                      |
| $\hat{E}_s/N_{oc}$              |          | dB        | N/A                  | 13.91                | 3.34                 |
| $BW_{\text{Channel}}$           |          | MHz       | 10                   | 10                   | 10                   |

|   |               |                                 |                                 |                                 |
|---|---------------|---------------------------------|---------------------------------|---------------------------------|
| Cyclic Prefix   |               | Normal                          | Normal                          | Normal                          |
| Subframe Configuration  |               | Non-MBSFN                       | Non-MBSFN                       | Non-MBSFN                       |
| EPDCCH Precoder Update Granularity  | PRB           | 1                               | N/A                             | N/A                             |
|   | ms            | 1                               | N/A                             | N/A                             |
| EPDCCH Beamforming Pre-Coder  |               | Annex B. 4.5                    | N/A                             | N/A                             |
| CSI-RS Reference Signal   |               | Port 15 and 16                  | N/A                             | N/A                             |
| CSI-RS reference signal resource configuration  |               | 0                               | N/A                             | N/A                             |
| CSI reference signal subframe configuration $l_{\text{CSI-RS}}$   |               | 2                               | N/A                             | N/A                             |
| ZP-CSI-RS configuration bitmap  |               | 000001000000<br>0000            | N/A                             | N/A                             |
| ZP-CSI-RS subframe configuration $l_{\text{ZP-CSI-RS}}$   |               | 2                               | N/A                             | N/A                             |
| Number of EPDCCH Sets   |               | 1                               | N/A                             | N/A                             |
| EPDCCH Set type   |               | Localized                       | N/A                             | N/A                             |
| Number of PRB per EPDCCH Set  |               | 8                               | N/A                             | N/A                             |
| EPDCCH Set PRBs   |               | 0, 7, 14, 21,<br>28, 35, 42, 49 | N/A                             | N/A                             |
| PDSCH TM  |               | TM9                             | N/A                             | N/A                             |
| Interference model  |               | N/A                             | As specified in<br>clause B.6.5 | As specified in<br>clause B.6.5 |
| Time offset to cell 1   | $\mu\text{s}$ | N/A                             | 2                               | 3                               |
| Frequency offset to cell 1  | Hz            | N/A                             | 200                             | 300                             |
| TDD UL/DL Configuration   |               | 0                               | 0                               | 0                               |
| TDD Special Subframe  |               | 1 (Note 4)                      | 1                               | 1                               |
| Note 1: The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . CFI is set to 1. |               |                                 |                                 |                                 |
| Note 2: EPDCCH is scheduled in every subframe. EPDCCH Subframe Monitoring pattern is not configured.      |               |                                 |                                 |                                 |
| Note 3: Demodulation performance is averaged over normal and special subframes.                           |               |                                 |                                 |                                 |

**Table 8.8.4.2-2: Minimum performance for EPDCCH for enhanced downlink control channel performance requirements Type A**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 TDD          | OP.7 TDD     | EPA5                  | 2 x 2 Low                                    | 1               | 14.2     |

## 8.8.5 Enhanced Downlink Control Channel Performance Requirements Type A - Distributed Transmission with TM9 Interference Model

### 8.8.5.1 TDD

For the parameters specified in Table 8.8.5.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.5.1-2. The purpose of this test is to verify the distributed EPDCCH performance when the EPDCCH transmission in the serving cell is interfered by two interfering cells and applying TM9 interference model. In Table 8.8.5.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical setup is in accordance with Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

**Table 8.8.5.1-1: Test Parameters for EPDCCH**

| Parameter                 |          | Unit    | Cell 1     | Cell 2 | Cell 3 |
|---------------------------|----------|---------|------------|--------|--------|
| Number of PDCCH symbols   |          | symbols | 2 (Note 1) | 2      | 2      |
| PHICH duration            |          |         | Normal     | Normal | Normal |
| Cell ID                   |          |         | 0          | 6      | 1      |
| Downlink power allocation | $\rho_A$ | dB      | -3         | -3     | -3     |
|                           | $\rho_B$ | dB      | -3         | -3     | -3     |

|  |          |           |                      |                                 |                                 |
|--|----------|-----------|----------------------|---------------------------------|---------------------------------|
|  | $\sigma$ | dB        | 0                    | 0                               | 0                               |
|  | $\delta$ | dB        | 3                    | 3                               | 3                               |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |          | dB        | N/A                  | 13.91                           | 3.34                            |
| $BW_{Channel}$   |          | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |          |           | Normal               | Normal                          | Normal                          |
| Subframe Configuration   |          |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| EPDCCH precoder Update Granularity   |          | PRB       | 1                    | N/A                             | N/A                             |
|  |          | ms        | 1                    | N/A                             | N/A                             |
| Beamforming Pre-Coder  |          |           | Annex B. 4.4         | N/A                             | N/A                             |
| Number of EPDCCH Sets Configured   |          |           | 1                    | N/A                             | N/A                             |
| EPDCCH Set type  |          |           | Distributed          | N/A                             | N/A                             |
| Number of PRB per EPDCCH Set   |          |           | 4                    | N/A                             | N/A                             |
| EPDCCH Set PRBs  |          |           | 3, 17, 31, 45        | N/A                             | N/A                             |
| PDSCH TM   |          |           | TM9                  | N/A                             | N/A                             |
| Interference model   |          |           | N/A                  | As specified in<br>clause B.5.4 | As specified in<br>clause B.5.4 |
| Probability of occurrence of<br>PDSCH transmission rank in<br>interfering cells  |          | Rank 1    | %                    | N/A                             | 70                              |
|  |          | Rank 2    | %                    | N/A                             | 30                              |
| PDSCH precoder update granularity  |          | PRB       | N/A                  | 50                              | 50                              |
| Time offset to cell 1  |          | $\mu$ s   | N/A                  | 2                               | 3                               |
| Frequency offset to cell 1   |          | Hz        | N/A                  | 200                             | 300                             |
| TDD UL/DL Configuration  |          |           | 0                    | 0                               | 0                               |
| TDD Special Subframe   |          |           | 1 (Note 3)           | 1                               | 1                               |
| Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured. |          |           |                      |                                 |                                 |
| Note 2: EPDCCH is scheduled in every subframe. EPDCCH Subframe Monitoring pattern is not configured.                               |          |           |                      |                                 |                                 |
| Note 3: Demodulation performance is averaged over normal and special subframes.  |          |           |                      |                                 |                                 |

**Table 8.8.5.1-2: Minimum performance for EPDCCH for enhanced downlink control channel performance requirements Type A**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55-1 TDD        | OP.7 TDD     | EPA5                  | 2 x 2 Low                                    | 1               | 14.8     |

## 8.8.6 Enhanced Downlink Control Channel Performance Requirements Type A - Distributed Transmission with TM3 Interference Model

### 8.8.6.1 FDD

For the parameters specified in Table 8.8.6.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.6.1-2. The purpose of this test is to verify the distributed EPDCCH performance when the serving cell EPDCCH transmission is interfered by two interfering cells applying asynchronous TM3 interference model. In Table 8.8.6.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical setup is in accordance with Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is not provided.

**Table 8.8.6.1-1: Test Parameters for EPDCCH**

| Parameter               | Unit    | Cell 1     | Cell 2 | Cell 3 |
|-------------------------|---------|------------|--------|--------|
| Number of PDCCH symbols | symbols | 2 (Note 1) | 2      | 2      |
| PHICH duration          |         | Normal     | Normal | Normal |



|  |          |           |                      |                                 |                                 |
|--|----------|-----------|----------------------|---------------------------------|---------------------------------|
| Cell ID  |          |           | 0                    | 1                               | 6                               |
| Downlink power allocation  | $\rho_A$ | dB        | -3                   | -3                              | -3                              |
|  | $\rho_B$ | dB        | -3                   | -3                              | -3                              |
|  | $\sigma$ | dB        | 0                    | 0                               | 0                               |
|  | $\delta$ | dB        | 3                    | 0                               | 0                               |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  |                                 |                                 |
| $\bar{E}_s/N_{oc}$   |          | dB        | N/A                  | 13.91                           | 3.34                            |
| BW <sub>Channel</sub>  |          | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |          |           | Normal               | Normal                          | Normal                          |
| Subframe Configuration   |          |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| EPDCCH Precoder Update Granularity   | PRB      |           | 1                    | N/A                             | N/A                             |
|  | ms       |           | 1                    | N/A                             | N/A                             |
| EPDCCH Beamforming Pre-Coder   |          |           | Annex B.4.4          | N/A                             | N/A                             |
| Number of EPDCCH Sets Configured   |          |           | 1                    | N/A                             | N/A                             |
| EPDCCH Set type  |          |           | Distributed          | N/A                             | N/A                             |
| Number of PRB per EPDCCH Set   |          |           | 4                    | N/A                             | N/A                             |
| EPDCCH Set PRBs  |          |           | 3, 17, 31, 45        | N/A                             | N/A                             |
| PDSCH TM   |          |           | TM9                  | N/A                             | N/A                             |
| Interference model   |          |           | N/A                  | As specified in<br>clause B.5.2 | As specified in<br>clause B.5.2 |
| Probability of occurrence of<br>PDSCH transmission rank in<br>interfering cells  | Rank 1   | %         | N/A                  | 70                              | 70                              |
|  | Rank 2   | %         | N/A                  | 30                              | 30                              |
| Time offset to cell 1  |          | $\mu$ s   | N/A                  | 330                             | 667                             |
| Frequency offset to cell 1   |          | Hz        | N/A                  | 0                               | 0                               |
| Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured. |          |           |                      |                                 |                                 |
| Note 2: EPDCCH is scheduled in every subframe. EPDCCH Subframe Monitoring pattern is not configured.                               |          |           |                      |                                 |                                 |

**Table 8.8.6.1-2: Minimum performance for EPDCCH for enhanced downlink control channel performance requirements Type A**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55-1 FDD        | OP.7 FDD     | EVA70                 | 2 x 2 Low                                    | 1               | 15.9     |

## 8.9 Demodulation (single receiver antenna)

The SNR definition is given in Clause 8.1.1 where the number of receiver antennas  $N_{RX}$  assumed for the minimum performance requirement in this clause is 1.

### 8.9.1 PDSCH

#### 8.9.1.1 FDD and half-duplex FDD (Fixed Reference Channel)

The parameters specified in Table 8.9.1.1-1 are valid for FDD and half-duplex FDD tests unless otherwise stated.

**Table 8.9.1.1-1: Common Test Parameters (FDD and half-duplex FDD)**

| Parameter          | Unit | Value |
|--------------------|------|-------|
| Inter-TTI Distance |      | 1     |

|  |              |  |
|--|--------------|--|
| Number of HARQ processes per component carrier         | Processes    | 8  |
| Maximum number of HARQ transmission                    |              | 4  |
| Redundancy version coding sequence                     |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix  |              | Normal   |
| Precoder update granularity                            |              | Frequency domain: 1 PRG<br>Time domain: 1 ms for Transmission mode 9                                     |

### 8.9.1.1.1 Transmit diversity performance (Cell-Specific Reference Symbols)

#### 8.9.1.1.1.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.1.1-2, with the addition of the parameters in Table 8.9.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.9.1.1.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 |          | Unit      | Test 1-2    |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| PDSCH transmission mode   |          |           | 2           |
| Note 1: $P_B = 1$ .       |          |           |             |

**Table 8.9.1.1.1-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz 16QAM 1/2  | R.62 FDD          | OP.1 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.0      | 0              |
| 2           | 10 MHz 16QAM 1/2  | R.84 FDD          | OP.1 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.3      | 1bis           |

### 8.9.1.1.2 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

#### 8.9.1.1.2.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.1.2-2, with the addition of the parameters in Table 8.9.1.1.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.1.2.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1    |             |
|---|-----------|-----------|-------------|
| Downlink power allocation   | $\rho_A$  | dB        | -3          |
|   | $\rho_B$  | dB        | -3 (Note 1) |
|   | $\sigma$  | dB        | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98       |             |
| Precoding granularity   | PRB       | 6         |             |
| PMI delay (Note 2)  | ms        | 8         |             |
| Reporting interval  | ms        | 8         |             |
| Reporting mode  |           | PUSCH 1-2 |             |
| CodeBookSubsetRestriction bitmap  |           | 001111    |             |
| PDSCH transmission mode   |           | 4         |             |
| Note 1: $P_B = 1$ .   |           |           |             |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |           |             |

**Table 8.9.1.1.2.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth and MCS      | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|------------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                        |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>64QAM<br>1/2 | R.63 FDD          | OP.1 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 13.2     | 0              |

#### 8.9.1.1.2.2 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

The requirements are specified in Table 8.9.1.1.2.2-2, with the addition of the parameters in Table 8.9.1.1.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.1.2.2-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1           |             |
|---|-----------|------------------|-------------|
| Downlink power allocation   | $\rho_A$  | dB               | -6          |
|   | $\rho_B$  | dB               | -6 (Note 1) |
|   | $\sigma$  | dB               | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98              |             |
| Precoding granularity   | PRB       | 6                |             |
| PMI delay (Note 2)  | ms        | 8                |             |
| Reporting interval  | ms        | 8                |             |
| Reporting mode  |           | PUSCH 1-2        |             |
| CodeBookSubsetRestriction bitmap  |           | 000000000000FFFF |             |
| PDSCH transmission mode   |           | 4                |             |
| Note 1: $P_B = 1$ .   |           |                  |             |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |                  |             |

**Table 8.9.1.1.2.2-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth and MCS      | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|------------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                        |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>64QAM<br>1/2 | R.85 FDD          | OP.1 FDD     | EPA5                  | 4x1 Low                                      | 70                                 | 11.3     | 1bis           |

### 8.9.1.1.2.3 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.9.1.1.2.3-2, with the addition of parameters in Table 8.9.1.1.2.3-1. In Table 8.9.1.1.2.3-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

**Table 8.9.1.1.2.3-1: Test Parameters**

| Parameter  |          | Unit      | Cell 1                | Cell 2                       | Cell 3                       |
|--|----------|-----------|-----------------------|------------------------------|------------------------------|
| Downlink power allocation  | $\rho_A$ | dB        | -6                    | -6                           | -6                           |
|  | $\rho_B$ | dB        | -6 (Note 1)           | -6 (Note 1)                  | -6 (Note 1)                  |
|  | $\sigma$ | dB        | 3                     | 3                            | 3                            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                   | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$   |          | dB        | N/A                   | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>  |          | MHz       | 10                    | 10                           | 10                           |
| Cyclic prefix  |          |           | Normal                | Normal                       | Normal                       |
| Subframe Configuration   |          |           | Non-MBSFN             | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID  |          |           | 0                     | 1                            | 6                            |
| Cell-specific reference signals  |          |           | Antenna ports 0,1,2,3 |                              |                              |
| Number of control OFDM symbols (CFI)   |          |           | 2                     | 2                            | 2                            |
| PDSCH transmission mode  |          |           | 4                     | N/A                          | N/A                          |
| Precoding granularity  |          | PRB       | 50                    | N/A                          | N/A                          |
| PMI delay (Note 2)   |          | ms        | 8                     | N/A                          | N/A                          |
| Reporting interval   |          | ms        | 1                     | N/A                          | N/A                          |
| Reporting mode   |          |           | PUSCH 3-1             | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap   |          |           | 000000000000<br>FFFF  | N/A                          | N/A                          |
| Time offset relative to Cell 1   |          | $\mu$ s   | N/A                   | 3                            | -1                           |
| Frequency shift relative to Cell 1   |          | Hz        | N/A                   | 300                          | -100                         |
| Interference model   |          |           | N/A                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells  |          | %         | N/A                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1   | %         | N/A                   | 80                           | 80                           |
|  | Rank 2   | %         | N/A                   | 20                           | 20                           |
| Note 1: $P_B = 1$ .  |          |           |                       |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF #(n+4). |          |           |                       |                              |                              |
| Note 3: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.   |          |           |                       |                              |                              |

Table 8.9.1.1.2.3-2: Minimum performance for PDSCH

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.93 FDD          | OP.1 FDD     | N/A    | N/A    | EPA5                           |        |        | 4x1 Low   | 70                                 | 16.7              | 1bis        |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.  
Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of cell 1.

### 8.9.1.1.3 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

#### 8.9.1.1.3.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.9.1.1.3.1-2 with the addition of the parameters in Table 8.9.1.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.9.1.1.3.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| parameter  |          | Unit               | Test 1                  | Test 2               |
|--|----------|--------------------|-------------------------|----------------------|
| Downlink power allocation  | $\rho_A$ | dB                 | 0                       |                      |
|  | $\rho_B$ | dB                 | 0 (Note 1)              |                      |
|  | $\sigma$ | dB                 | -3                      |                      |
| Beamforming model  |          |                    | Annex B.4.1             | Annex B.4.3          |
| Cell-specific reference signals  |          |                    | Antenna ports 0,1       | Antenna ports 0,1    |
| CSI reference signals  |          |                    | Antenna ports 15,...,18 | Antenna ports 15,16  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes          | 5 / 2                   | 5 / 2                |
| CSI reference signal configuration   |          |                    | 0                       | 0                    |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |          | Subframes / bitmap | 3 / 0001000000000000    | 3 / 0001000000000000 |
| $N_{oc}$ at antenna port   |          | dBm/15kHz          | -98                     | -98                  |
| Symbols for unused PRBs  |          |                    | OCNG (Note 4)           | OCNG (Note 3)        |
| Reporting mode   |          |                    | N/A                     | PUSCH 3-1            |
| Reporting interval   |          |                    | N/A                     | 5                    |
| PMI delay (Note 4)   |          |                    | N/A                     | 8                    |
| CodeBookSubsetRestriction bitmap   |          |                    | N/A                     | 001111               |
| Number of allocated resource blocks (Note 2)   |          | PRB                | 6                       | 50                   |
| PDSCH transmission mode  |          |                    | 9                       |                      |

Note 1:  $P_B = 1$ .  
Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.

|         |   |
|---------|---|
| Note 3: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |
| Note 4: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).       |

**Table 8.9.1.1.3.1-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz QPSK 1/3   | R.64 FDD          | OP.1 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 4.7      | 0              |
| 2           | 10 MHz QPSK 1/3   | R.86 FDD          | OP.1 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 2.5      | 1bis           |

#### 8.9.1.1.3.2 Single-layer Spatial Multiplexing with CRS assistance information

The requirements are specified in Table 8.9.1.1.3.2-2, with the addition of parameters in Table 8.9.1.1.3.2-1. In Table 8.9.1.1.3.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the single-layer spatial multiplexing TM9 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.9.1.1.3.2-1: Test Parameters**

| Parameter  | Unit               | Cell 1                                       | Cell 2     | Cell 3     |
|--|--------------------|--|------------|------------|
| Downlink power allocation  | $\rho_A$           | dB   | 0          | 0          |
|  | $\rho_B$           | dB   | 0 (Note 1) | 0 (Note 1) |
|  | $\sigma$           | dB   | -3         | -3         |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98  | N/A        | N/A        |
| $\hat{E}_s/N_{oc}$   | dB                 | N/A  | 11.75      | 5.69       |
| $BW_{Channel}$   | MHz                | 10   | 10         | 10         |
| Cyclic prefix  |                    | Normal                                       | Normal     | Normal     |
| Subframe Configuration   |                    | Non-MBSFN                                    | Non-MBSFN  | Non-MBSFN  |
| Cell ID  |                    | 0  | 1          | 6          |
| Cell-specific reference signals  |                    | Antenna ports 0,1                            |            |            |
| Number of control OFDM symbols (CFI)                                     |                    | 2  | 2          | 2          |
| CSI reference signals  |                    | Antenna ports 15,16                          | N/A        | N/A        |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes          | 5 / 2  | N/A        | N/A        |
| CSI reference signal configuration                                       |                    | 8  | N/A        | N/A        |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap | Subframes / bitmap | 3 / 001000000000000                          | N/A        | N/A        |
| PDSCH transmission mode  |                    | TM9  | N/A        | N/A        |
| Precoding granularity  |                    | Frequency domain: 1 PRG<br>Time domain: 1 ms | N/A        | N/A        |
| Beamforming model  |                    | Annex B.4.1                                  | N/A        | N/A        |

|  |        |               |        |                              |                              |
|--|--------|---------------|--------|------------------------------|------------------------------|
| CodeBookSubsetRestriction bitmap   |        |               | 001111 | N/A                          | N/A                          |
| Time offset relative to Cell 1   |        | $\mu\text{s}$ | N/A    | 3                            | -1                           |
| Frequency shift relative to Cell 1   |        | Hz            | N/A    | 300                          | -100                         |
| Interference model   |        |               | N/A    | As specified in clause B.5.4 | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells  |        | %             | N/A    | 10                           | 10                           |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | %             | N/A    | 80                           | 80                           |
|  | Rank 2 | %             | N/A    | 20                           | 20                           |
| Note 1: $P_B = 1$ .  |        |               |        |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |        |               |        |                              |                              |
| Note 3: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.   |        |               |        |                              |                              |

Table 8.9.1.1.3.2-2: Minimum Performance

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.94 FDD          | OP.1 FDD     | N/A    | N/A    | EPA5                           |        |        | 2x1 Low   | 70                                 | 11.9              | 1bis        |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.  |                   |              |        |        |                                |        |        |   |                                    |                   |             |

### 8.9.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.9.1.2-1 are valid for all TDD tests unless otherwise stated.

Table 8.9.1.2-1: Common Test Parameters (TDD)

| Parameter  | Unit         | Value  |
|--|--------------|--|
| Uplink downlink configuration (Note 1)                 |              | 1  |
| Special subframe configuration (Note 2)                |              | 4  |
| Cyclic prefix  |              | Normal   |
| Cell ID  |              | 0  |
| Inter-TTI Distance                                     |              | 1  |
| Number of HARQ processes per component carrier         | Processes    | 7  |
| Maximum number of HARQ transmission                    |              | 4  |
| Redundancy version coding sequence                     |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM  |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Precoder update granularity                            |              | Frequency domain: 1 PRG<br>Time domain: 1 ms for Transmission mode 9                                     |
| ACK/NACK feedback mode                                 |              | Multiplexing   |

|         |   |
|---------|---|
| Note 1: | as specified in Table 4.2-2 in TS 36.211 [4]. |
| Note 2: | as specified in Table 4.2-1 in TS 36.211 [4]. |

### 8.9.1.2.1 Transmit diversity performance (Cell-Specific Reference Symbols)

#### 8.9.1.2.1.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.2.1.1-2, with the addition of the parameters in Table 8.9.1.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.9.1.2.1.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter                 |          | Unit      | Test 1-2    |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| PDSCH transmission mode   |          |           | 2           |
| Note 1: $P_B = 1$ .       |          |           |             |

**Table 8.9.1.2.1.1-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Bandwidth              | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|------------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                        |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>16QAM<br>1/2 | R.62 TDD          | OP.1 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 8.8      | 0              |
| 2           | 10 MHz<br>16QAM<br>1/2 | R.84 TDD          | OP.1 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.5      | 1bis           |

### 8.9.1.2.2 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

#### 8.9.1.2.2.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.2.2.1-2, with the addition of the parameters in Table 8.9.1.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.2.2.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter                 |          | Unit      | Test 1          |
|---------------------------|----------|-----------|-----------------|
| Downlink power allocation | $\rho_A$ | dB        | -3              |
|                           | $\rho_B$ | dB        | -3 (Note 1)     |
|                           | $\sigma$ | dB        | 0               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98             |
| Precoding granularity     |          | PRB       | 6               |
| PMI delay (Note 2)        |          | ms        | 10 or 11        |
| Reporting interval        |          | ms        | 1 or 4 (Note 3) |
| Reporting mode            |          |           | PUSCH 1-2       |



|  |  |              |
|--|--|--------------|
| CodeBookSubsetRestriction bitmap   |  | 001111       |
| ACK/NACK feedback mode   |  | Multiplexing |
| PDSCH transmission mode  |  | 4            |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |  |              |

**Table 8.9.1.2.2.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth           | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>64QAM 1/2 | R.63 TDD          | OP.1 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 13.1     | 0              |

8.9.1.2.2.2 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

The requirements are specified in Table 8.9.1.2.2.2-2, with the addition of the parameters in Table 8.9.1.2.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.2.2.2-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter  | Unit      | Test 1           |             |
|--|-----------|------------------|-------------|
| Downlink power allocation  | $\rho_A$  | dB               | -6          |
|  | $\rho_B$  | dB               | -6 (Note 1) |
|  | $\sigma$  | dB               | 0           |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98              |             |
| Precoding granularity  | PRB       | 6                |             |
| PMI delay (Note 2)   | ms        | 10 or 11         |             |
| Reporting interval   | ms        | 1 or 4 (Note 3)  |             |
| Reporting mode   |           | PUSCH 1-2        |             |
| CodeBookSubsetRestriction bitmap   |           | 000000000000FFFF |             |
| ACK/NACK feedback mode   |           | Multiplexing     |             |
| PDSCH transmission mode  |           | 4                |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |           |                  |             |

**Table 8.9.1.2.2.2-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth           | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>64QAM 1/2 | R.85 TDD          | OP.1 TDD     | EPA5                  | 4x1 Low                                      | 70                                 | 11.6     | 1bis           |

8.9.1.2.2.3 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Ports with CRS assistance information

The requirements are specified in Table 8.9.1.2.2.3-2, with the addition of parameters in Table 8.9.1.2.2.3-1. In Table 8.9.1.2.2.3-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

**Table 8.9.1.2.2.3-1: Test Parameters**

| Parameter   |          | Unit      | Cell 1                | Cell 2                       | Cell 3                       |
|---|----------|-----------|-----------------------|------------------------------|------------------------------|
| Uplink downlink Configuration   |          |           | 1                     | 1                            | 1                            |
| Special subframe configuration  |          |           | 4                     | 4                            | 4                            |
| Downlink power allocation   | $\rho_A$ | dB        | -6                    | -6                           | -6                           |
|   | $\rho_B$ | dB        | -6 (Note 1)           | -6 (Note 1)                  | -6 (Note 1)                  |
|   | $\sigma$ | dB        | 3                     | 3                            | 3                            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                   | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$  |          | dB        | N/A                   | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>   |          | MHz       | 10                    | 10                           | 10                           |
| Cyclic prefix   |          |           | Normal                | Normal                       | Normal                       |
| Subframe Configuration  |          |           | Non-MBSFN             | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID   |          |           | 0                     | 1                            | 6                            |
| Cell-specific reference signals   |          |           | Antenna ports 0,1,2,3 |                              |                              |
| Number of control OFDM symbols (CFI)  |          |           | 2                     | 2                            | 2                            |
| PDSCH transmission mode   |          |           | 4                     | N/A                          | N/A                          |
| Precoding granularity   |          | PRB       | 50                    | N/A                          | N/A                          |
| PMI delay (Note 2)  |          | ms        | 8                     | N/A                          | N/A                          |
| Reporting interval  |          | ms        | 1 or 4 (Note 4)       | N/A                          | N/A                          |
| Reporting mode  |          |           | PUSCH 3-1             | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 000000000000<br>FFFF  | N/A                          | N/A                          |
| Time offset relative to Cell 1  |          | $\mu$ s   | N/A                   | 3                            | -1                           |
| Frequency shift relative to Cell 1  |          | Hz        | N/A                   | 300                          | -100                         |
| Interference model  |          |           | N/A                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells   |          | %         | N/A                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1   | %         | N/A                   | 80                           | 80                           |
|   | Rank 2   | %         | N/A                   | 20                           | 20                           |
| Note 1: $P_B = 1$ .   |          |           |                       |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |                       |                              |                              |
| Note 3: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.  |          |           |                       |                              |                              |
| Note 4: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.  |          |           |                       |                              |                              |

**Table 8.9.1.2.2.3-2: Minimum performance for PDSCH**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
|             |                   |              |        |        |                                |        |        |   |                                    |                   |             |

|  |          |             |     |     |      |         |    |      |      |
|--|----------|-------------|-----|-----|------|---------|----|------|------|
| 1  | R.93 TDD | OP.1<br>TDD | N/A | N/A | EPA5 | 4x1 Low | 70 | 16.8 | 1bis |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1. |          |             |     |     |      |         |    |      |      |

### 8.9.1.2.3 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

#### 8.9.1.2.3.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.9.1.2.3.1-2 with the addition of the parameters in Table 8.9.1.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.9.1.2.3.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter   |          | Unit               | Test 1                  | Test 2               |
|---|----------|--------------------|-------------------------|----------------------|
| Downlink power allocation   | $\rho_A$ | dB                 | 0                       |                      |
|   | $\rho_B$ | dB                 | 0 (Note 1)              |                      |
|   | $\sigma$ | dB                 | -3                      |                      |
| Cell-specific reference signals   |          |                    | Antenna ports 0,1       | Antenna ports 0,1    |
| CSI reference signals   |          |                    | Antenna ports 15,...,18 | Antenna ports 15,16  |
| Beamforming model   |          |                    | Annex B.4.1             | Annex B.4.3          |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          | Subframes          | 5 / 4                   | 5 / 4                |
| CSI reference signal configuration  |          |                    | 1                       | 1                    |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS bitmap}$  |          | Subframes / bitmap | 4 / 0010000100000000    | 4 / 0000001000000000 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz          | -98                     | -98                  |
| Symbols for unused PRBs   |          |                    | OCNG (Note 4)           | OCNG (Note 3)        |
| Reporting mode  |          |                    | N/A                     | PUSCH 3-1            |
| Reporting interval  |          |                    | N/A                     | 5                    |
| PMI delay (Note 4)  |          |                    | N/A                     | 10                   |
| CodeBookSubsetRestriction bitmap  |          |                    | N/A                     | 001111               |
| Number of allocated resource blocks (Note 2)  |          | PRB                | 6                       |                      |
| Simultaneous transmission   |          |                    | No                      |                      |
| PDSCH transmission mode   |          |                    | 9                       |                      |
| Note 1: $P_B = 1$ .<br>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |                    |                         |                      |

**Table 8.9.1.2.3.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz QPSK 1/3   | R.64 TDD          | OP.1 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 4.5      | 0              |
| 2           | 10 MHz QPSK 1/3   | R.86 TDD          | OP.1 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 2.9      | 1bis           |

### 8.9.1.2.3.2 Single-layer Spatial Multiplexing with CRS assistance information

The requirements are specified in Table 8.9.1.2.3.2-2, with the addition of parameters in Table 8.9.1.2.3.2-1. In Table 8.9.1.2.3.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the single-layer spatial multiplexing TM9 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.9.1.2.3.2-1: Test Parameters**

| Parameter  | Unit               | Cell 1                                       | Cell 2     | Cell 3     |
|--|--------------------|--|------------|------------|
| Uplink downlink Configuration  |                    | 1  | 1          | 1          |
| Special subframe configuration   |                    | 4  | 4          | 4          |
| Downlink power allocation  | $\rho_A$           | dB   | 0          | 0          |
|  | $\rho_B$           | dB   | 0 (Note 1) | 0 (Note 1) |
|  | $\sigma$           | dB   | -3         | -3         |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98  | N/A        | N/A        |
| $\hat{E}_s/N_{oc}$   | dB                 | N/A  | 11.75      | 5.69       |
| $BW_{Channel}$   | MHz                | 10   | 10         | 10         |
| Cyclic prefix  |                    | Normal                                       | Normal     | Normal     |
| Subframe Configuration   |                    | Non-MBSFN                                    | Non-MBSFN  | Non-MBSFN  |
| Cell ID  |                    | 0  | 1          | 128        |
| Cell-specific reference signals  |                    | Antenna ports 0,1                            |            |            |
| Number of control OFDM symbols (CFI)                                     |                    | 2  | 2          | 2          |
| CSI reference signals  |                    | Antenna ports 15,16                          | N/A        | N/A        |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes          | 5 / 4  | N/A        | N/A        |
| CSI reference signal configuration                                       |                    | 1  | N/A        | N/A        |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap | Subframes / bitmap | 4 / 00100000000000                           | N/A        | N/A        |
| Number of control OFDM symbols   |                    | 2  | 2          | 2          |
| PDSCH transmission mode  |                    | TM9  | N/A        | N/A        |
| Precoding granularity  |                    | Frequency domain: 1 PRG<br>Time domain: 1 ms | N/A        | N/A        |
| Beamforming model  |                    | Annex B.4.1                                  | N/A        | N/A        |
| CodeBookSubsetRestriction bitmap   |                    | 001111                                       | N/A        | N/A        |

|   |        |    |     |                              |                              |
|---|--------|----|-----|------------------------------|------------------------------|
| Time offset relative to Cell 1  |        | μs | N/A | 3                            | -1                           |
| Frequency shift relative to Cell 1  |        | Hz | N/A | 300                          | -100                         |
| Interference model  |        |    | N/A | As specified in clause B.5.4 | As specified in clause B.5.4 |
| Probability of occurrence of transmission in interference cells   |        | %  | N/A | 10                           | 10                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %  | N/A | 80                           | 80                           |
|   | Rank 2 | %  | N/A | 20                           | 20                           |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test. |        |    |     |                              |                              |

**Table 8.9.1.2.3.2-2: Minimum performance for PDSCH**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.94 TDD          | OP.1 TDD     | N/A    | N/A    | EPA5                           |        |        | 2x1 Low   | 70                                 | 11.3              | 1bis        |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\bar{E}_s/N_{oc}$ of cell 1. |                   |              |        |        |                                |        |        |   |                                    |                   |             |

## 8.9.2 PHICH

### 8.9.2.1 FDD and half-duplex FDD

#### 8.9.2.1.1 Transmit diversity performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.9.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.2.1.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE DL category |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|----------------|
|             |           |                   |              |                       |  | $P_{m-an}$ (%)  | SNR (dB) |                |
| 1           | 10 MHz    | R.19              | OP.1 FDD     | EPA5                  | 2 x 1 Low                                    | 0.1             | 8.6      | 0, 1bis        |

### 8.9.2.2 TDD

#### 8.9.2.2.1 Transmit diversity performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK ( $P_{m-an}$ ) shall be below the specified value in Table 8.9.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.2.2.1-1: Minimum performance PHICH**

| Bandwidth | Reference value |
|-----------|-----------------|
|-----------|-----------------|

| Test number |        | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Pm-an (%) | SNR (dB) | UE DL category |
|-------------|--------|-------------------|--------------|-----------------------|--|-----------|----------|----------------|
| 1           | 10 MHz | R.19              | OP.1 TDD     | EPA5                  | 2 x 1 Low                                    | 0.1       | 8.6      | 0, 1bis        |

## 8.9.3 PBCH

### 8.9.3.1 FDD and half-duplex FDD

#### 8.9.3.1.1 Transmit diversity performance

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.9.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.3.1.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE DL category |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|----------------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |                |
| 1           | 1.4 MHz   | R.22              | EPA5                  | 2 x 1 Low                                    | 1               | -1.3     | 0, 1bis        |

### 8.9.3.2 TDD

#### 8.9.3.2.1 Transmit diversity performance

For the parameters specified in Table 8.6.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.9.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.3.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE DL category |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|----------------|
|             |           |                   |                       |  | Pm-bch (%)      | SNR (dB) |                |
| 1           | 1.4 MHz   | R.22              | EPA5                  | 2 x 1 Low                                    | 1               | -1.7     | 0, 1bis        |

## 8.9.4 PDCCH/PCFICH

### 8.9.4.1 FDD and half-duplex FDD

#### 8.9.4.1.1 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.1-1 and Table 8.9.4.1.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.9.4.1.1-2. In Table 8.9.4.1.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.

Table 8.9.4.1.1-1: Test Parameters for PDCCH/PCFICH

| Parameter  |                                  | Unit      | Cell 1                                 | Cell 2                          | Cell 3                          |
|--|----------------------------------|-----------|--|---------------------------------|---------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                                     | -3                              | -3                              |
|  | PHICH_RA                         | dB        | -3                                     | N/A                             | N/A                             |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                                     | -3                              | -3                              |
|  | PHICH_RB                         | dB        | -3                                     | N/A                             | N/A                             |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1                   | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                                    |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | As defined in<br>Table 8.9.4.1.1-<br>2 | 13.91                           | 3.34                            |
| BW <sub>Channel</sub>  |                                  | MHz       | 10                                     | 10                              | 10                              |
| Cyclic Prefix  |                                  |           | Normal                                 | Normal                          | Normal                          |
| Cell Id  |                                  |           | 0                                      | 1                               | 6                               |
| Subframe Configuration   |                                  |           | Non-MBSFN                              | Non-MBSFN                       | Non-MBSFN                       |
| Number of DL control region OFDM symbols   |                                  |           | 1                                      | 1                               | 1                               |
| CFI indicated in PCFICH  |                                  |           | 1                                      | 1                               | 1                               |
| PHICH Ng (Note 1)  |                                  |           | 1/6                                    | N/A                             | N/A                             |
| PHICH duration   |                                  |           | Normal                                 | N/A                             | N/A                             |
| PDSCH TM   |                                  |           | 4                                      | N/A                             | N/A                             |
| Interference model   |                                  |           | NA                                     | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                                   | OCNG                            | OCNG                            |
| Time Offset relative to Cell 1   |                                  | μs        | N/A                                    | 2                               | 3                               |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                                    | 200                             | 300                             |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |  |                                 |                                 |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |  |                                 |                                 |

Table 8.9.4.1.1-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 4 CCE             | R.16-4 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 16.0              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.9.4.1.2 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.4.1-1 and Table 8.9.4.1.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.9.4.1.2-2. In Table 8.9.4.1.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes information on Cell 2 and Cell 3.

Table 8.9.4.1.2-1: Test Parameters for PDCCH/PCFICH

| Parameter  |                                  | Unit      | Cell 1                          | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|---------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                              | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                              | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports 0,1,2,3           |                              |                              |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                             |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | As defined in Table 8.9.4.1.2-2 | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                                  | MHz       | 10                              | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal                          | Normal                       | Normal                       |
| Cell ID  |                                  |           | 0                               | 1                            | 6                            |
| Subframe Configuration   |                                  |           | Non-MBSFN                       | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 2                               | 2                            | 2                            |
| CFI indicated in PCFICH  |                                  |           | 2                               | 2                            | 2                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                             | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal                          | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                               | N/A                          | N/A                          |
| Interference model   |                                  |           | NA                              | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                            | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | $\mu$ s   | N/A                             | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                             | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                                 |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                 |                              |                              |

Table 8.9.4.1.2-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A

| Test Number | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|-------------|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|             |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1           | 4 CCE             | R.17-3 FDD        | OP.1 FDD              | EPA5                            | EPA5   | EPA5   | 4x1 Low   | 1               | 15.4              |

Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.

Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.

Note 4: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

## 8.9.4.2 TDD

### 8.9.4.2.1 Enhanced Downlink Control Channel Performance Requirement Type A - 2 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 2 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1. For the parameters specified in Table 8.4.2-1 and Table 8.9.4.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.9.4.2.1-2. In Table 8.9.4.2.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes Cell 2 and Cell 3.



Table 8.9.4.2.1-1: Test Parameters for PDCCH/PCFICH

| Parameter  |                                  | Unit      | Cell 1                                 | Cell 2                          | Cell 3                          |
|--|----------------------------------|-----------|--|---------------------------------|---------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                                     | -3                              | -3                              |
|  | PHICH_RA                         | dB        | -3                                     | N/A                             | N/A                             |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                                     | -3                              | -3                              |
|  | PHICH_RB                         | dB        | -3                                     | N/A                             | N/A                             |
| Cell-specific reference signals  |                                  |           | Antenna ports<br>0,1                   | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                                    |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | As defined in<br>Table 8.9.4.2.1-<br>2 | 13.91                           | 3.34                            |
| BW <sub>Channel</sub>  |                                  | MHz       | 10                                     | 10                              | 10                              |
| Cyclic Prefix  |                                  |           | Normal                                 | Normal                          | Normal                          |
| Cell Id  |                                  |           | 0                                      | 1                               | 6                               |
| Subframe Configuration   |                                  |           | Non-MBSFN                              | Non-MBSFN                       | Non-MBSFN                       |
| Number of DL control region OFDM symbols   |                                  |           | 1                                      | 1                               | 1                               |
| CFI indicated in PCFICH  |                                  |           | 1                                      | 1                               | 1                               |
| PHICH Ng (Note 1)  |                                  |           | 1/6                                    | N/A                             | N/A                             |
| PHICH duration   |                                  |           | Normal                                 | N/A                             | N/A                             |
| PDSCH TM   |                                  |           | 4                                      | N/A                             | N/A                             |
| Interference model   |                                  |           | NA                                     | As specified in<br>clause B.7.1 | As specified in<br>clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                                   | OCNG                            | OCNG                            |
| Time Offset relative to Cell 1   |                                  | μs        | N/A                                    | 2                               | 3                               |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                                    | 200                             | 300                             |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |  |                                 |                                 |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |  |                                 |                                 |

Table 8.9.4.2.1-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 4 CCE             | R.16-4 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 16.9              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.                                 |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |                   |                       |                                 |        |        |   |                 |                   |
| Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.             |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.9.4.2.2 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.4.2-1 and Table 8.9.4.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.9.4.2.2-2. In Table 8.9.4.2.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided and includes information on Cell 2 and Cell 3.

Table 8.9.4.2.2-1: Test Parameters for PDCCH/PCFICH

| Parameter  |                                  | Unit      | Cell 1                          | Cell 2                       | Cell 3                       |
|--|----------------------------------|-----------|---------------------------------|------------------------------|------------------------------|
| Downlink power allocation  | PDCCH_RA<br>OCNG_RA              | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RA                         | dB        | -3                              | N/A                          | N/A                          |
|  | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                              | -3                           | -3                           |
|  | PHICH_RB                         | dB        | -3                              | N/A                          | N/A                          |
| Cell-specific reference signals  |                                  |           | Antenna ports 0,1,2,3           |                              |                              |
| $N_{oc}$ at antenna port   |                                  | dBm/15kHz | -98                             |                              |                              |
| $\hat{E}_s/N_{oc}$   |                                  | dB        | As defined in Table 8.9.4.2.2-2 | 13.91                        | 3.34                         |
| $BW_{Channel}$   |                                  | MHz       | 10                              | 10                           | 10                           |
| Cyclic Prefix  |                                  |           | Normal                          | Normal                       | Normal                       |
| Cell ID  |                                  |           | 0                               | 1                            | 6                            |
| Subframe Configuration   |                                  |           | Non-MBSFN                       | Non-MBSFN                    | Non-MBSFN                    |
| Number of DL control region OFDM symbols   |                                  |           | 2                               | 2                            | 2                            |
| CFI indicated in PCFICH  |                                  |           | 2                               | 2                            | 2                            |
| PHICH Ng (Note 1)  |                                  |           | 1/6                             | N/A                          | N/A                          |
| PHICH duration   |                                  |           | Normal                          | N/A                          | N/A                          |
| PDSCH TM   |                                  |           | 4                               | N/A                          | N/A                          |
| Interference model   |                                  |           | NA                              | As specified in clause B.7.1 | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)   |                                  |           | OCNG                            | OCNG                         | OCNG                         |
| Time Offset relative to Cell 1   |                                  | $\mu$ s   | N/A                             | 2                            | 3                            |
| Frequency shift relative to Cell 1   |                                  | Hz        | N/A                             | 200                          | 300                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                                      |                                  |           |                                 |                              |                              |
| Note 2: For Cell 2 and Cell 3 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                 |                              |                              |

Table 8.9.4.2.2-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A

| Test Number | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|-------------|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|             |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1           | 4 CCE             | R.17-3 TDD        | OP.1 TDD              | EPA5                            | EPA5   | EPA5   | 4x1 Low   | 1               | 15.6              |

Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.

Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.

Note 4: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

## 8.10 Demodulation (4 receiver antenna ports)

The performance requirements specified in this clause are valid for 4Rx capable UEs.

### 8.10.1 PDSCH

#### 8.10.1.1 FDD (Fixed Reference Channel)

The parameters specified in Table 8.10.1.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.10.1.1-1: Common Test Parameters (FDD)**

| Parameter                                      | Unit         | Value  |
|--|--------------|--|
| Inter-TTI Distance                             |              | 1  |
| Number of HARQ processes per component carrier | Processes    | 8  |
| Maximum number of HARQ transmission            |              | 4  |
| Redundancy version coding sequence             |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM  |
| Number of OFDM symbols for PDCCH               | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Precoder update granularity                    |              | Frequency domain: 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms   |
| Cyclic Prefix                                  |              | Normal   |
| Cell_ID  |              | 0  |
| Cross carrier scheduling                       |              | Not configured   |

#### 8.10.1.1.1 Transmit diversity performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.1-2, with the addition of the parameters in Table 8.10.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.10.1.1.1-1: Test Parameters for Transmit diversity Performance (FRC) with 4 RX Antenna Ports**

| Parameter                 | Unit     | Test 1            |
|---------------------------|----------|-------------------|
| Downlink power allocation | $\rho_A$ | dB<br>-3          |
|                           | $\rho_B$ | dB<br>-3 (NOTE 1) |
|                           | $\sigma$ | dB<br>0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>-98  |
| PDSCH transmission mode   |          | 2                 |
| NOTE 1: $P_B = 1$ .       |          |                   |

**Table 8.10.1.1.1-2: Minimum performance Transmit Diversity (FRC) with 4 RX Antenna Ports**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.11 FDD          | OP.1 FDD     | EVA5                  | 2x4 Medium correlation A, ULA                | 70                                 | 3.9      | $\geq 2$    |

8.10.1.1.1A Transmit diversity performance with Enhanced Performance Requirement Type A - 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.10.1.1A-2, with the addition of parameters in Table 8.10.1.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.10.1.1A-1, Cell 1 is the serving cell, and Cell 2 is an interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.10.1.1A-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter   |          | Unit      | Cell 1            | Cell 2                       |
|---|----------|-----------|-------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3                | -3                           |
|   | $\rho_B$ | dB        | -3 (NOTE 1)       | -3                           |
|   | $\sigma$ | dB        | 0                 | 0                            |
| Cell-specific reference signals                                     |          |           | Antenna ports 0,1 | Antenna ports 0,1            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98               | N/A                          |
| DIP (NOTE 2)  |          | dB        | N/A               | -2.23                        |
| $BW_{Channel}$  |          | MHz       | 10                | 10                           |
| Cyclic Prefix   |          |           | Normal            | Normal                       |
| Cell Id   |          |           | 0                 | 1                            |
| Number of control OFDM symbols                                      |          |           | 2                 | 2                            |
| PDSCH transmission mode   |          |           | 2                 | N/A                          |
| Interference model  |          |           | N/A               | As specified in clause B.5.2 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1   | %         | N/A               | 80                           |
|   | Rank 2   | %         | N/A               | 20                           |
| Reporting interval  |          | ms        | 5                 | N/A                          |
| Reporting mode  |          |           | PUCCH 1-0         | N/A                          |
| Physical channel for CQI reporting                                  |          |           | PUSCH(Note 5)     | N/A                          |
| cqi-pmi-ConfigurationIndex  |          |           | 2                 | N/A                          |

NOTE 1:  $P_B = 1$   
 NOTE 2: The respective received power spectral density of each interfering cell relative to  $N_{oc}$  is defined by its associated DIP value as specified in clause B.5.1.  
 NOTE 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.  
 NOTE 4: Cell 2 transmission is delayed with respect to Cell 1 by 0.33 ms.  
 NOTE 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 and #0.

**Table 8.10.1.1A-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value                    |                    | UE Category |
|-------------|-------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (NOTE 2) |             |
| 1           | R.46 FDD          | OP.1 FDD     | N/A    | EVA70                  | EVA70  | 2x4 Low   | 70                                 | -4.4               | ≥1          |

NOTE 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

NOTE 2: SINR corresponds to  $\widehat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

### 8.10.1.1.2 Open-loop spatial multiplexing performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.2-2, with the addition of the parameters in Table 8.10.1.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.2-1: Test Parameters for Large Delay CDD (FRC) with 4 RX Antenna Ports**

| Parameter                 | Unit      | Test 1 |
|---------------------------|-----------|--------|
| Downlink power allocation | $\rho_A$  | dB     |
|                           | $\rho_B$  | dB     |
|                           | $\sigma$  | dB     |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98    |
| PDSCH transmission mode   |           | 3      |
| NOTE 1: $P_B = 1$ .       |           |        |

**Table 8.10.1.1.2-2: Minimum performance Large Delay CDD (FRC) with 4 RX Antenna Ports**

| Test num | Bandwidth and MCS      | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|----------|------------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|          |                        |                   |              |                       |  | Fraction of maximum Throughput (%) | SNR (dB) |             |
| 1        | 10 MHz<br>16QAM<br>1/2 | R.11 FDD          | OP.1 FDD     | EVA70                 | 2x4 Low                                | 70                                 | 8.0      | $\geq 2$    |

### 8.10.1.1.3 Closed-loop spatial multiplexing Enhanced Performance Requirements Type A - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.3-2, with the addition of the parameters in Table 8.10.1.1.3-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.10.1.1.3-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.10.1.1.3-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model and 4 RX Antenna Ports**

| Parameter                       | Unit      | Cell 1            | Cell 2            |
|---------------------------------|-----------|-------------------|-------------------|
| Downlink power allocation       | $\rho_A$  | dB                | -3                |
|                                 | $\rho_B$  | dB                | -3 (Note 1)       |
|                                 | $\sigma$  | dB                | 0                 |
| Cell-specific reference signals |           | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port        | dBm/15kHz | -98               | N/A               |
| DIP (Note 2)                    | dB        | N/A               | -1.73             |

|   |        |     |           |                              |
|---|--------|-----|-----------|------------------------------|
| BW <sub>Channel</sub>   |        | MHz | 10        | 10                           |
| Cell Id   |        |     | 0         | 1                            |
| PDSCH transmission mode   |        |     | 6         | 4                            |
| Interference model  |        |     | N/A       | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | %   | N/A       | 80                           |
|   | Rank 2 | %   | N/A       | 20                           |
| Precoding granularity   |        | PRB | 50        | 6                            |
| PMI delay (Note 4)  |        | ms  | 8         | N/A                          |
| Reporting interval  |        | ms  | 5         | N/A                          |
| Reporting mode  |        |     | PUCCH 1-1 | N/A                          |
| CodeBookSubsetRestriction bitmap                                    |        |     | 1111      | N/A                          |

Note 1:  $P_B = 1$   
 Note 2: The respective received power spectral density of each interfering cell relative to  $N_{oc}$  is defined by its associated DIP value as specified in clause B.5.1.  
 Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.  
 Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  
 Note 5: All cells are time-synchronous.

**Table 8.10.1.1.3-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model and 4 RX Antenna Ports**

| Test Number | Reference Channel and MCS | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|-------------|---------------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|             |                           | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1           | R.47 FDD 16QAM            | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x4 Low   | 70                                 | -2.3               | ≥1          |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**8.10.1.1.4 Closed-loop spatial multiplexing performance, Dual-Layer Spatial Multiplexing 4 Tx Antenna Port (Cell-Specific Reference Symbols)**

For single carrier, the requirements are specified in Table 8.10.1.1.4-2, with the addition of the parameters in Table 8.10.1.1.4-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.4-1: Test Parameters for Dual-Layer Spatial Multiplexing (FRC) with 4 RX Antenna Ports**

| Parameter                        | Unit      | Test 1-2   | Test 3   |
|----------------------------------|-----------|--|--|
| Downlink power allocation        | $\rho_A$  | -6   | -6   |
|                                  | $\rho_B$  | -6 (Note 1)  | -6 (Note 1)  |
|                                  | $\sigma$  | 3  | 3  |
| $N_{oc}$ at antenna port         | dBm/15kHz | -98  | -98  |
| Precoding granularity            | PRB       | 6  | 50   |
| PMI delay (Note 2)               | ms        | 8  | 8  |
| Reporting interval               | ms        | 1  | 1  |
| Reporting mode                   |           | PUSCH 1-2  | PUSCH 3-1  |
| CodeBookSubsetRestriction bitmap |           | 00000000000000000000000000000000<br>0000111111111111111110000000<br>00000000 | 00000000000000000000000000000000<br>0000111111111111111110000000<br>00000000 |

|                         |   |   |   |
|-------------------------|---|---|---|
| PDSCH transmission mode |   | 4 | 4 |
| Note 1:                 | $P_B = 1$ .   |   |   |
| Note 2:                 | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |   |   |

**Table 8.10.1.1.4-2: Minimum performance Dual-Layer Spatial Multiplexing (FRC) with 4 RX Antenna Ports**

| Test num. | Bandwidth and MCS | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category | DL UE category |
|-----------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|           |                   |                   |              |                       |  | Fraction of maximum throughput (%) | SNR (dB) |             |                |
| 1         | 10 MHz            | R.36 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                                | 70                                 | 10.1     | ≥2          | ≥6             |
| 2         | 10 MHz<br>256 QAM | R.72 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                                | 70                                 | 18.0     | 11-12       | ≥11            |
| 3         | 10MHz<br>1024QAM  | R.102 FDD         | OP.1 FDD     | EPA5                  | 4x4 Low                                | 70                                 | 27.7     | TBD         | 20, ≥22        |

#### 8.10.1.1.4A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing with 2Tx Antenna Ports

The requirements are specified in Table 8.10.1.1.4A-2, with the addition of the parameters in Table 8.10.1.1.4A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

**Table 8.10.1.1.4A-1: Test Parameters for Dual-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1    |
|---|-----------|-----------|
| Downlink power allocation   | $\rho_A$  | dB        |
|   | $\rho_B$  | dB        |
|   | $\sigma$  | dB        |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98       |
| Precoding granularity   | PRB       | 50        |
| PMI delay (Note 2)  | ms        | 8         |
| Reporting interval  | ms        | 1         |
| Reporting mode  |           | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap  |           | 110000    |
| PDSCH transmission mode   |           | 4         |
| Note 1: $P_B = 1$ .   |           |           |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |           |

**Table 8.10.1.1.4A-2: Enhanced Performance Requirement Type C for Dual-Layer Spatial Multiplexing with TM4 (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.11 FDD          | OP.1 FDD     | ETU70                 | 2x4 Medium                                   | 70                                 | 16.8     | ≥2          |

### 8.10.1.1.5 Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.5-2, with the addition of the parameters in Table 8.10.1.1.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.10.1.1.5-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.10.1.1.5-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model and 4 RX Antenna Ports**

| parameter   |          | Unit      | Cell 1  | Cell 2                       |
|---|----------|-----------|---|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0   | 0                            |
|   | $\rho_B$ | dB        | 0 (Note 1)  | 0                            |
|   | $\sigma$ | dB        | -3  | -3                           |
| Cell-specific reference signals   |          |           | Antenna ports 0,1   | Antenna ports 0,1            |
| CSI reference signals   |          |           | Antenna ports 15,16   | N/A                          |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | Subframes | 5 / 2   | N/A                          |
| CSI reference signal configuration  |          |           | 0   | N/A                          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   | N/A                          |
| DIP (Note 2)  |          | dB        | N/A   | -1.73                        |
| $BW_{\text{Channel}}$   |          | MHz       | 10  | 10                           |
| Cell Id   |          |           | 0   | 126                          |
| PDSCH transmission mode   |          |           | 9   | 9                            |
| Beamforming model   |          |           | As specified in clause B.4.3 (Note 4, 5)  | N/A                          |
| Interference model  |          |           | N/A   | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells                 | Rank 1   |           | N/A   | 70                           |
|   | Rank 2   |           | N/A   | 30                           |
| Precoder update granularity   |          | PRB       | 50  | 6                            |
| PMI delay (Note 5)  |          | Ms        | 8   | N/A                          |
| Reporting interval  |          | Ms        | 5   | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1   | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 001111  | N/A                          |
| Symbols for unused PRBs   |          |           | OCNG (Note 6)   | N/A                          |
| Simultaneous transmission   |          |           | No simultaneous transmission on the other antenna port in (7 or 8) used for the input signal under test | N/A                          |
| Physical channel for CQI reporting  |          |           | PUSCH(Note 8)   | N/A                          |
| cqi-pmi-ConfigurationIndex  |          |           | 5   | N/A                          |



|         |  |
|---------|--|
| Note 1: | $P_B = 1$  |
| Note 2: | The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |
| Note 3: | The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.   |
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI.   |
| Note 5: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.  |
| Note 7: | All cells are time-synchronous.  |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |

**Table 8.10.1.1.5-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model and 4 RX Antenna Ports**

| Test Number   | Reference Channel and MCS | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|---|---------------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|   |                           | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1   | R. 76 FDD QPSK            | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x4 Low   | 70                                 | -3.0               | ≥1          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: SINR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                           |              |        |                        |        |   |                                    |                    |             |

**8.10.1.1.5A Single-layer Spatial Multiplexing (User-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.1.5A-2, with the addition of the parameters in Table 8.10.1.1.5A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 with a simultaneous transmission on the other antenna port in the serving cell, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.10.1.1.5A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter  | Unit      | Test 1                  |            |
|--|-----------|-------------------------|------------|
| Downlink power allocation  | $\rho_A$  | dB                      | 0          |
|  | $\rho_B$  | dB                      | 0 (Note 1) |
|  | $\sigma$  | dB                      | -3         |
| Beamforming model  |           | Annex B.4.1             |            |
| Cell-specific reference signals  |           | Antenna ports 0,1       |            |
| CSI reference signals  |           | Antenna ports 15,...,18 |            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes | 5 / 2                   |            |
| CSI reference signal configuration                                       |           | 3                       |            |

|   |                    |                         |
|---|--------------------|-------------------------|
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$<br>bitmap   | Subframes / bitmap | 3 /<br>0001000000000000 |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98                     |
| Symbols for unused PRBs   |                    | OCNG (Note 4)           |
| Number of allocated resource blocks (Note 2)  | PRB                | 50                      |
| Simultaneous transmission   |                    | Yes (Note 3, 5)         |
| PDSCH transmission mode   |                    | 9                       |
| Number of MBSFN subframes   | Subframes          | NA                      |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.</p> <p>Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 5: The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.</p> |                    |                         |

**Table 8.10.1.1.5A-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number   | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz<br>64QAM 1/2 | R.50 FDD          | OP.1 FDD     | EPA5                  | 2x4 Low                                      | 70                                 | 15.8     | ≥2          |
| Note 1: The reference channel applies to both the input signal under test and the interfering signal. |                     |                   |              |                       |  |                                    |          |             |

**8.10.1.1.5B Single-layer Spatial Multiplexing (With Enhanced DMRS table configured)**

For single-layer transmission on antenna port 7, 8, 11 or 13 upon detection of a PDCCH with DCI format 2C, the requirement is specified in Table 8.10.1.1.5B-2, with the addition of the parameters in Table 8.10.1.1.5B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of the test is to verify rank-1 performance on antenna port 11 with a simultaneous transmission on the antenna port 7, 8 or 13 with DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.10.1.1.5B-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Parameter                       | Unit     | Test 1                  |
|---------------------------------|----------|-------------------------|
| Downlink power allocation       | $\rho_A$ | dB                      |
|                                 | $\rho_B$ | dB                      |
|                                 | $\sigma$ | dB                      |
| Beamforming model               |          | Annex B.4.1A            |
| Cell-specific reference signals |          | Antenna ports 0,1       |
| CSI reference signals           |          | Antenna ports 15,...,18 |

|  |                    |                         |
|--|--------------------|-------------------------|
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   | Subframes          | 5 / 2                   |
| CSI reference signal configuration   |                    | 3                       |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap   | Subframes / bitmap | 3 /<br>0001000000000000 |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                     |
| Symbols for unused PRBs  |                    | OCNG (Note 4)           |
| Number of allocated resource blocks (Note 2)   | PRB                | 50                      |
| Simultaneous transmission  |                    | Yes (Note 3, 5)         |
| dmrs-Enhancements-r13  |                    | Enable                  |
| PDSCH transmission mode  |                    | 9                       |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 11.</p> <p>Note 3: Modulation symbols of an interference signal are random mapped onto one antenna port among antenna port 7, 8 and 13. The update granularity for randomized mapping antenna port is 1 PRG in frequency domain and 1ms in time domain.</p> <p>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 5: The two UEs' scrambling identities <math>n_{\text{SCID}}</math> are set to 0 with OCC =4.</p> |                    |                         |

**Table 8.10.1.1.5B-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM 1/2 | R.50 FDD          | OP.1 FDD     | EPA5                  | 2x4 Low                                      | 70                                 | 15.8     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

8.10.1.1.6 Dual-Layer Spatial Multiplexing (User-Specific Reference Symbols)

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.10.1.1.6-2, with the addition of the parameters in Table 8.10.1.1.6-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.10.1.1.6-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations with 4 RX Antenna Ports**

| Parameter                       | Unit     | Test 1                |                       |    |
|---------------------------------|----------|-----------------------|-----------------------|----|
|                                 |          | Cell 1                | Cell 2                |    |
| Downlink power allocation       | $\rho_A$ | dB                    | 0                     | 0  |
|                                 | $\rho_B$ | dB                    | 0 (Note 1)            | 0  |
|                                 | $\sigma$ | dB                    | -3                    | -3 |
|                                 | PDSCH_RA | dB                    | 4                     | NA |
|                                 | PDSCH_RB | dB                    | 4                     | NA |
| Cell-specific reference signals |          | Antenna ports 0 and 1 | Antenna ports 0 and 1 |    |

|  |                    |                                       |         |
|--|--------------------|---------------------------------------|---------|
| Cell ID  |                    | 0                                     | 126     |
| CSI reference signals  |                    | Antenna ports 15,16                   | NA      |
| Beamforming model  |                    | Annex B.4.2                           | NA      |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   | Subframes          | 5 / 2                                 | NA      |
| CSI reference signal configuration   |                    | 8                                     | NA      |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>$ZeroPowerCSI-RS$<br>bitmap   | Subframes / bitmap | 3 /<br>0010000000000000               | NA      |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                                   | NA      |
| $\hat{E}_s / N_{oc}$   |                    | Reference Value in Table 8.10.1.1.6-2 | 7.25dB  |
| Symbols for unused PRBs  |                    | OCNG (Note 2)                         | NA      |
| Number of allocated resource blocks (Note 2)   | PRB                | 50                                    | NA      |
| Simultaneous transmission  |                    | No                                    | NA      |
| PDSCH transmission mode  |                    | 9                                     | Blanked |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                    |                                       |         |

**Table 8.10.1.1.6-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations and 4 RX Antenna Ports**

| Test number   | Bandwidth and MCS   | Reference Channel | OCNG Pattern |        | Propagation Condition |        | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|---------------------|-------------------|--------------|--------|-----------------------|--------|--|------------------------------------|----------|-------------|
|   |                     |                   | Cell1        | Cell 2 | Cell 1                | Cell 2 |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz<br>16QAM 1/2 | R.51 FDD          | OP.1 FDD     | N/A    | ETU5                  | ETU5   | 2x4 Low                                      | 70                                 | 9.2      | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1. |                     |                   |              |        |                       |        |  |                                    |          |             |

**8.10.1.1.6A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing**

The requirements are specified in 8.10.1.1.6A-2, with the addition of the parameters in 8.10.1.1.6A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify rank-two performance for full RB allocation upon antenna ports 7 and 8.

**8.10.1.1.6A-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter                 | Unit     | Test 1     |
|---------------------------|----------|------------|
| Downlink power allocation | $\rho_A$ | dB         |
|                           | $\rho_B$ | dB         |
|                           | $\sigma$ | dB         |
|                           |          | 0          |
|                           |          | 0 (Note 1) |
|                           |          | -3         |

|  |                    |                       |
|--|--------------------|-----------------------|
| Cell-specific reference signals  |                    | Antenna ports 0 and 1 |
| CSI reference signals  |                    | Antenna ports 15,16   |
| Beamforming model  |                    | Annex B.4.3           |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   | Subframes          | 5 / 2                 |
| CSI reference signal configuration   |                    | 8                     |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap   | Subframes / bitmap | 3 / 0010000000000000  |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                   |
| Symbols for unused PRBs  |                    | OCNG (Note 2)         |
| Number of allocated resource blocks (Note 2)   | PRB                | 50                    |
| Simultaneous transmission  |                    | No                    |
| Reporting mode   |                    | PUSCH 3-1             |
| PDSCH transmission mode  |                    | 9                     |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                    |                       |

**8.10.1.1.6A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.51 FDD          | OP.1 FDD     | EPA5                  | 2x4 Medium                                   | 70                                 | 16.2     | ≥2          |

**8.10.1.1.6B Dual-Layer Spatial Multiplexing with altCQI-Table-1024QAM configured (User-Specific Reference Symbols)**

The requirements are specified in 8.10.1.1.6B-2, with the addition of the parameters in 8.10.1.1.6B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify rank-two performance for full RB allocation upon antenna ports 7 and 8.

**8.10.1.1.6B-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter                       | Unit     | Test 1                |
|---------------------------------|----------|-----------------------|
| Downlink power allocation       | $\rho_A$ | dB                    |
|                                 | $\rho_B$ | dB                    |
|                                 | $\sigma$ | dB                    |
| Cell-specific reference signals |          | Antenna ports 0 and 1 |

|  |                       |                                |
|--|-----------------------|--------------------------------|
| CSI reference signals  |                       | Antenna ports<br>15,16, 17, 18 |
| Beamforming model  |                       | Annex B.4.3                    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   | Subframes             | 5 / 2                          |
| CSI reference signal configuration   |                       | 3                              |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>$ZeroPowerCSI-RS$<br>bitmap   | Subframes<br>/ bitmap | N/A                            |
| $N_{oc}$ at antenna port   | dBm/15kHz             | -98                            |
| Symbols for unused PRBs  |                       | OCNG (Note 2)                  |
| Number of allocated resource blocks (Note 2)   | PRB                   | 50                             |
| Simultaneous transmission  |                       | No                             |
| Reporting mode   |                       | PUSCH 3-1                      |
| PDSCH transmission mode  |                       | 9                              |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                       |                                |

**8.10.1.1.6B-2: Minimum performance Dual-Layer Spatial Multiplexing with altCQI-Table-1024QAM**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz<br>1024QAM | R.102<br>FDD      | OP.1 FDD     | EPA5                  | 4x4 Low                                      | 70                                 | 29.4     | 20, ≥ 22       |

**8.10.1.1.7 Open-loop spatial multiplexing, 3 Layer Multiplexing with 4 Tx Antenna Ports (Cell-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.1.7-2, with the addition of the parameters in Table 8.10.1.1.7-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.7-1: Test parameters for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Parameter                       | Unit          | Test 1                   |
|---------------------------------|---------------|--------------------------|
| Downlink power allocation       | $\rho_A$      | dB                       |
|                                 | $\rho_B$      | dB                       |
|                                 | $\sigma$      | dB                       |
| Cell-specific reference signals |               | Antenna ports<br>0,1,2,3 |
| $N_{oc}$ at antenna port        | dBm/15k<br>Hz | -98                      |
| PDSCH transmission mode         |               | 3                        |
| PDSCH rank                      |               | 3                        |

|                                     |  |      |
|-------------------------------------|--|------|
| CodeBookSubsetRestriction<br>bitmap |  | 0100 |
| Note 1: $P_B = 1$ .                 |  |      |

**Table 8.10.1.1.7-2: Minimum performance Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM   | R.73 FDD          | OP.1<br>FDD  | EVA70                 | 4x4 Low                                      | 70                                 | 15.1     | ≥5          |

### 8.10.1.1.7A Enhanced Performance Requirement Type C - Open-loop spatial multiplexing, 3 Layer Multiplexing with 4 Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.7A-2, with the addition of the parameters in Table 8.10.1.1.7A-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.7A-1: Test parameters for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Parameter                           | Unit          | Test 1                   |
|-------------------------------------|---------------|--------------------------|
| Downlink power allocation           | $\rho_A$      | dB                       |
|                                     | $\rho_B$      | dB                       |
|                                     | $\sigma$      | dB                       |
| Cell-specific reference signals     |               | Antenna ports<br>1,2,3,4 |
| $N_{oc}$ at antenna port            | dBm/15k<br>Hz | -98                      |
| PDSCH transmission mode             |               | 3                        |
| PDSCH rank                          |               | 3                        |
| CodeBookSubsetRestriction<br>bitmap |               | 0100                     |
| Note 1: $P_B = 1$ .                 |               |                          |

**Table 8.10.1.1.7A-2: Enhanced Performance Requirement Type C for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM   | R.73-1<br>FDD     | OP.1<br>FDD  | EVA70                 | 4x4 Medium A                                 | 70                                 | 22.2     | ≥5          |

### 8.10.1.1.8 Closed-loop spatial multiplexing performance, 4 Layers spatial multiplexing 4 Tx antennas (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.8-2, with the addition of the parameters in Table 8.10.1.1.8-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.8-1: Test parameters for Closed Loop spatial multiplexing, 4 Layers spatial multiplexing with 4 Tx ports and 4 Rx ports**

| Parameter                        |          | Unit       | Test 1                |
|----------------------------------|----------|------------|-----------------------|
| Downlink power allocation        | $\rho_A$ | dB         | -6                    |
|                                  | $\rho_B$ | dB         | -6 (Note 1)           |
|                                  | $\sigma$ | dB         | 0                     |
| $N_{oc}$ at antenna port         |          | dBm/15k Hz | -98                   |
| Cell-specific reference signals  |          |            | Antenna Ports 0,1,2,3 |
| PDSCH transmission mode          |          |            | 4                     |
| PDSCH rank                       |          |            | 4                     |
| Precoding granularity            |          | PRB        | 50                    |
| PMI delay                        |          | ms         | 8                     |
| Reporting interval               |          | ms         | 1                     |
| Reporting mode                   |          |            | PUSCH 3-1             |
| CodeBookSubsetRestriction bitmap |          |            | 0xFFFFF0000000000000  |
| Note 1: $P_B = 1$ .              |          |            |                       |

**Table 8.10.1.1.8-2: Minimum performance for Closed Loop spatial multiplexing, 4 Layers spatial multiplexing with 4 Tx ports and 4 Rx ports**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.74 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                                      | 70                                 | 14.9     | ≥5          |

8.10.1.1.9 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.9-2, with the addition of the parameters in Table 8.10.1.1.9-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.9-1: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Parameter   |          | Unit               | Test 1                                     | Test 1a                                    |
|---|----------|--------------------|--|--|
| Downlink power allocation   | $\rho_A$ | dB                 | 0  | 0  |
|   | $\rho_B$ | dB                 | 0 (Note 1)                                 | 0 (Note 1)                                 |
|   | $\sigma$ | dB                 | -3   | -3   |
| Beamforming model   |          |                    | 4 layer precoding based on WB PMI feedback | 4 layer precoding based on WB PMI feedback |
| Cell-specific reference signals   |          |                    | Antenna ports 0,1                          | Antenna ports 0,1                          |
| CSI reference signals   |          |                    | Antenna ports 15,...,18                    | Antenna ports 15,...,18                    |
| Beamforming model   |          |                    | Annex B.4.3                                | Annex B.4.3                                |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$    |          | Subframes          | 5 / 2                                      | 5 / 2                                      |
| CSI reference signal configuration  |          |                    | 3  | 3  |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>ZeroPowerCSI-RS bitmap |          | Subframes / bitmap | 3 /<br>0001000000000000                    | 3 /<br>0001000000000000                    |
| $N_{oc}$ at antenna port  |          | dBm/15kHz          | -98  | -98  |
| Symbols for unused PRBs   |          |                    | OCNG (Note 3)                              | OCNG (Note 3)                              |



|   |     |                    |                    |
|---|-----|--------------------|--------------------|
| Number of allocated resource blocks (Note 2)  | PRB | 50                 | 50                 |
| Simultaneous transmission   |     | No                 | No                 |
| PDSCH transmission mode   |     | 9                  | 9                  |
| Precoding granularity   |     | 50                 | 50                 |
| PMI delay   |     | 8                  | 8                  |
| Reporting interval  |     | 1                  | 1                  |
| Reporting mode  |     | PUSCH 3-1          | PUSCH 3-1          |
| alternativeCodeBookEnabledFor4TX-r12  |     | False              | False              |
| CodeBookSubsetRestriction bitmap  |     | 0xFFFF000000000000 | 0xFFFF000000000000 |
| DMRS OCC length per port  |     | 2                  | 4                  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.</p> <p>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> |     |                    |                    |

**Table 8.10.1.1.9-2: Minimum performance for for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Test number   | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1   | 10 MHz 16QAM      | R.75 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                                      | 70                                 | 18.4     | ≥5          |
| 1a  | 10MHz 16QAM       | R.75A FDD         | OP.1 FDD     | EPA5                  | 4x4 Low                                      | 70                                 | [17.4]   | ≥5          |
| <p>NOTE: For a UE supporting TM9 rank3/4 transmission based on DMRS OCC length 4, Test 1a will be run and Test 1 will be skipped. Otherwise, Test 1a is not applicable and only Test 1 will be run.</p> |                   |                   |              |                       |  |                                    |          |             |

**8.10.1.1.9A Enhanced Performance Requirement Type C - 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.1.9A-2, with the addition of the parameters in Table 8.10.1.1.9A-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.1.9A-1: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Parameter   | Unit               | Test 1                  |            |
|---|--------------------|-------------------------|------------|
| Downlink power allocation   | $\rho_A$           | dB                      | 0          |
|   | $\rho_B$           | dB                      | 0 (Note 1) |
|   | $\sigma$           | dB                      | -3         |
| Cell-specific reference signals   |                    | Antenna ports 0,1       |            |
| CSI reference signals   |                    | Antenna ports 15,...,18 |            |
| Beamforming model   |                    | Annex B.4.3(Note 4, 5)  |            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes          | 5 / 2                   |            |
| CSI reference signal configuration  |                    | 3                       |            |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>ZeroPowerCSI-RS bitmap | Subframes / bitmap | 3 /<br>0001000000000000 |            |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98                     |            |
| Symbols for unused PRBs   |                    | OCNG (Note 3)           |            |

|   |     |                    |
|---|-----|--------------------|
| Number of allocated resource blocks (Note 2)  | PRB | 50                 |
| Simultaneous transmission   |     | No                 |
| PDSCH transmission mode   |     | 9                  |
| Precoding granularity   |     | 50                 |
| PMI delay   |     | 8                  |
| Reporting interval  |     | 1                  |
| Reporting mode  |     | PUSCH 3-1          |
| alternativeCodeBookEnabledFor4TX-r12  |     | False              |
| CodeBookSubsetRestriction bitmap  |     | 0xFFFF000000000000 |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.</p> <p>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCN G PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> |     |                    |

**Table 8.10.1.1.9A-2: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM   | R.75 FDD          | OP.1 FDD     | EPA5                  | 4x4 Medium A Xpol                            | 70                                 | 18.2     | ≥5          |

#### 8.10.1.1.10 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with CRS assistance information (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.10-2, with the addition of parameters in Table 8.10.1.1.10-1. In Table 8.10.1.1.10-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.10.1.1.10-1: Test Parameters**

| Parameter                       |          | Unit      | Cell 1                                 | Cell 2      | Cell 3      |
|---------------------------------|----------|-----------|--|-------------|-------------|
| Downlink power allocation       | $\rho_A$ | dB        | -3                                     | -3          | -3          |
|                                 | $\rho_B$ | dB        | -3 (Note 1)                            | -3 (Note 1) | -3 (Note 1) |
|                                 | $\sigma$ | dB        | 0                                      | 0           | 0           |
| $N_{oc}$ at antenna port        |          | dBm/15kHz | -98                                    | N/A         | N/A         |
| $\hat{E}_s / N_{oc}$            |          | dB        | Reference Value in Table 8.10.1.1.10-2 | 10.45       | 4.6         |
| $BW_{Channel}$                  |          | MHz       | 10                                     | 10          | 10          |
| Cyclic prefix                   |          |           | Normal                                 | Normal      | Normal      |
| Subframe Configuration          |          |           | Non-MBSFN                              | Non-MBSFN   | Non-MBSFN   |
| Cell ID                         |          |           | 0                                      | 1           | 6           |
| Cell-specific reference signals |          |           | Antenna ports 0,1                      |             |             |

|   |        |         |           |                              |                              |
|---|--------|---------|-----------|------------------------------|------------------------------|
| Number of control OFDM symbols (CFI)  |        |         | 2         | 2                            | 2                            |
| PDSCH transmission mode   |        |         | 4         | N/A                          | N/A                          |
| Precoding granularity   |        | PRB     | 50        | N/A                          | N/A                          |
| PMI delay (Note 2)  |        | ms      | 8         | N/A                          | N/A                          |
| Reporting interval  |        | ms      | 1         | N/A                          | N/A                          |
| Reporting mode  |        |         | PUSCH 3-1 | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap  |        |         | 001111    | N/A                          | N/A                          |
| Time Offset relative to Cell 1  |        | $\mu$ s | N/A       | 3                            | -1                           |
| Frequency shift relative to Cell 1  |        | Hz      | N/A       | 300                          | -100                         |
| Interference model  |        |         | N/A       | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells   |        | %       | N/A       | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %       | N/A       | 80                           | 80                           |
|   | Rank 2 | %       | N/A       | 20                           | 20                           |
| Note 1: $P_B = 1$ .   |        |         |           |                              |                              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |        |         |           |                              |                              |

Table 8.10.1.1.10-2: Minimum Performance for PDSCH

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.35 FDD          | OP.1 FDD     | N/A    | N/A    | EVA5                           | EVA5   | EVA5   | 2x4 low   | 70                                 | 11.1              | $\geq 2$    |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.  |                   |              |        |        |                                |        |        |   |                                    |                   |             |

#### 8.10.1.1.11 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing 4 Tx Antenna Port with CRS assistance information (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.11-2, with the addition of parameters in Table 8.10.1.1.11-1. In Table 8.10.1.1.11-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cell.

Table 8.10.1.1.11-1: Test Parameters

| Parameter                 | Unit       | Cell 1                                 | Cell 2      |
|---------------------------|------------|--|-------------|
| Downlink power allocation | $\rho_A$   | -6                                     | -6          |
|                           | $\rho_B$   | -6 (Note 1)                            | -6 (Note 1) |
|                           | $\sigma$   | 3                                      | 3           |
| $N_{oc}$ at antenna port  | dBm/15k Hz | -98                                    | N/A         |
| $\hat{E}_s/N_{oc}$        | dB         | Reference Value in Table 8.10.1.1.11-2 | 10.45       |

|  |        |                       |                              |    |
|--|--------|-----------------------|------------------------------|----|
| BW <sub>Channel</sub>  | MHz    | 10                    | 10                           |    |
| Cyclic prefix  |        | Normal                | Normal                       |    |
| Subframe Configuration   |        | Non-MBSFN             | Non-MBSFN                    |    |
| Cell ID  |        | 0                     | 1                            |    |
| Cell-specific reference signals  |        | Antenna ports 0,1,2,3 |                              |    |
| Number of control OFDM symbols (CFI)   |        | 2                     | 2                            |    |
| PDSCH transmission mode  |        | 4                     | N/A                          |    |
| Precoding granularity  | PRB    | 50                    | N/A                          |    |
| PMI delay (Note 2)   | ms     | 8                     | N/A                          |    |
| Reporting interval   | ms     | 1                     | N/A                          |    |
| Reporting mode   |        | PUSCH 3-1             | N/A                          |    |
| CodeBookSubsetRestriction bitmap   |        | 000000000000FFFF      | N/A                          |    |
| Time Offset relative to Cell 1   | μs     | N/A                   | 3                            |    |
| Frequency shift relative to Cell 1   | Hz     | N/A                   | 300                          |    |
| Interference model   |        | N/A                   | As specified in clause B.5.3 |    |
| Probability of occurrence of transmission in interference cells  | %      | N/A                   | 20                           |    |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | %                     | N/A                          | 80 |
|  | Rank 2 | %                     | N/A                          | 20 |
| Note 1: $P_B = 1$ .  |        |                       |                              |    |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF #(n+4). |        |                       |                              |    |

Table 8.10.1.1.11-2: Minimum Performance for PDSCH

| Test Number   | Reference Channel | OCNG Pattern |        | Propagation Conditions (Note 1) |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|---------------------------------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 1                          | Cell 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.36-1 FDD        | OP.1 FDD     | N/A    | EVA5                            | EVA5   | 4x4 low   | 70                                 | 9.3               | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |              |        |                                 |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.   |                   |              |        |                                 |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.                                |                   |              |        |                                 |        |   |                                    |                   |             |

#### 8.10.1.1.12 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing with CRS assistance information (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.1.12-2, with the addition of parameters in Table 8.10.1.1.12-1. In Table 8.10.1.1.12-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM9 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

Table 8.10.1.1.12-1: Test Parameters

| Parameter                 |          | Unit      | Cell 1     | Cell 2     | Cell 3     |
|---------------------------|----------|-----------|------------|------------|------------|
| Downlink power allocation | $\rho_A$ | dB        | 0          | 0          | 0          |
|                           | $\rho_B$ | dB        | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
|                           | $\sigma$ | dB        | -3         | -3         | -3         |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98        | N/A        | N/A        |

|   |                       |   |                              |                              |    |
|---|-----------------------|---|------------------------------|------------------------------|----|
| $\hat{E}_s/N_{oc}$  | dB                    | Reference Value in Table 8.10.1.1.12-2        | 10.45                        | 4.6                          |    |
| $BW_{Channel}$  | MHz                   | 10  | 10                           | 10                           |    |
| Cyclic prefix   |                       | Normal  | Normal                       | Normal                       |    |
| Subframe Configuration  |                       | Non-MBSFN                                     | Non-MBSFN                    | Non-MBSFN                    |    |
| Cell ID   |                       | 0   | 1                            | 6                            |    |
| Cell-specific reference signals   |                       | Antenna ports 0,1                             |                              |                              |    |
| CSI reference signals   |                       | Antenna ports 15,16                           | N/A                          | N/A                          |    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes             | 5 / 2   | N/A                          | N/A                          |    |
| CSI reference signal configuration  |                       | 8   | N/A                          | N/A                          |    |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$<br>bitmap | Subframes /<br>bitmap | 3 /<br>001000000000<br>0000                   | N/A                          | N/A                          |    |
| Number of control OFDM symbols (CFI)  |                       | 2   | 2                            | 2                            |    |
| PDSCH transmission mode   |                       | 9   | N/A                          | N/A                          |    |
| Precoding granularity   | PRB                   | Frequency domain: 50 PRB<br>Time domain: 1 ms | N/A                          | N/A                          |    |
| Beamforming model   |                       | Annex B.4.1                                   |                              |                              |    |
| Time Offset relative to Cell 1  | $\mu s$               | N/A   | 3                            | -1                           |    |
| Frequency shift relative to Cell 1  | Hz                    | N/A   | 300                          | -100                         |    |
| Interference model  |                       | N/A   | As specified in clause B.5.4 | As specified in clause B.5.4 |    |
| Probability of occurrence of transmission in interference cells             | %                     | N/A   | 20                           | 20                           |    |
| Probability of occurrence of transmission rank in interfering cells         | Rank 1                | %   | N/A                          | 80                           | 80 |
|   | Rank 2                | %   | N/A                          | 20                           | 20 |
| Note 1: $P_B = 1$ .   |                       |   |                              |                              |    |

Table 8.10.1.1.12-2: Minimum Performance for PDSCH

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.X FDD           | OP.1 FDD     | N/A    | N/A    | EVA5                           | EVA5   | EVA5   | 2x4 low   | 70                                 | 12.3              | $\geq 2$    |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1. |                   |              |        |        |                                |        |        |   |                                    |                   |             |

8.10.1.1.13 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

8.10.1.1.13.1 Minimum requirements for QCL Type C and 3 Layers Spatial Multiplexing

The requirements are specified in Table 8.10.1.1.13.1-3, with the additional parameters in Table 8.10.1.1.13.1-1 and Table 8.10.1.1.13.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and

compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.10.1.1.13.1-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP 1 and TP 2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

**Table 8.10.1.1.13.1-1: Test Parameters**

| Parameter  |          | Unit             | TP 1                        | TP 2                        |
|--|----------|------------------|-----------------------------|-----------------------------|
| Downlink power allocation  | $\rho_A$ | dB               | 0                           | 0                           |
|  | $\rho_B$ | dB               | 0 (Note 1)                  | 0                           |
|  | $\sigma$ | dB               | -3                          | -3                          |
| Beamforming model  |          |                  | Random beamforming (rank 2) | Random beamforming (rank 1) |
| Cell-specific reference signals  |          |                  | Antenna ports 0,1           | Antenna ports 0,1           |
| CSI reference signals 0  |          |                  | Antenna ports {15,16,17,18} | N/A                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  |          | Subframes        | 5 / 2                       |                             |
| CSI reference signal 0 configuration   |          |                  | 0                           |                             |
| CSI reference signals 1  |          |                  | N/A                         | Antenna ports {15,16,17,18} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  |          | Subframes        |                             | 5 / 2                       |
| CSI reference signal 1 configuration   |          |                  |                             | 8                           |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / \text{ZeroPower CSI-RS}$ bitmap                                  |          | Subframes/bitmap | 2/<br>0010000000000000      | N/A                         |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / \text{ZeroPower CSI-RS}$ bitmap                                   |          | Subframes/bitmap | N/A                         | 2/<br>0010000000000000      |
| $\hat{E}_s / N_{oc}$   |          | dB               | SNR1                        | SNR2 = SNR1-3dB             |
| $N_{oc}$ at antenna port   |          | dBm/15kHz        | -98                         | -98                         |
| BW <sub>Channel</sub>  |          | MHz              | 10                          | 10                          |
| Cyclic Prefix  |          |                  | Normal                      | Normal                      |
| Cell ID  |          |                  | 0                           | 126                         |
| Number of control OFDM symbols / PDSCH start   |          |                  | 2                           | 2                           |
| Timing offset relative to TP 1   |          | us               | N/A                         | 2                           |
| Frequency offset relative to TP 1  |          | Hz               | N/A                         | 200                         |
| <i>qcl-Operation</i> , ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’  |          |                  | Type C, ‘00’                |                             |
| PDSCH transmission mode (Note 2)   |          |                  | 10                          | 10                          |
| Number of allocated resource block   |          |                  | 50                          | 50                          |
| Note 1: $P_B = 1$  |          |                  |                             |                             |
| Note 2: PDSCH transmission is done from both TPs (CW2 is transmitted from TP 1 and CW1 is transmitted from TP 2) |          |                  |                             |                             |

**Table 8.10.1.1.13.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | DL transmission hypothesis for each PQI Set |
|---------------|----------------------------|---|
|---------------|----------------------------|---|

|           | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
|-----------|--|-------------------------|-------|-------|
| PQI set 0 | CSI-RS 0 for CW2<br>CSI-RS 1 for CW1     | ZP CSI-RS 0             | PDSCH | PDSCH |

**Table 8.10.1.1.13.1-3: Performance Requirements**

| Test Number   | Reference Channel |          | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|---|-------------------|----------|--------------|----------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|   | TP 1              | TP 2     | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1   | R.98 FDD          | R.99 FDD | OP.1F DD     | OP.1F DD | EPA5                           | EPA5 | 4x4 Low   | 70                                 | 11.0               | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of TP 1 and TP 2 as defined in clause 8.1.1. |                   |          |              |          |                                |      |   |                                    |                    |             |

8.10.1.1.13.2 Minimum requirements for QCL Type C and 4 Layers Spatial Multiplexing

The requirements are specified in Table 8.10.1.1.13.2-3, with the additional parameters in Table 8.10.1.1.13.2-1 and Table 8.10.1.1.13.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.10.1.1.13.2-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP 1 and TP 2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

**Table 8.10.1.1.13.2-1: Test Parameters**

| Parameter  | Unit             | TP 1                        | TP 2                        |
|--|------------------|-----------------------------|-----------------------------|
| Downlink power allocation  | $\rho_A$         | dB                          | 0                           |
|  | $\rho_B$         | dB                          | 0 (Note 1)                  |
|  | $\sigma$         | dB                          | -3                          |
| Beamforming model  |                  | Random beamforming (rank 2) | Random beamforming (rank 2) |
| Cell-specific reference signals  |                  | Antenna ports 0,1,2,3       | Antenna ports 0,1,2,3       |
| CSI reference signals 0  |                  | Antenna ports {15,16,17,18} | N/A                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes        | 5 / 2                       |                             |
| CSI reference signal 0 configuration                                       |                  | 0                           |                             |
| CSI reference signals 1  |                  | N/A                         | Antenna ports {15,16,17,18} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes        |                             | 5 / 2                       |
| CSI reference signal 1 configuration                                       |                  |                             | 8                           |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ | Subframes/bitmap | 2/<br>0010000000000000      | N/A                         |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$  | Subframes/bitmap | N/A                         | 2/<br>0010000000000000      |
| $\hat{E}_s / N_{oc}$   | dB               | SNR1                        | SNR2 = SNR1                 |

|   |  |              |        |
|---|--|--------------|--------|
| $N_{oc}$ at antenna port  | dBm/15kHz  | -98          | -98    |
| BW <sub>Channel</sub>   | MHz  | 10           | 10     |
| Cyclic Prefix   |  | Normal       | Normal |
| Cell ID   |  | 0            | 126    |
| Number of control OFDM symbols / PDSCH start                              |  | 2            | 2      |
| Timing offset relative to TP 1  | us   | N/A          | 2      |
| Frequency offset relative to TP 1   | Hz   | N/A          | 200    |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator' |  | Type C, '00' |        |
| PDSCH transmission mode (Note 2)  |  | 10           | 10     |
| Number of allocated resource block  |  | 50           | 50     |
| Note 1:   | $P_b = 1$  |              |        |
| Note 2:   | PDSCH transmission is done from both TPs (CW1 is transmitted from TP 1 and CW2 is transmitted from TP 2) |              |        |

Table 8.10.1.1.13.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     | ZP CSI-RS 0             | PDSCH                                       | PDSCH |

Table 8.10.1.1.13.2-3: Performance Requirements

| Test Number | Reference Channel  |                  | OCNG Pattern |             | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|-------------|--|------------------|--------------|-------------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|             | TP 1   | TP 2             | TP 1         | TP 2        | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1           | R.10<br>0<br>FDD   | R.10<br>0<br>FDD | OP.1F<br>DD  | OP.1F<br>DD | EPA5                           | EPA5 | 4x4 Low   | 70                                 | 14.8               | ≥2          |
| Note 1:     | The propagation conditions for TP 1 and TP 2 are statistically independent.              |                  |              |             |                                |      |   |                                    |                    |             |
| Note 2:     | Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2. |                  |              |             |                                |      |   |                                    |                    |             |
| Note 3:     | SNR corresponds to $\hat{E}_s/N_{oc}$ of TP 1 and TP 2 as defined in clause 8.1.1.       |                  |              |             |                                |      |   |                                    |                    |             |

#### 8.10.1.1.14 HST-SFN performance

##### 8.10.1.1.14.1 Minimum Requirement for Rel-16 further enhanced HST

The requirements are specified in Table 8.10.1.1.14.1-2, with the addition of the parameters in Table 8.10.1.1.14.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify UE performance in the HST-SFN-500 scenario. The test for HST-SFN-500 scenario defined in B.3B is applied when *highSpeedEnhDemodFlag2-r16* [7] is received.



**Table 8.10.1.1.14.1-1: Test Parameters for UE performance in HST-SFN-500 scenario (FRC)**

| Parameter                 | Unit     | Test 1            |
|---------------------------|----------|-------------------|
| Downlink power allocation | $\rho_A$ | dB<br>-3          |
|                           | $\rho_B$ | dB<br>-3 (NOTE 1) |
|                           | $\sigma$ | dB<br>0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>-98  |
| PDSCH transmission mode   |          | 3                 |
| NOTE 1: $P_B = 1$ .       |          |                   |

**Table 8.10.1.1.14.1-2: Minimum performance UE in HST-SFN-500 scenario (FRC)**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1 <sup>NOTE 2</sup>   | 10 MHz    | R.87-1 FDD        | OP.1 FDD     | HST-SFN-500           | 2x4  | 70                                 | 6.8      | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.6.  |           |                   |              |                       |  |                                    |          |             |
| NOTE 2: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |           |                   |              |                       |  |                                    |          |             |

### 8.10.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.10.1.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.10.1.2-1: Common Test Parameters (TDD)**

| Parameter                                      | Unit         | Value  |
|--|--------------|--|
| Uplink downlink configuration (Note 1)         |              | 1  |
| Special subframe configuration (Note 2)        |              | 4  |
| Cyclic prefix                                  |              | Normal   |
| Cell ID  |              | 0  |
| Inter-TTI Distance                             |              | 1  |
| Number of HARQ processes per component carrier | Processes    | 7  |
| Maximum number of HARQ transmission            |              | 4  |
| Redundancy version coding sequence             |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM, 256QAM and 1024QAM  |
| Number of OFDM symbols for PDCCH               | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cross carrier scheduling                       |              | Not configured   |
| Precoder update granularity                    |              | Frequency domain: 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms   |
| ACK/NACK feedback mode                         |              | Multiplexing   |

Note 1: as specified in Table 4.2-2 in TS 36.211 [4].  
 Note 2: as specified in Table 4.2-1 in TS 36.211 [4].

### 8.10.1.2.1 Transmit diversity performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.1-2, with the addition of the parameters in Table 8.10.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.10.1.2.1-1: Test Parameters for Transmit diversity Performance (FRC) with 4Rx Antenna Ports**

| Parameter                 | Unit     | Test 1    |             |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
|                           | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| PDSCH transmission mode   |          |           | 2           |
| Note 1: $P_B = 1$         |          |           |             |

**Table 8.10.1.2.1-2: Minimum performance Transmit Diversity (FRC) with 4Rx Antenna Ports**

| Test number | Bandwidth h and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.11 TDD          | OP.1 TDD     | EVA5                  | 2x4 Medium correlation A, ULA                | 70                                 | 3.9      | ≥2          |

### 8.10.1.2.1A Transmit diversity performance with Enhanced Performance Requirement Type A – 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.10.1.2.1A-2, with the addition of parameters in Table 8.10.1.2.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.10.1.2.1A-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.10.1.2.1A-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter                       | Unit      | Cell 1            | Cell 2            |    |
|---------------------------------|-----------|-------------------|-------------------|----|
| Downlink power allocation       | $\rho_A$  | dB                | -3                | -3 |
|                                 | $\rho_B$  | dB                | -3 (Note 1)       | -3 |
|                                 | $\sigma$  | dB                | 0                 | 0  |
| Cell-specific reference signals |           | Antenna ports 0,1 | Antenna ports 0,1 |    |
| $N_{oc}$ at antenna port        | dBm/15kHz | -98               | N/A               |    |
| DIP (Note 2)                    | dB        | N/A               | -1.73             |    |
| $BW_{Channel}$                  | MHz       | 10                | 10                |    |

|   |        |    |               |                              |
|---|--------|----|---------------|------------------------------|
| Cyclic Prefix   |        |    | Normal        | Normal                       |
| Cell Id   |        |    | 0             | 1                            |
| Number of control OFDM symbols  |        |    | 2             | 2                            |
| PDSCH transmission mode   |        |    | 2             | N/A                          |
| Interference model  |        |    | N/A           | As specified in clause B.5.2 |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %  | N/A           | 80                           |
|   | Rank 2 | %  | N/A           | 20                           |
| Reporting interval  |        | ms | 5             | N/A                          |
| Reporting mode  |        |    | PUCCH 1-0     | N/A                          |
| ACK/NACK feedback mode  |        |    | Multiplexing  | N/A                          |
| Physical channel for CQI reporting  |        |    | PUSCH(Note 5) | N/A                          |
| cqi-pmi-ConfigurationIndex  |        |    | 4             | N/A                          |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.</p> <p>Note 4: The cells are time-synchronous.</p> <p>Note 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |    |               |                              |

**Table 8.10.1.2.1A-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number   | Reference Channel | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |  |
|---|-------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|--|
|   |                   | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |  |
| 1   | R.46 TDD          | OP.1 TDD     | N/A    | EVA70                  | EVA70  | 2x4 Low   | 70                                 | -4.9               | ≥1          |  |
| <p>Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.</p> <p>Note 2: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> <p>Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.</p> |                   |              |        |                        |        |   |                                    |                    |             |  |

**8.10.1.2.2 Open-loop spatial multiplexing performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.2.2-2, with the addition of the parameters in Table 8.10.1.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.2-1: Test Parameters for Large Delay CDD (FRC) with 4Rx Antenna Ports**

| Parameter                 | Unit      | Test 1   |
|---------------------------|-----------|----------|
| Downlink power allocation | $\rho_A$  | dB       |
|                           | $\rho_B$  | dB       |
|                           | $\sigma$  | dB       |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98      |
| ACK/NACK feedback mode    |           | Bundling |
| PDSCH transmission mode   |           | 3        |

Note 1:  $P_B = 1$

**Table 8.10.1.2.2-2: Minimum performance Large Delay CDD (FRC) with 4Rx Antenna Ports**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.11-1<br>TDD     | OP.1<br>TDD  | EVA70                 | 2x4 Low                                      | 70                                 | 7.7      | ≥2          |

### 8.10.1.2.3 Closed-loop spatial multiplexing Enhanced Performance Requirements Type A - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.3-2, with the addition of the parameters in Table 8.10.1.2.3-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.10.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.10.1.2.3-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model and 4Rx Antenna Ports**

| Parameter   |          | Unit      | Cell 1            | Cell 2                       |
|---|----------|-----------|-------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3                | -3                           |
|   | $\rho_B$ | dB        | -3 (Note 1)       | -3                           |
|   | $\sigma$ | dB        | 0                 | 0                            |
| Cell-specific reference signals   |          |           | Antenna ports 0,1 | Antenna ports 0,1            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98               | N/A                          |
| DIP (Note 2)  |          | dB        | N/A               | -1.73                        |
| $BW_{Channel}$  |          | MHz       | 10                | 10                           |
| Cell Id   |          |           | 0                 | 1                            |
| PDSCH transmission mode   |          |           | 6                 | N/A                          |
| Interference model  |          |           | N/A               | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1   | %         | N/A               | 80                           |
|   | Rank 2   | %         | N/A               | 20                           |
| Precoding granularity   |          | PRB       | 50                | 6                            |
| PMI delay (Note 4)  |          | ms        | 10 or 11          | N/A                          |
| Reporting interval  |          | ms        | 5                 | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1         | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 1111              | N/A                          |
| Note 1: $P_B = 1$   |          |           |                   |                              |
| Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.   |          |           |                   |                              |
| Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.  |          |           |                   |                              |
| Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |                   |                              |
| Note 5: All cells are time-synchronous.   |          |           |                   |                              |

**Table 8.10.1.2.3-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model and 4Rx Antenna Ports**

| Test Number | Reference Channel and MCS | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|-------------|---------------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|             |                           | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1           | R.47 TDD 16QAM            | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x4 Low   | 70                                 | -1.9               | ≥1          |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**8.10.1.2.4 Closed-loop spatial multiplexing performance, Dual-Layer Spatial Multiplexing 4 Tx Antenna Ports (Cell-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.2.4-2, with the addition of the parameters in Table 8.10.1.2.4-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.4-1: Test Parameters for Dual-Layer Spatial Multiplexing (FRC) with 4Rx Antenna Ports**

| Parameter                        | Unit      | Test 1-2  | Test 3  |
|----------------------------------|-----------|---|---|
| Downlink power allocation        | $\rho_A$  | dB  | -6  |
|                                  | $\rho_B$  | dB  | -6 (Note 1)   |
|                                  | $\sigma$  | dB  | 3   |
| $N_{oc}$ at antenna port         | dBm/15kHz | -98   | -98   |
| Precoding granularity            | PRB       | 6   | 6   |
| PMI delay (Note 2)               | ms        | 10 or 11  | 10 or 11  |
| Reporting interval               | ms        | 1 or 4 (Note 3)   | 1 or 4 (Note 3)   |
| Reporting mode                   |           | PUSCH 1-2   | PUSCH 3-1   |
| ACK/NACK feedback mode           |           | Bundling  | Bundling  |
| CodeBookSubsetRestriction bitmap |           | 00000000000000000000000000000000<br>00001111111111111111100000000<br>00000000 | 00000000000000000000000000000000<br>00001111111111111111100000000<br>00000000 |
| PDSCH transmission mode          |           | 4   | 4   |

Note 1:  $P_B = 1$ .  
 Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)  
 Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.

**Table 8.10.1.2.4-2: Minimum performance Dual-Layer Spatial Multiplexing (FRC) with 4Rx Antenna Ports**

|   | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | DL UE category |
|---|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|----------------|
|   |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |                |
| 1 | 10 MHz 64 QAM     | R.36 TDD          | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 10.4     | ≥2          | ≥6             |
| 2 | 10 MHz 256QAM     | R.72 TDD          | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 17.5     | 11-12       | ≥11            |
| 3 | 10MHz 1024QAM     | R.102 TDD         | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 28.6     | TBD         | 20, ≥ 2:       |

8.10.1.2.4A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing with 2Tx Antenna Ports

The requirements are specified in Table 8.10.1.2.4A-2, with the addition of the parameters in Table 8.10.1.2.4A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

**Table 8.10.1.2.4A-1: Test Parameters for Dual-Layer Spatial Multiplexing (FRC)**

| Parameter                        | Unit      | Test 1          |             |
|----------------------------------|-----------|-----------------|-------------|
| Downlink power allocation        | $\rho_A$  | dB              | -3          |
|                                  | $\rho_B$  | dB              | -3 (Note 1) |
|                                  | $\sigma$  | dB              | 0           |
| $N_{oc}$ at antenna port         | dBm/15kHz | -98             |             |
| Precoding granularity            | PRB       | 50              |             |
| PMI delay (Note 2)               | ms        | 10 or 11        |             |
| Reporting interval               | ms        | 1 or 4 (Note 3) |             |
| Reporting mode                   |           | PUSCH 3-1       |             |
| ACK/NACK feedback mode           |           | Bundling        |             |
| CodeBookSubsetRestriction bitmap |           | 110000          |             |
| PDSCH transmission mode          |           | 4               |             |

Note 1:  $P_B = 1$ .

Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).

Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.

**Table 8.10.1.2.4A-2: Enhanced Performance Requirement Type C for Dual-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | ETU70                 | 2x4 Medium                                   | 70                                 | 16.9     | ≥2          |

8.10.1.2.5 Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.5-2, with the addition of the parameters in Table 8.10.1.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed-loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.10.1.2.5-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.10.1.2.5-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model and 4Rx Antenna Ports**

| parameter                 | Unit     | Cell 1 | Cell 2     |
|---------------------------|----------|--------|------------|
| Downlink power allocation | $\rho_A$ | dB     | 0          |
|                           | $\rho_B$ | dB     | 0 (Note 1) |
|                           | $\sigma$ | dB     | -3         |

|  |        |           |   |                              |
|--|--------|-----------|---|------------------------------|
| Cell-specific reference signals  |        |           | Antenna ports 0,1   | Antenna ports 0,1            |
| CSI reference signals  |        |           | Antenna ports 15,16   | N/A                          |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |        | Subframes | 5 / 4   | N/A                          |
| CSI reference signal configuration   |        |           | 0   | N/A                          |
| $N_{oc}$ at antenna port   |        | dBm/15kHz | -98   | N/A                          |
| DIP (Note 2)   |        | dB        | N/A   | -1.73                        |
| $BW_{\text{Channel}}$  |        | MHz       | 10  | 10                           |
| Cell Id  |        |           | 0   | 126                          |
| PDSCH transmission mode  |        |           | 9   | 9                            |
| Beamforming model  |        |           | As specified in clause B.4.3 (Note 4, 5)  | N/A                          |
| Interference model   |        |           | N/A   | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 |           | N/A   | 70                           |
|  | Rank 2 |           | N/A   | 30                           |
| Precoder update granularity  |        | PRB       | 50  | 6                            |
| PMI delay (Note 5)   |        | ms        | 10 or 11  | N/A                          |
| Reporting interval   |        | ms        | 5   | N/A                          |
| Reporting mode   |        |           | PUCCH 1-1   | N/A                          |
| CodeBookSubsetRestriction bitmap   |        |           | 001111  | N/A                          |
| Symbols for unused PRBs  |        |           | OCNG (Note 6)   | N/A                          |
| Simultaneous transmission  |        |           | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A                          |
| Physical channel for CQI reporting   |        |           | PUSCH(Note 8)   | N/A                          |
| cqi-pmi-ConfigurationIndex   |        |           | 4   | N/A                          |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 6: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 7: All cells are time-synchronous.</p> <p>Note 8: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |           |   |                              |

**Table 8.10.1.2.5-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model and 4Rx Antenna Ports**

| Test Number  | Reference Channel and MCS | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value                    |                    | UE Category |
|--|---------------------------|--------------|--------|------------------------|--------|---|------------------------------------|--------------------|-------------|
|  |                           | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |             |
| 1  | R.76 TDD QPSK             | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x4 Low   | 70                                 | -3.3               | ≥1          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                           |              |        |                        |        |   |                                    |                    |             |
| Note 2: SINR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.               |                           |              |        |                        |        |   |                                    |                    |             |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                           |              |        |                        |        |   |                                    |                    |             |

**8.10.1.2.5A Single-layer Spatial Multiplexing (with multiple CSI-RS configurations)**

The requirements are specified in Table 8.10.1.2.5A-2, with the addition of the parameters in Table 8.10.1.2.5A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 with a simultaneous transmission on the other antenna port in the serving cell, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.10.1.2.5A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter   | Unit               | Test 1                  |            |
|---|--------------------|-------------------------|------------|
| Downlink power allocation   | $\rho_A$           | dB                      | 0          |
|   | $\rho_B$           | dB                      | 0 (Note 1) |
|   | $\sigma$           | dB                      | -3         |
| Cell-specific reference signals   |                    | Antenna ports 0,1       |            |
| CSI reference signals   |                    | Antenna ports 15,...,18 |            |
| Beamforming model   |                    | Annex B.4.1             |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  | Subframes          | 5 / 4                   |            |
| CSI reference signal configuration  |                    | 3                       |            |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$<br>bitmap   | Subframes / bitmap | 4 /<br>0010000000000000 |            |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98                     |            |
| Symbols for unused PRBs   |                    | OCNG (Note 4)           |            |
| Number of allocated resource blocks (Note 2)  | PRB                | 50                      |            |
| Simultaneous transmission   |                    | Yes (Note 3, 5)         |            |
| PDSCH transmission mode   |                    | 9                       |            |
| Number of MBSFN subframes   | Subframes          | NA                      |            |
| Note 1: $P_B = 1$ .   |                    |                         |            |
| Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.  |                    |                         |            |
| Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test. |                    |                         |            |



Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

Note 5: The two UEs' scrambling identities  $n_{\text{SCID}}$  are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.

**Table 8.10.1.2.5A-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM 1/2 | R.44 TDD          | OP.1 TDD     | EPA5                  | 2x4 Low                                      | 70                                 | 15.8     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

**Table 8.10.1.2.5A-3: Void**

#### 8.10.1.2.5B Single-layer Spatial Multiplexing (With Enhanced DMRS table configured)

For single-layer transmission on antenna port 7, 8, 11 or 13 upon detection of a PDCCH with DCI format 2C, the requirement is specified in Table 8.10.1.2.5B -2, with the addition of the parameters in Table 8.10.1.2.5B -1 and the downlink physical channel setup according to Annex C.3.2. The purpose of the test is to verify rank-1 performance on antenna port 11 with a simultaneous transmission on the antenna port 7, 8 or 13 with DMRS enhancement table and 4 orthogonal DMRS ports (dmrs-Enhancements-r13 UE-EUTRA-Capability [7]).

**Table 8.10.1.2.5B-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Parameter  | Unit               | Test 1                  |            |
|--|--------------------|-------------------------|------------|
| Downlink power allocation  | $\rho_A$           | dB                      | 0          |
|  | $\rho_B$           | dB                      | 0 (Note 1) |
|  | $\sigma$           | dB                      | -3         |
| Beamforming model  |                    | Annex B.4.1A            |            |
| Cell-specific reference signals  |                    | Antenna ports 0,1       |            |
| CSI reference signals  |                    | Antenna ports 15,...,18 |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | Subframes          | 5 / 4                   |            |
| CSI reference signal configuration   |                    | 3                       |            |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS bitmap}$ | Subframes / bitmap | 4 /<br>0010000000000000 |            |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                     |            |
| Symbols for unused PRBs  |                    | OCNG (Note 4)           |            |
| Number of allocated resource blocks (Note 2)   | PRB                | 50                      |            |
| Simultaneous transmission  |                    | Yes (Note 3, 5)         |            |
| dmrs-Enhancements-r13  |                    | Enable                  |            |
| PDSCH transmission mode  |                    | 9                       |            |

|         |  |
|---------|--|
| Note 1: | $P_B = 1$ .  |
| Note 2: | The modulation symbols of the signal under test are mapped onto antenna port 11.   |
| Note 3: | Modulation symbols of an interference signal are random mapped onto one antenna port among antenna port 7, 8 and 13. The update granularity for randomized mapping antenna port is 1 PRG in frequency domain and 1ms in time domain. |
| Note 4: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.        |
| Note 5: | The two UEs' scrambling identities $n_{SCID}$ are set to 0 with OCC =4.  |

**Table 8.10.1.2.5B-2: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations with Enhanced DMRS table**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>64QAM 1/2 | R.44 TDD          | OP.1 TDD     | EPA5                  | 2x4 Low                                      | 70                                 | 15.8     | ≥2          |

Note 1: The reference channel applies to both the input signal under test and the interfering signal.

8.10.1.2.6 Dual-Layer Spatial Multiplexing (User-Specific Reference Symbols)

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.10.1.2.6-2, with the addition of the parameters in Table 8.10.1.2.6-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.10.1.2.6-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations and 4Rx Antenna Ports**

| Parameter  |          | Unit               | Test 1                |                       |
|--|----------|--------------------|-----------------------|-----------------------|
|  |          |                    | Cell 1                | Cell 2                |
| Downlink power allocation  | $\rho_A$ | dB                 | 0                     | 0                     |
|  | $\rho_B$ | dB                 | 0 (Note 1)            | 0                     |
|  | $\sigma$ | dB                 | -3                    | -3                    |
|  | PDSCH_RA | dB                 | 4                     | NA                    |
|  | PDSCH_RB | dB                 | 4                     | NA                    |
| Cell-specific reference signals  |          |                    | Antenna ports 0 and 1 | Antenna ports 0 and 1 |
| Cell ID  |          |                    | 0                     | 126                   |
| CSI reference signals  |          |                    | Antenna ports 15,16   | NA                    |
| Beamforming model  |          |                    | Annex B.4.2           | NA                    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |          | Subframes          | 5 / 4                 | NA                    |
| CSI reference signal configuration                                       |          |                    | 8                     | NA                    |
| Zero-power CSI-RS configuration  |          | Subframes / bitmap | 4 / 0010000000000000  | NA                    |

|   |           |                                       |         |
|---|-----------|---------------------------------------|---------|
| $I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap   |           |                                       |         |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98                                   | NA      |
| $\widehat{E}_s / N_{oc}$  |           | Reference Value in Table 8.10.1.2.6-2 | 7.25dB  |
| Symbols for unused PRBs   |           | OCNG (Note 2)                         | NA      |
| Number of allocated resource blocks (Note 2)  | PRB       | 50                                    | NA      |
| Simultaneous transmission   |           | No                                    | NA      |
| PDSCH transmission mode   |           | 9                                     | Blanked |
| Note 1: $P_b = 1$   |           |                                       |         |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |           |                                       |         |

**Table 8.10.1.2.6-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number  | Bandwidth and MCS   | Reference Channel | OCNG Pattern |        | Propagation Condition |        | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|--|---------------------|-------------------|--------------|--------|-----------------------|--------|--|------------------------------------|----------|-------------|
|  |                     |                   | Cell 1       | Cell 2 | Cell 1                | Cell 2 |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1  | 10 MHz<br>16QAM 1/2 | R.51 TDD          | OP.1 TDD     | N/A    | ETU5                  | ETU5   | 2x4 Low                                      | 70                                 | 9.5      | $\geq 2$    |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                     |                   |              |        |                       |        |  |                                    |          |             |
| Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                     |                   |              |        |                       |        |  |                                    |          |             |
| Note 3: SNR corresponds to $\widehat{E}_s / N_{oc}$ of Cell 1.                                       |                     |                   |              |        |                       |        |  |                                    |          |             |

#### 8.10.1.2.6A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing

The requirements are specified in Table 8.10.1.2.6A-2, with the addition of the parameters in Table 8.10.1.2.6A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the rank-two performance for full RB allocation upon antenna ports 7 and 8.

**Table 8.10.1.2.6A-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer)**

| Parameter                           | Unit      | Test 1                            |
|-------------------------------------|-----------|-----------------------------------|
| Downlink power allocation           | $\rho_A$  | dB                                |
|                                     | $\rho_B$  | dB                                |
|                                     | $\sigma$  | dB                                |
| Cell-specific reference symbols     |           | Antenna port 0 and antenna port 1 |
| Beamforming model                   |           | Annex B.4.3                       |
| $N_{oc}$ at antenna port            | dBm/15kHz | -98                               |
| Symbols for unused PRBs             |           | OCNG (Note 2)                     |
| Number of allocated resource blocks | PRB       | 50                                |
| Reporting mode                      |           | PUSCH 3-1                         |

|  |  |   |
|--|--|---|
| PDSCH transmission mode  |  | 9 |
| Note 1: $P_B = 1$ .<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |  |   |

**Table 8.10.1.2.6A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC)**

| Test number | Bandwidth and MCS   | Reference Channel | OCNB Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.32 TDD          | OP.1 TDD     | EPA5                  | 2x4 Medium                                   | 70                                 | 15.8     | ≥2          |

#### 8.10.1.2.6B Dual-Layer Spatial Multiplexing with altCQI-Table-1024QAM configured (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.6B-2, with the addition of the parameters in Table 8.10.1.2.6B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the rank-two performance for full RB allocation upon antenna ports 7 and 8.

**Table 8.10.1.2.6B-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| Parameter  | Unit               | Test 1                            |            |
|--|--------------------|-----------------------------------|------------|
| Downlink power allocation  | $\rho_A$           | dB                                | 0          |
|  | $\rho_B$           | dB                                | 0 (Note 1) |
|  | $\sigma$           | dB                                | -3         |
| Cell-specific reference symbols  |                    | Antenna port 0 and antenna port 1 |            |
| CSI reference signals  |                    | Antenna ports 15,16, 17, 18       |            |
| Beamforming model  |                    | Annex B.4.3                       |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | Subframes          | 5 / 4                             |            |
| CSI reference signal configuration   |                    | 3                                 |            |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap | Subframes / bitmap | N/A                               |            |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98                               |            |
| Symbols for unused PRBs  |                    | OCNB (Note 2)                     |            |
| Number of allocated resource blocks  | PRB                | 50                                |            |

|  |  |           |
|--|--|-----------|
| Reporting mode   |  | PUSCH 3-1 |
| PDSCH transmission mode  |  | 9         |
| Note 1: $P_B = 1$ .<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |  |           |

**Table 8.10.1.2.6B-2: Minimum performance Dual-Layer Spatial Multiplexing with altCQI-Table-1024QAM**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE DL Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|----------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |                |
| 1           | 10 MHz 1024QAM    | R.102 TDD         | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 29.0     | 20, ≥ 22       |

8.10.1.2.7 Open-loop spatial multiplexing, 3 Layer Multiplexing with 4 Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.7-2, with the addition of the parameters in Table 8.10.1.2.7-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.7-1: Test parameters for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Parameter                        | Unit      |    |                       |
|----------------------------------|-----------|----|-----------------------|
| Downlink power allocation        | $\rho_A$  | dB | -6                    |
|                                  | $\rho_B$  | dB | -6 (Note 1)           |
|                                  | $\sigma$  | dB | 0                     |
| $N_{oc}$ at antenna port         | dBm/15kHz |    | -98                   |
| Cell-specific reference signals  |           |    | Antenna Ports 0,1,2,3 |
| PDSCH transmission mode          |           |    | 3                     |
| PDSCH rank                       |           |    | 3                     |
| CodeBookSubsetRestriction bitmap |           |    | 0100                  |
| Note 1: $P_B = 1$ .              |           |    |                       |

**Table 8.10.1.2.7-2: Minimum performance Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz 64QAM      | R.73 TDD          | OP.1 TDD     | EVA70                 | 4x4 Low                                      | 70                                 | 14.9     | ≥5          |

### 8.10.1.2.7A Enhanced Performance Requirement Type C - Open-loop spatial multiplexing, 3 Layer Multiplexing with 4 Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.7A-2, with the addition of the parameters in Table 8.10.1.2.7A-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.7A-1: Test parameters for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports and 4 Rx ports**

| Parameter                        |          | Unit      |                       |
|----------------------------------|----------|-----------|-----------------------|
| Downlink power allocation        | $\rho_A$ | dB        | -6                    |
|                                  | $\rho_B$ | dB        | -6 (Note 1)           |
|                                  | $\sigma$ | dB        | 0                     |
| $N_{oc}$ at antenna port         |          | dBm/15kHz | -98                   |
| Cell-specific reference signals  |          |           | Antenna Ports 0,1,2,3 |
| PDSCH transmission mode          |          |           | 3                     |
| PDSCH rank                       |          |           | 3                     |
| CodeBookSubsetRestriction bitmap |          |           | 0100                  |
| Note 1: $P_B = 1$ .              |          |           |                       |

**Table 8.10.1.2.7A-2: Enhanced Performance Requirement Type C for Open Loop spatial multiplexing, 3 Layers with 4 Tx ports**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz 16QAM      | R.73-1 TDD        | OP.1 TDD     | EVA70                 | 4x4 medium A                                 | 70                                 | 22.2     | $\geq 5$    |

### 8.10.1.2.8 Closed-loop spatial multiplexing performance, 4 Layers spatial multiplexing 4 Tx antennas

The requirements are specified in Table 8.10.1.2.8-2, with the addition of the parameters in Table 8.10.1.2.8-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.8-1: Test parameters for Closed Loop spatial multiplexing, 4 Layers spatial multiplexing with 4 Tx ports and 4 Rx ports**

| Parameter                        |          | Unit       | Test 1                |
|----------------------------------|----------|------------|-----------------------|
| Downlink power allocation        | $\rho_A$ | dB         | -6                    |
|                                  | $\rho_B$ | dB         | -6 (Note 1)           |
|                                  | $\sigma$ | dB         | 0                     |
| $N_{oc}$ at antenna port         |          | dBm/15k Hz | -98                   |
| Cell-specific reference signals  |          |            | Antenna ports 0,1,2,3 |
| PDSCH transmission mode          |          |            | 4                     |
| PDSCH rank                       |          |            | 4                     |
| Precoding granularity            |          | PRB        | 50                    |
| PMI delay                        |          | ms         | 10 or 11              |
| Reporting interval               |          | ms         | 1 or 4                |
| Reporting mode                   |          |            | PUSCH 3-1             |
| CodeBookSubsetRestriction bitmap |          |            | 0xFFFF000000000000    |
| Uplink-Downlink Configuration    |          |            | 1                     |
| Special subframe configuration   |          |            | 4                     |

|                     |
|---------------------|
| Note 1: $P_B = 1$ . |
|---------------------|

**Table 8.10.1.2.8-2: Minimum performance for Closed Loop spatial multiplexing, 4 Layers spatial multiplexing with 4 Tx ports and 4 Rx ports**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.74 TDD          | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 14.4     | ≥5          |

### 8.10.1.2.9 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.9-2, with the addition of the parameters in Table 8.10.1.2.9-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.9-1: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Parameter  | Unit               | Test 1                                     | Test 1a                                    |
|--|--------------------|--|--|
| Downlink power allocation  | $\rho_A$           | dB   | 0  |
|  | $\rho_B$           | dB   | 0 (Note 1)                                 |
|  | $\sigma$           | dB   | -3   |
| Beamforming model  |                    | 4 layer precoding based on WB PMI feedback | 4 layer precoding based on WB PMI feedback |
| Cell-specific reference signals  |                    | Antenna ports 0,1                          | Antenna ports 0,1                          |
| CSI reference signals  |                    | Antenna ports 15,...,18                    | Antenna ports 15,...,18                    |
| Beamforming model  |                    | Annex B.4.3                                | Annex B.4.3                                |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   | Subframes          | 5 / 4                                      | 5 / 4                                      |
| CSI reference signal configuration   |                    | 3  | 3  |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} /$<br>ZeroPowerCSI-RS bitmap   | Subframes / bitmap | 4 /<br>0010000000000000                    | 4 /<br>0010000000000000                    |
| $N_{oc}$ at antenna port   | dBm/15kHz          | -98  | -98  |
| Symbols for unused PRBs  |                    | OCNG (Note 3)                              | OCNG (Note 3)                              |
| Number of allocated resource blocks (Note 2)   | PRB                | 50   | 50   |
| Simultaneous transmission  |                    | No   | No   |
| PDSCH transmission mode  |                    | 9  | 9  |
| Precoding granularity  |                    | 50   | 50   |
| PMI delay  |                    | 10 or 11                                   | 10 or 11                                   |
| Reporting interval   |                    | 1 or 4                                     | 1 or 4                                     |
| Reporting mode   |                    | PUSCH 3-1                                  | PUSCH 3-1                                  |
| alternativeCodeBookEnabledFor4TX-r12   |                    | False                                      | False                                      |
| CodeBookSubsetRestriction bitmap   |                    | 0xFFFF000000000000                         | 0xFFFF000000000000                         |
| DMRS OCC length per port   |                    | 2  | 4  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0,1 and 6.</p> <p>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> |                    |  |  |

**Table 8.10.1.2.9-2: Minimum performance for for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz 16QAM      | R.75 TDD          | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | 19.0     | ≥5          |
| 1a          | 10MHz 16QAM       | R.75A TDD         | OP.1 TDD     | EPA5                  | 4x4 Low                                      | 70                                 | [18.0]   | ≥5          |

NOTE: For a UE supporting TM9 rank3/4 transmission based on DMRS OCC length 4, Test 1a will be run and Test 1 will be skipped. Otherwise, Test 1a is not applicable and only Test 1 will be run.

**8.10.1.2.9A Enhanced Performance Requirement Type C - 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.2.9A-2, with the addition of the parameters in Table 8.10.1.2.9A-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.10.1.2.9A-1: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Parameter   | Unit               | Test 1                  |            |
|---|--------------------|-------------------------|------------|
| Downlink power allocation   | $\rho_A$           | dB                      | 0          |
|   | $\rho_B$           | dB                      | 0 (Note 1) |
|   | $\sigma$           | dB                      | -3         |
| Cell-specific reference signals   |                    | Antenna ports 0,1       |            |
| CSI reference signals   |                    | Antenna ports 15,...,18 |            |
| Beamforming model   |                    | Annex B.4.3 (Note 4, 5) |            |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  | Subframes          | 5 / 4                   |            |
| CSI reference signal configuration  |                    | 3                       |            |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} /$<br>ZeroPowerCSI-RS bitmap   | Subframes / bitmap | 4 /<br>0010000000000000 |            |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98                     |            |
| Symbols for unused PRBs   |                    | OCNG (Note 3)           |            |
| Number of allocated resource blocks (Note 2)  | PRB                | 50                      |            |
| Simultaneous transmission   |                    | No                      |            |
| PDSCH transmission mode   |                    | 9                       |            |
| Precoding granularity   |                    | 50                      |            |
| PMI delay   |                    | 10 or 11                |            |
| Reporting interval  |                    | 1 or 4                  |            |
| Reporting mode  |                    | PUSCH 3-1               |            |
| alternativeCodeBookEnabledFor4TX-r12  |                    | False                   |            |
| CodeBookSubsetRestriction bitmap  |                    | 0xFFFF000000000000      |            |
| Note 1: $P_B = 1$<br>Note 2: 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0,1 and 6.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                    |                         |            |



|         |   |
|---------|---|
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI.  |
| Note 5: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |

**Table 8.10.1.2.9A-2: Minimum performance for 4 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM   | R.75 TDD          | OP.1<br>TDD  | EPA5                  | 4x4 Medium A<br>Xpol                         | 70                                 | 18.1     | ≥5          |

#### 8.10.1.2.10 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with CRS assistance information (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.10-2, with the addition of parameters in Table 8.10.1.2.10-1. In Table 8.10.1.2.10-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.10.1.2.10-1: Test Parameters**

| Parameter                            | Unit      | Cell 1                                 | Cell 2                       | Cell 3                       |
|--------------------------------------|-----------|--|------------------------------|------------------------------|
| Uplink/downlink configuration        |           | 1                                      | 1                            | 1                            |
| Special subframe configuration       |           | 4                                      | 4                            | 4                            |
| Downlink power allocation            | $\rho_A$  | dB                                     | -3                           | -3                           |
|                                      | $\rho_B$  | dB                                     | -3 (Note 1)                  | -3 (Note 1)                  |
|                                      | $\sigma$  | dB                                     | 0                            | 0                            |
| $N_{oc}$ at antenna port             | dBm/15kHz | -98                                    | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$                   | dB        | Reference Value in Table 8.10.1.2.10-2 | 10.45                        | 4.6                          |
| BW <sub>Channel</sub>                | MHz       | 10                                     | 10                           | 10                           |
| Cyclic prefix                        |           | Normal                                 | Normal                       | Normal                       |
| Subframe Configuration               |           | Non-MBSFN                              | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID                              |           | 0                                      | 1                            | 6                            |
| Cell-specific reference signals      |           | Antenna ports 0,1                      |                              |                              |
| Number of control OFDM symbols (CFI) |           | 2                                      | 2                            | 2                            |
| PDSCH transmission mode              |           | 4                                      | N/A                          | N/A                          |
| Precoding granularity                | PRB       | 50                                     | N/A                          | N/A                          |
| PMI delay (Note 2)                   | ms        | 8                                      | N/A                          | N/A                          |
| Reporting interval                   | ms        | 1 or 4 (Note 3)                        | N/A                          | N/A                          |
| Reporting mode                       |           | PUSCH 3-1                              | N/A                          | N/A                          |
| CodeBookSubsetRestriction bitmap     |           | 001111                                 | N/A                          | N/A                          |
| ACK/NACK feedback mode               |           | Multiplexing                           | N/A                          | N/A                          |
| Time Offset relative to Cell 1       | μs        | N/A                                    | 3                            | -1                           |
| Frequency shift relative to Cell 1   | Hz        | N/A                                    | 300                          | -100                         |
| Interference model                   |           | N/A                                    | As specified in clause B.5.3 | As specified in clause B.5.3 |

|   |        |   |     |    |    |
|---|--------|---|-----|----|----|
| Probability of occurrence of transmission in interference cells   |        | % | N/A | 20 | 20 |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | % | N/A | 80 | 80 |
|   | Rank 2 | % | N/A | 20 | 20 |
| Note 1: $P_B = 1$ .   |        |   |     |    |    |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |        |   |     |    |    |
| Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.  |        |   |     |    |    |

Table 8.10.1.2.10-2: Minimum Performance for PDSCH

| Test Number   | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.35 TDD          | OP.1 TDD     | N/A    | N/A    | EVA5                           | EVA5   | EVA5   | 2x4 low   | 70                                 | 11.2              | ≥2          |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.   |                   |              |        |        |                                |        |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.  |                   |              |        |        |                                |        |        |   |                                    |                   |             |

#### 8.10.1.2.11 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing 4 Tx Antenna Port with CRS assistance information (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.10.1.2.11-2, with the addition of parameters in Table 8.10.1.2.11-1. In Table 8.10.1.2.11-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2.

The purpose of the test is to verify the closed loop single layer TM4 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cell.

Table 8.10.1.2.11-1: Test Parameters

| Parameter                            | Unit       | Cell 1                                 | Cell 2      |
|--------------------------------------|------------|--|-------------|
| Uplink downlink configuration        |            | 1                                      | 1           |
| Special subframe configuration       |            | 4                                      | 4           |
| Downlink power allocation            | $\rho_A$   | dB                                     | -6          |
|                                      | $\rho_B$   | dB                                     | -6 (Note 1) |
|                                      | $\sigma$   | dB                                     | 3           |
| $N_{oc}$ at antenna port             | dBm/15k Hz | -98                                    | N/A         |
| $\hat{E}_s/N_{oc}$                   | dB         | Reference Value in Table 8.10.1.2.11-2 | 10.45       |
| BW <sub>Channel</sub>                | MHz        | 10                                     | 10          |
| Cyclic prefix                        |            | Normal                                 | Normal      |
| Subframe Configuration               |            | Non-MBSFN                              | Non-MBSFN   |
| Cell ID                              |            | 0                                      | 1           |
| Cell-specific reference signals      |            | Antenna ports 0,1,2,3                  |             |
| Number of control OFDM symbols (CFI) |            | 2                                      | 2           |
| PDSCH transmission mode              |            | 4                                      | N/A         |
| Precoding granularity                | PRB        | 50                                     | N/A         |

|  |        |                  |                              |    |
|--|--------|------------------|------------------------------|----|
| PMI delay (Note 2)   | ms     | 8                | N/A                          |    |
| Reporting interval   | ms     | 1 or 4 (Note 3)  | N/A                          |    |
| Reporting mode   |        | PUSCH 3-1        | N/A                          |    |
| CodeBookSubsetRestriction bitmap   |        | 000000000000FFFF | N/A                          |    |
| ACK/NACK feedback mode   |        | Multiplexing     | N/A                          |    |
| Time Offset relative to Cell 1   | μs     | N/A              | 3                            |    |
| Frequency shift relative to Cell 1   | Hz     | N/A              | 300                          |    |
| Interference model   |        | N/A              | As specified in clause B.5.3 |    |
| Probability of occurrence of transmission in interference cells  | %      | N/A              | 20                           |    |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 | %                | N/A                          | 80 |
|  | Rank 2 | %                | N/A                          | 20 |
| Note 1: $P_B = 1$ .  |        |                  |                              |    |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4), this reported PMI cannot be applied at the eNB downlink before SF #(n+4). |        |                  |                              |    |
| Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.   |        |                  |                              |    |

**Table 8.10.1.2.11-2: Minimum Performance for PDSCH**

| Test Number   | Reference Channel | OCNG Pattern |        | Propagation Conditions (Note1) |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|---|-------------------|--------------|--------|--------------------------------|--------|---|------------------------------------|-------------------|-------------|
|   |                   | Cell 1       | Cell 2 | Cell 1                         | Cell 2 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1   | R.36-1 TDD        | OP.1 TDD     | N/A    | EVA5                           | EVA5   | 4x4 low   | 70                                 | 9.8               | ≥2          |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. |                   |              |        |                                |        |   |                                    |                   |             |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.   |                   |              |        |                                |        |   |                                    |                   |             |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.                                |                   |              |        |                                |        |   |                                    |                   |             |

**8.10.1.2.12 Closed loop spatial multiplexing performance - Single-Layer Spatial Multiplexing with CRS assistance information (User-Specific Reference Symbols)**

The requirements are specified in Table 8.10.1.2.12-2, with the addition of parameters in Table 8.10.1.2.12-1. In Table 8.10.1.2.12-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single layer TM9 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.10.1.2.12-1: Test Parameters**

| Parameter                      | Unit      | Cell 1                                 | Cell 2     | Cell 3     |
|--------------------------------|-----------|--|------------|------------|
| Uplink downlink configuration  |           | 1                                      | 1          | 1          |
| Special subframe configuration |           | 4                                      | 4          | 4          |
| Downlink power allocation      | $\rho_A$  | dB                                     | 0          | 0          |
|                                | $\rho_B$  | dB                                     | 0 (Note 1) | 0 (Note 1) |
|                                | $\sigma$  | dB                                     | -3         | -3         |
| $N_{oc}$ at antenna port       | dBm/15kHz | -98                                    | N/A        | N/A        |
| $\hat{E}_s/N_{oc}$             | dB        | Reference Value in Table 8.10.1.2.12-2 | 10.45      | 4.6        |
| $BW_{Channel}$                 | MHz       | 10                                     | 10         | 10         |

|  |                       |   |                              |                              |    |
|--|-----------------------|---|------------------------------|------------------------------|----|
| Cyclic prefix  |                       | Normal  | Normal                       | Normal                       |    |
| Subframe Configuration   |                       | Non-MBSFN                                     | Non-MBSFN                    | Non-MBSFN                    |    |
| Cell ID  |                       | 0   | 1                            | 6                            |    |
| Cell-specific reference signals  |                       | Antenna ports 0,1                             |                              |                              |    |
| CSI reference signals  |                       | Antenna ports 15,16                           | N/A                          | N/A                          |    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$           | Subframes             | 5 / 4   | N/A                          | N/A                          |    |
| CSI reference signal configuration   |                       | 8   | N/A                          | N/A                          |    |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / \text{ZeroPowerCSI-RS}$<br>bitmap | Subframes /<br>bitmap | 4<br>/00100000000<br>00000                    | N/A                          | N/A                          |    |
| Number of control OFDM symbols (CFI)   |                       | 2   | 2                            | 2                            |    |
| PDSCH transmission mode  |                       | 9   | N/A                          | N/A                          |    |
| Precoding granularity  | PRB                   | Frequency domain: 50 PRB<br>Time domain: 1 ms | N/A                          | N/A                          |    |
| Beamforming model  |                       | Annex B.4.1                                   |                              |                              |    |
| ACK/NACK feedback mode   |                       | Multiplexing                                  | N/A                          | N/A                          |    |
| Time Offset relative to Cell 1   | $\mu\text{s}$         | N/A   | 3                            | -1                           |    |
| Frequency shift relative to Cell 1   | Hz                    | N/A   | 300                          | -100                         |    |
| Interference model   |                       | N/A   | As specified in clause B.5.4 | As specified in clause B.5.4 |    |
| Probability of occurrence of transmission in interference cells                    | %                     | N/A   | 20                           | 20                           |    |
| Probability of occurrence of transmission rank in interfering cells                | Rank 1                | %   | N/A                          | 80                           | 80 |
|  | Rank 2                | %   | N/A                          | 20                           | 20 |
| Note 1: $P_B = 1$ .  |                       |   |                              |                              |    |

Table 8.10.1.2.12-2: Minimum Performance for PDSCH

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.X TDD           | OP.1 TDD     | N/A    | N/A    | EVA5                           | EVA5   | EVA5   | 2x4 low   | 70                                 | 12.0              | $\geq 2$    |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of cell 1. |                   |              |        |        |                                |        |        |   |                                    |                   |             |

8.10.1.2.13 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

8.10.1.2.13.1 Minimum requirements for QCL Type C and 3 Layers Spatial Multiplexing

The requirements are specified in Table 8.10.1.2.13.1-3, with the additional parameters in Table 8.10.1.2.13.1-1 and Table 8.10.1.2.13.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.10.1.2.13.1-1, transmission point 1 (TP 1) is the serving cell transmitting

PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP 1 and TP 2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

**Table 8.10.1.2.13.1-1: Test Parameters**

| Parameter  |          | Unit             | TP 1                        | TP 2                        |
|--|----------|------------------|-----------------------------|-----------------------------|
| Uplink downlink configuration  |          |                  | 1                           | 1                           |
| Special subframe configuration   |          |                  | 4                           | 4                           |
| Downlink power allocation  | $\rho_A$ | dB               | 0                           | 0                           |
|  | $\rho_B$ | dB               | 0 (Note 1)                  | 0                           |
|  | $\sigma$ | dB               | -3                          | -3                          |
| Beamforming model  |          |                  | Random beamforming (rank 2) | Random beamforming (rank 1) |
| Cell-specific reference signals  |          |                  | Antenna ports 0,1           | Antenna ports 0,1           |
| CSI reference signals 0  |          |                  | Antenna ports {15,16,17,18} | N/A                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  |          | Subframes        | 5 / 4                       |                             |
| CSI reference signal 0 configuration   |          |                  | 0                           |                             |
| CSI reference signals 1  |          |                  | N/A                         | Antenna ports {15,16,17,18} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  |          | Subframes        |                             | 5 / 4                       |
| CSI reference signal 1 configuration   |          |                  |                             | 8                           |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / \text{ZeroPower CSI-RS bitmap}$                                  |          | Subframes/bitmap | 4/<br>0010000000000000      | N/A                         |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / \text{ZeroPower CSI-RS bitmap}$                                   |          | Subframes/bitmap | N/A                         | 4/<br>0010000000000000      |
| $\widehat{E}_s / N_{oc}$   |          | dB               | SNR1                        | SNR2 = SNR1-3dB             |
| $N_{oc}$ at antenna port   |          | dBm/15kHz        | -98                         | -98                         |
| BW <sub>Channel</sub>  |          | MHz              | 10                          | 10                          |
| Cyclic Prefix  |          |                  | Normal                      | Normal                      |
| Cell ID  |          |                  | 0                           | 126                         |
| Number of control OFDM symbols / PDSCH start   |          |                  | 2                           | 2                           |
| Timing offset relative to TP 1   |          | us               | N/A                         | 2                           |
| Frequency offset relative to TP 1  |          | Hz               | N/A                         | 200                         |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'  |          |                  | Type C, '00'                |                             |
| PDSCH transmission mode (Note 2)   |          |                  | 10                          | 10                          |
| Number of allocated resource block   |          |                  | 50                          | 50                          |
| Note 1: $P_B = 1$  |          |                  |                             |                             |
| Note 2: PDSCH transmission is done from both TPs (CW2 is transmitted from TP 1 and CW1 is transmitted from TP 2) |          |                  |                             |                             |

**Table 8.10.1.2.13.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | DL transmission hypothesis for each PQI Set |
|---------------|----------------------------|---|
|---------------|----------------------------|---|

|           | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
|-----------|--|-------------------------|-------|-------|
| PQI set 0 | CSI-RS 0 for CW2<br>CSI-RS 1 for CW1     | ZP CSI-RS 0             | PDSCH | PDSCH |

Table 8.10.1.2.13.1-3: Performance Requirements

| Test Number   | Reference Channel |          | OCNG Pattern |          | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|---|-------------------|----------|--------------|----------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|   | TP 1              | TP 2     | TP 1         | TP 2     | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1   | R.98 TDD          | R.99 TDD | OP.1T DD     | OP.1T DD | EPA5                           | EPA5 | 4x4 Low   | 70                                 | 11.1               | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of TP 1 and TP 2 as defined in clause 8.1.1. |                   |          |              |          |                                |      |   |                                    |                    |             |

## 8.10.1.2.13.2 Minimum requirements for QCL Type C and 4 Layers Spatial Multiplexing

The requirements are specified in Table 8.10.1.2.13.2-3, with the additional parameters in Table 8.10.1.2.13.2-1 and Table 8.10.1.2.13.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-co-located antenna ports when the UE receives DCI format 2D in a scenario with non-coherent joint transmission from two transmission points. The test verifies that the UE configured with quasi co-location type C performs correct tracking and compensation of the frequency and time difference between two transmission points, channel parameters estimation, channel estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In Table 8.10.1.2.13.2-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and PDSCH, and transmission point 2 (TP 2) has different Cell ID and transmits PDSCH. In the test the PDSCH is transmitted from TP 1 and TP 2. The downlink physical channel setup for TP 1 is according to Annex C.3.2 and for TP 2 according to Annex C.3.2.

Table 8.10.1.2.13.2-1: Test Parameters

| Parameter   | Unit             | TP 1                        | TP 2                        |
|---|------------------|-----------------------------|-----------------------------|
| Uplink downlink configuration   |                  | 1                           | 1                           |
| Special subframe configuration  |                  | 4                           | 4                           |
| Downlink power allocation   | $\rho_A$         | dB                          | 0                           |
|   | $\rho_B$         | dB                          | 0 (Note 1)                  |
|   | $\sigma$         | dB                          | -3                          |
| Beamforming model   |                  | Random beamforming (rank 2) | Random beamforming (rank 2) |
| Cell-specific reference signals   |                  | Antenna ports 0,1,2,3       | Antenna ports 0,1,2,3       |
| CSI reference signals 0   |                  | Antenna ports {15,16,17,18} | N/A                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}/\Delta_{CSI-RS}$   | Subframes        | 5 / 4                       |                             |
| CSI reference signal 0 configuration                                    |                  | 0                           |                             |
| CSI reference signals 1   |                  | N/A                         | Antenna ports {15,16,17,18} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}/\Delta_{CSI-RS}$   | Subframes        |                             | 5 / 4                       |
| CSI reference signal 1 configuration                                    |                  |                             | 8                           |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}/ZeroPower\ CSI-RS$ bitmap | Subframes/bitmap | 4/<br>0010000000000000      | N/A                         |
| Zero-power CSI-RS1 configuration  | Subframes/bitmap | N/A                         | 4/                          |

|   |           |              |                  |
|---|-----------|--------------|------------------|
| l <sub>CSI-RS</sub> / ZeroPower CSI-RS bitmap   |           |              | 0010000000000000 |
| $\widehat{E}_s / N_{oc}$  | dB        | SNR1         | SNR2 = SNR1      |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98          | -98              |
| BW <sub>Channel</sub>   | MHz       | 10           | 10               |
| Cyclic Prefix   |           | Normal       | Normal           |
| Cell ID   |           | 0            | 126              |
| Number of control OFDM symbols / PDSCH start  |           | 2            | 2                |
| Timing offset relative to TP 1  | us        | N/A          | 2                |
| Frequency offset relative to TP 1   | Hz        | N/A          | 200              |
| qcl-Operation, 'PDSCH RE Mapping and Quasi-Co-Location Indicator'   |           | Type C, '00' |                  |
| PDSCH transmission mode (Note 2)  |           | 10           | 10               |
| Number of allocated resource block  |           | 50           | 50               |
| Note 1: $P_B = 1$<br>Note 2: PDSCH transmission is done from both TPs (CW1 is transmitted from TP 1 and CW2 is transmitted from TP 2) |           |              |                  |

**Table 8.10.1.2.13.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     | ZP CSI-RS 0             | PDSCH                                       | PDSCH |

**Table 8.10.1.2.13.2-3: Performance Requirements**

| Test Number   | Reference Channel |                  | OCNG Pattern |             | Propagation Conditions (Note1) |      | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                    | UE Category |
|---|-------------------|------------------|--------------|-------------|--------------------------------|------|---|------------------------------------|--------------------|-------------|
|   | TP 1              | TP 2             | TP 1         | TP 2        | TP 1                           | TP 2 |   | Fraction of Maximum Throughput (%) | SNR1 (dB) (Note 3) |             |
| 1   | R.10<br>0<br>TDD  | R.10<br>0<br>TDD | OP.1T<br>DD  | OP.1T<br>DD | EPA5                           | EPA5 | 4x4 Low   | 70                                 | 15.4               | ≥2          |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\widehat{E}_s / N_{oc}$ of TP 1 and TP 2 as defined in clause 8.1.1. |                   |                  |              |             |                                |      |   |                                    |                    |             |

8.10.1.2.14 HST-SFN performance

8.10.1.2.14.1 Minimum Requirement for Rel-16 further enhanced HST

The requirements are specified in Table 8.10.1.2.14-2, with the addition of the parameters in Table 8.10.1.2.14-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify UE performance in

the HST-SFN-500 scenario. The test for HST-SFN-500 scenario defined in B.3B is applied when *highSpeedEnhDemodFlag2-r16* [7] is received.

**Table 8.10.1.2.14-1: Void**

**Table 8.10.1.2.14-2: Void**

NOTE: Table 8.10.1.2.14-1 and Table 8.10.1.2.14-2 are moved to subclause 8.10.1.2.14.1 as Table 8.10.1.2.14.1-1 and Table 8.10.1.2.14.1-2.

**Table 8.10.1.2.14.1-1: Test Parameters for UE performance in HST-SFN-500 scenario (FRC)**

| Parameter                 | Unit     | Test 1       |
|---------------------------|----------|--------------|
| Downlink power allocation | $\rho_A$ | dB           |
|                           | $\rho_B$ | dB           |
|                           | $\sigma$ | dB           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz    |
| ACK/NACK feedback mode    |          | Multiplexing |
| PDSCH transmission mode   |          | 3            |
| NOTE 1: $P_B = 1$ .       |          |              |

**Table 8.10.1.2.14.1-2: Minimum performance UE in HST-SFN-500 scenario (FRC)**

| Test number   | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|---|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|   |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1 NOTE 2  | 10 MHz    | R.87-1 TDD        | OP.1 TDD     | HST-SFN-500           | 2x4  | 70                                 | 6.8      | $\geq 1$    |
| NOTE 1: Test case applicability is defined in 8.1.2.1 and 8.1.2.6.  |           |                   |              |                       |  |                                    |          |             |
| NOTE 2: The requirement defined is based on the normalized channel model, i.e.the power of each tap is normalized to the instantaneous total received power from four taps. |           |                   |              |                       |  |                                    |          |             |

## 8.10.2 PDCCH/PCFICH

### 8.10.2.1 FDD

The parameters specified in Table 8.10.2.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.10.2.1-1: Test Parameters for PDCCH/PCFICH with 4 Rx Antenna Ports**

| Parameter                      | Unit     | Single antenna port | Transmit diversity |
|--------------------------------|----------|---------------------|--------------------|
| Number of PDCCH symbols        | symbols  | 2                   | 2                  |
| PHICH Ng (Note 1)              |          | 1                   | 1                  |
| PHICH duration                 |          | Normal              | Normal             |
| Unused RE-s and PRB-s (Note 2) |          | OCNG                | OCNG               |
| Cell ID                        |          | 0                   | 0                  |
| Downlink power allocation      | $\rho_A$ | dB                  | -3                 |
|                                | $\rho_B$ | dB                  | -3                 |
|                                | $\sigma$ | dB                  | 0                  |
| $N_{oc}$ at antenna port       |          | dBm/15kHz           | -98                |
| Cyclic prefix                  |          | Normal              | Normal             |



|   |
|---|
| Note 1: according to Clause 6.9 in TS 36.211 [4]. |
| Note 2: PDSCH is mapped as OCNG.                  |

### 8.10.2.1.1 Single-antenna port performance

For the parameters specified in Table 8.10.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.1.1-1: Minimum performance PDCCH/PCFICH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 FDD          | OP.1 FDD     | ETU70                 | 1x4 Low                                      | 1               | -5.4     |

### 8.10.2.1.2 Transmit diversity performance with 2 Tx Antenna Ports

For the parameters specified in Table 8.10.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.1.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.1.2-1: Minimum performance PDCCH/PCFICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 FDD          | OP.1 FDD     | EVA70                 | 2 x 4 Low                                    | 1               | -3.5     |

### 8.10.2.1.3 Transmit diversity performance with 4 Tx Antenna Ports

For the parameters specified in Table 8.10.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.1.3-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.1.3-1: Minimum performance PDCCH/PCFICH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 5 MHz     | 2 CCE             | R.17 FDD          | OP.1 FDD     | EPA5                  | 4 x 4 Medium A Xpol                          | 1               | -0.4     |

### 8.10.2.1.4 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.10.2.1.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.1.4-2. In Table 8.10.2.1.4-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell, respectively.

Table 8.10.2.1.4-1: Test Parameters for PDCCH/PCFICH

| Parameter   |                                  | Unit      | Cell 1                           | Cell 2                       |
|---|----------------------------------|-----------|----------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3                               | -3                           |
|   | PHICH_RA                         | dB        | -3                               | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                               | -3                           |
|   | PHICH_RB                         | dB        | -3                               | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports 0,1,2,3            |                              |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98                              |                              |
| $\hat{E}_s/N_{oc}$  |                                  | dB        | As defined in Table 8.10.2.1.4-2 | 13.91                        |
| $BW_{Channel}$  |                                  | MHz       | 10                               | 10                           |
| Cyclic Prefix   |                                  |           | Normal                           | Normal                       |
| Cell ID   |                                  |           | 0                                | 1                            |
| Subframe Configuration  |                                  |           | Non-MBSFN                        | Non-MBSFN                    |
| Number of DL control region OFDM symbols                                    |                                  |           | 2                                | 2                            |
| CFI indicated in PCFICH   |                                  |           | 2                                | 2                            |
| PHICH Ng (Note 1)   |                                  |           | 1/6                              | N/A                          |
| PHICH duration  |                                  |           | Normal                           | N/A                          |
| PDSCH TM  |                                  |           | 4                                | N/A                          |
| Interference model  |                                  |           | NA                               | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG                             | OCNG                         |
| Time Offset relative to Cell 1  |                                  | $\mu$ s   | N/A                              | 2                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A                              | 200                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                           |                                  |           |                                  |                              |
| Note 2: For Cell 2 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                  |                              |

Table 8.10.2.1.4-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A

| Test Number | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|-------------|-------------------|-------------------|-----------------------|---------------------------------|--------|---|-----------------|-------------------|
|             |                   |                   |                       | Cell 1                          | Cell 2 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1           | 1 CCE             | R.17-2 FDD        | OP.1 FDD              | EPA5                            | EPA5   | 4x4 Low   | 1               | 16.5              |

Note 1: The OCNG pattern applies for Cell 1 and Cell 2.

Note 2: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.

Note 4: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

## 8.10.2.2 TDD

Table 8.10.2.2-1: Test Parameters for PDCCH/PCFICH

| Parameter                               | Unit    | Single antenna port | Transmit diversity |
|---|---------|---------------------|--------------------|
| Uplink downlink configuration (Note 1)  |         | 0                   | 0                  |
| Special subframe configuration (Note 2) |         | 4                   | 4                  |
| Number of PDCCH symbols                 | symbols | 2                   | 2                  |
| PHICH Ng (Note 3)                       |         | 1                   | 1                  |
| PHICH duration                          |         | Normal              | Normal             |
| Unused RE-s and PRB-s (Note 4)          |         | OCNG                | OCNG               |
| Cell ID                                 |         | 0                   | 0                  |

|   |          |           |              |              |
|---|----------|-----------|--------------|--------------|
| Downlink power allocation                             | $\rho_A$ | dB        | 0            | -3           |
|   | $\rho_B$ | dB        | 0            | -3           |
|   | $\sigma$ | dB        | 0            | 0            |
| $N_{oc}$ at antenna port                              |          | dBm/15kHz | -98          | -98          |
| Cyclic prefix   |          |           | Normal       | Normal       |
| ACK/NACK feedback mode                                |          |           | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. |          |           |              |              |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. |          |           |              |              |
| Note 3: according to Clause 6.9 in TS 36.211 [4].     |          |           |              |              |
| Note 4: PDSCH is mapped as OCNB.                      |          |           |              |              |

### 8.10.2.2.1 Single-antenna port performance

For the parameters specified in Table 8.10.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNB Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 TDD          | OP.1 TDD     | ETU70                 | 1x4 Low                                      | 1               | -4.7     |

### 8.10.2.2.2 Transmit diversity performance with 2 Tx Antenna Ports

For the parameters specified in Table 8.10.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.2.2-1: Minimum performance PDCCH/PCFICH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNB Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.16 TDD          | OP.1 TDD     | EVA70                 | 2 x 4 Low                                    | 1               | -3.2     |

### 8.10.2.2.3 Transmit diversity performance with 4 Tx Antenna Ports

For the parameters specified in Table 8.10.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.2.3-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.2.2.3-1: Minimum performance PDCCH/PCFICH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNB Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 5 MHz     | 2 CCE             | R.17 TDD          | OP.1 TDD     | EPA5                  | 4 x 4 Medium A Xpol                          | 1               | 0.0      |

#### 8.10.2.2.4 Enhanced Downlink Control Channel Performance Requirement Type A - 4 Tx Antenna Port with Non-Colliding CRS Dominant Interferer

The purpose of this test is to verify the Enhanced Downlink Control Channel Performance Requirement Type A for PDCCH/PCFICH with 4 transmit antennas for the case of dominant interferer with the non-colliding CRS pattern and applying interference model defined in clause B.7.1.

For the parameters specified in Table 8.10.2.2.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.2.2.4-2. In Table 8.10.2.2.4-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell, respectively.

**Table 8.10.2.2.4-1: Test Parameters for PDCCH/PCFICH**

| Parameter   |                                  | Unit      | Cell 1                           | Cell 2                       |
|---|----------------------------------|-----------|----------------------------------|------------------------------|
| Downlink power allocation   | PDCCH_RA<br>OCNG_RA              | dB        | -3                               | -3                           |
|   | PHICH_RA                         | dB        | -3                               | N/A                          |
|   | PCFICH_RB<br>PDCCH_RB<br>OCNG_RB | dB        | -3                               | -3                           |
|   | PHICH_RB                         | dB        | -3                               | N/A                          |
| Cell-specific reference signals   |                                  |           | Antenna ports 0,1,2,3            |                              |
| $N_{oc}$ at antenna port  |                                  | dBm/15kHz | -98                              |                              |
| $\hat{E}_s/N_{oc}$  |                                  | dB        | As defined in Table 8.10.2.1.4-2 | 13.91                        |
| BW <sub>Channel</sub>   |                                  | MHz       | 10                               | 10                           |
| Cyclic Prefix   |                                  |           | Normal                           | Normal                       |
| Cell ID   |                                  |           | 0                                | 1                            |
| UL/DL Configuration   |                                  |           | 0                                | 0                            |
| Special Subframe Configuration  |                                  |           | 4                                | 4                            |
| Subframe Configuration  |                                  |           | Non-MBSFN                        | Non-MBSFN                    |
| Number of DL control region OFDM symbols                                    |                                  |           | 2                                |                              |
| CFI indicated in PCFICH   |                                  |           | 2                                |                              |
| PHICH Ng (Note 1)   |                                  |           | 1/6                              | N/A                          |
| PHICH duration  |                                  |           | Normal                           | N/A                          |
| PDSCH TM  |                                  |           | 4                                | N/A                          |
| Interference model  |                                  |           | NA                               | As specified in clause B.7.1 |
| Unused RE-s and PRB-s (Note 2)  |                                  |           | OCNG                             | OCNG                         |
| Time Offset relative to Cell 1  |                                  | μs        | N/A                              | 2                            |
| Frequency shift relative to Cell 1  |                                  | Hz        | N/A                              | 200                          |
| Note 1: According to Clause 6.9 in TS 36.211 [4].                           |                                  |           |                                  |                              |
| Note 2: For Cell 2 unused RE-s and PRB-s do not include control region REs. |                                  |           |                                  |                              |

**Table 8.10.2.1.4-2: Minimum Performance for PDCCH/PCFICH for Enhanced Downlink Control Channel Performance Requirement Type A**

| Test Number | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|-------------|-------------------|-------------------|-----------------------|---------------------------------|--------|---|-----------------|-------------------|
|             |                   |                   |                       | Cell 1                          | Cell 2 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1           | 1 CCE             | R.17-2 TDD        | OP.1 TDD              | EPA5                            | EPA5   | 4x4 Low   | 1               | 17.9              |

Note 1: The OCNG pattern applies for Cell 1 and Cell 2.

Note 2: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.

Note 4: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.

## 8.10.3 PHICH

The receiver characteristics of the PHICH are determined by the probability of miss-detecting an ACK for a NACK (Pm-an). It is assumed that there is no bias applied to the detection of ACK and NACK (zero-threshold detection).

### 8.10.3.1 FDD

The parameters specified in Table 8.10.3.1-1 are valid for all FDD tests with 4Rx unless otherwise stated.

**Table 8.10.3.1-1: Test Parameters for PHICH with 4 Rx Antenna Ports**

| Parameter  |          | Unit      | Single antenna port  | Transmit diversity |
|--|----------|-----------|--|--------------------|
| Downlink power allocation  | $\rho_A$ | dB        | 0  | -3                 |
|  | $\rho_B$ | dB        | 0  | -3                 |
|  | $\sigma$ | dB        | 0  | 0                  |
| PHICH duration   |          |           | Normal   | Normal             |
| PHICH Ng (Note 1)  |          |           | Ng = 1   | Ng = 1             |
| PDCCH Content  |          |           | UL Grant should be included with the proper information aligned with A.3.6. DL Grant: Note 2 |                    |
| Unused RE-s and PRB-s (Note 2)   |          |           | OCNG   | OCNG               |
| Cell ID  |          |           | 0  | 0                  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98  | -98                |
| Cyclic prefix  |          |           | Normal   | Normal             |
| Note 1: according to Clause 6.9 in TS 36.211 [4].  |          |           |  |                    |
| Note 2: Reference measurement channel R.15 FDD for Single Tx Antenna 8.10.3.1.1, R15-2 FDD for Transmit Diversity with 2Tx Antenna Port 8.10.3.1.2, R17 FDD for Transmit diversity with 4Tx Antenna Port 8.10.3.1.3, according to Table A.3.5.1-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 for the serving cell. |          |           |  |                    |

#### 8.10.3.1.1 Single Tx Antenna Port performance

For the parameters specified in Table 8.10.3.1-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.1.1-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.18              | OP.1 FDD     | ETU70                 | 1 x 4 Low                                    | 0.1             | 1.6      |

#### 8.10.3.1.2 Transmit diversity performance with 2 Tx Antenna Ports

For the parameters specified in Table 8.10.3.1-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.1.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.1.2-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.19              | OP.1 FDD     | EVA70                 | 2 x 4 Low                                    | 0.1             | 0.6      |

### 8.10.3.1.3 Transmit diversity performance with 4 Tx Antenna Ports

For the parameters specified in Table 8.10.3.1-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.1.3-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.1.3-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 5 MHz     | R.20              | OP.1 FDD     | EPA5                  | 4 x 4 Medium correlation A, Cross polarized  | 0.1             | 0.1      |

### 8.10.3.2 TDD

The parameters specified in Table 8.10.3.2-1 are valid for all TDD tests with 4 Rx unless otherwise stated.

**Table 8.10.3.2-1: Test Parameters for PHICH with 4 Rx Antenna Ports**

| Parameter  | Unit      | Single antenna port  | Transmit diversity |
|--|-----------|--|--------------------|
| Uplink downlink configuration (Note 1)   |           | 1  | 1                  |
| Special subframe configuration (Note 2)  |           | 4  | 4                  |
| Downlink power allocation  | $\rho_A$  | dB   | -3                 |
|  | $\rho_B$  | dB   | -3                 |
|  | $\sigma$  | dB   | 0                  |
| PHICH duration   |           | Normal   | Normal             |
| PHICH Ng (Note 1)  |           | Ng = 1   | Ng = 1             |
| PDCCH Content  |           | UL Grant should be included with the proper information aligned with A.3.6. DL Grant: Note 4 |                    |
| Unused RE-s and PRB-s (Note 4)   |           | OCNG   | OCNG               |
| Cell ID  |           | 0  | 0                  |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98  | -98                |
| Cyclic prefix  |           | Normal   | Normal             |
| ACK/NACK feedback mode   |           | Multiplexing   | Multiplexing       |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4].<br>Note 3: according to Clause 6.9 in TS 36.211 [4].<br>Note 4: Reference measurement channel R.15 TDD for Single Tx Antenna 8.10.3.2.1, R15-2 TDD for Transmit Diversity with 2Tx Antenna Port 8.10.3.2.2, R17 TDD for Transmit diversity with 4Tx Antenna Port 8.10.3.2.3, according to Table A.3.5.2-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 for the serving cell |           |  |                    |

#### 8.10.3.2.1 Single Tx Antenna Port performance

For the parameters specified in Table 8.10.3.2-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.2.1-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.18              | OP.1 TDD     | ETU70                 | 1 x 4 Low                                    | 0.1             | 1.7      |

#### 8.10.3.2.2 Transmit diversity performance with 2 Tx Antenna Ports

For the parameters specified in Table 8.10.3.2-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.2.2-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.19              | OP.1 TDD     | EVA70                 | 2 x 4 Low                                    | 0.1             | 0.9      |

#### 8.10.3.2.3 Transmit diversity performance with 4 Tx Antenna Ports

For the parameters specified in Table 8.10.3.2-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.10.3.2.3-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.3.2.3-1: Minimum performance PHICH with 4 Rx Antenna Ports**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |              |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 5 MHz     | R.20              | OP.1 TDD     | EPA5                  | 4 x 4 Medium cotrrelation A, Cross polarized | 0.1             | 0.3      |

## 8.10.4 ePDCCH

The receiver characteristics of the EPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). For the distributed transmission tests in 8.10.4.1, EPDCCH and PCFICH are tested jointly, i.e. a miss detection of PCFICH implies a miss detection of EPDCCH. For other tests, EPDCCH and PCFICH are not tested jointly.

### 8.10.4.1 Distributed Transmission with 4Rx

#### 8.10.4.1.1 FDD

The parameters specified in Table 8.10.4.1.1-1 are valid for all FDD distributed EPDCCH test with 4Rx unless otherwise stated.

**Table 8.10.4.1.1-1: Test Parameters for Distributed EPDCCH with 4Rx**

| Parameter               | Unit    | Value      |
|-------------------------|---------|------------|
| Number of PDCCH symbols | symbols | 2 (Note 1) |
| PHICH duration          |         | Normal     |

|   |          |            |  |
|---|----------|------------|--|
| Unused RE-s and PRB-s   |          |            | OCNG   |
| Cell ID   |          |            | 0  |
| Downlink power allocation   | $\rho_A$ | dB         | -3   |
|   | $\rho_B$ | dB         | -3   |
|   | $\sigma$ | dB         | 0  |
|   | $\delta$ | dB         | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15 kHz | -98  |
| Cyclic prefix   |          |            | Normal   |
| Subframe Configuration  |          |            | Non-MBSFN  |
| Precoder Update Granularity   | PRB      |            | 1  |
|   | ms       |            | 1  |
| Beamforming Pre-Coder   |          |            | Annex B.4.4  |
| Cell Specific Reference Signal  |          |            | Port 0 and 1                                       |
| Number of EPDCCH Sets Configured  |          |            | 2 (Note 2)   |
| Number of PRB per EPDCCH Set  |          |            | 4 (1 <sup>st</sup> Set)<br>8 (2 <sup>nd</sup> Set) |
| EPDCCH Subframe Monitoring  |          |            | NA   |
| PDSCH TM  |          |            | TM3  |
| DCI Format  |          |            | 2A   |
| <p>Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured.</p> <p>Note 2: The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured.</p> |          |            |  |

For the parameters specified in Table 8.10.4.1.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.4.1.1-2. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.4.1.1-2: Minimum performance Distributed EPDCCH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55 FDD          | OP.7 FDD     | EVA5                  | 2 x 4 Low                                    | 1               | -0.7     |
| 2           | 10 MHz    | 16 ECCE           | R.56 FDD          | OP.7 FDD     | EVA70                 | 2 x 4 Low                                    | 1               | -5.8     |

#### 8.10.4.1.2 TDD

The parameters specified in Table 8.10.4.1.2-1 are valid for all TDD distributed EPDCCH tests with 4Rx unless otherwise stated.

**Table 8.10.4.1.2-1: Test Parameters for Distributed EPDCCH with 4Rx**

| Parameter                 | Unit       | Value      |    |
|---------------------------|------------|------------|----|
| Number of PDCCH symbols   | symbols    | 2 (Note 1) |    |
| PHICH duration            |            | Normal     |    |
| Unused RE-s and PRB-s     |            | OCNG       |    |
| Cell ID                   |            | 0          |    |
| Downlink power allocation | $\rho_A$   | dB         | -3 |
|                           | $\rho_B$   | dB         | -3 |
|                           | $\sigma$   | dB         | 0  |
|                           | $\delta$   | dB         | 3  |
| $N_{oc}$ at antenna port  | dBm/15 kHz | -98        |    |
| Cyclic prefix             |            | Normal     |    |
| Subframe Configuration    |            | Non-MBSFN  |    |



|                                  |  |                         |
|----------------------------------|--|-------------------------|
| Precoder Update Granularity      | PRB  | 1                       |
|                                  | ms   | 1                       |
| Beamforming Pre-Coder            |  | Annex B.4.4             |
| Cell Specific Reference Signal   |  | Port 0 and 1            |
| Number of EPDCCH Sets Configured |  | 2 (Note 2)              |
| Number of PRB per EPDCCH Set     |  | 4 (1 <sup>st</sup> Set) |
|                                  |  | 8 (2 <sup>nd</sup> Set) |
| EPDCCH Subframe Monitoring       |  | NA                      |
| PDSCH TM                         |  | TM3                     |
| DCI Format                       |  | 2A                      |
| TDD UL/DL Configuration          |  | 0                       |
| TDD Special Subframe             |  | 1 (Note 3)              |
| Note 1:                          | The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling <i>epdcch-StartSymbol-r11</i> is not configured.   |                         |
| Note 2:                          | The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured. |                         |
| Note 3:                          | Demodulation performance is averaged over normal and special subframe.   |                         |

For the parameters specified in Table 8.10.4.1.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.4.1.2-2. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.4.1.2-2: Minimum performance Distributed EPDCCH with 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 ECCE            | R.55 TDD          | OP.7 TDD     | EVA5                  | 2 x 4 Low                                    | 1               | -0.7     |
| 2           | 10 MHz    | 16 ECCE           | R.56 TDD          | OP.7 TDD     | EVA70                 | 2 x 4 Low                                    | 1               | -5.8     |

## 8.10.4.2 Localized Transmission with TM9 and 4Rx

### 8.10.4.2.1 FDD

The parameters specified in Table 8.10.4.2.1-1 are valid for all FDD TM9 localized ePDCCH tests with 4Rx unless otherwise stated.

**Table 8.10.4.2.1-1: Test Parameters for Localized EPDCCH with TM9 and 4Rx**

| Parameter                   | Unit       | Value      |    |
|-----------------------------|------------|------------|----|
| Number of PDCCH symbols     | symbols    | 1 (Note 1) |    |
| EPDCCH starting symbol      | symbols    | 2 (Note 1) |    |
| PHICH duration              |            | Normal     |    |
| Unused RE-s and PRB-s       |            | OCNG       |    |
| Cell ID                     |            | 0          |    |
| Downlink power allocation   | $\rho_A$   | dB         | 0  |
|                             | $\rho_B$   | dB         | 0  |
|                             | $\sigma$   | dB         | -3 |
|                             | $\delta$   | dB         | 0  |
| $N_{oc}$ at antenna port    | dBm/15 kHz | -98        |    |
| Cyclic prefix               |            | Normal     |    |
| Subframe Configuration      |            | Non-MBSFN  |    |
| Precoder Update Granularity | PRB        | 1          |    |
|                             | ms         | 1          |    |

|   |   |   |
|---|---|---|
| Beamforming Pre-Coder   |   | Annex B.4.5   |
| Cell Specific Reference Signal                                      |   | Port 0 and 1  |
| CSI-RS Reference Signal   |   | Port 15 and 16  |
| CSI-RS reference signal resource configuration                      |   | 0   |
| CSI reference signal subframe configuration $I_{\text{CSI-RS}}$     |   | 2   |
| ZP-CSI-RS configuration bitmap                                      |   | 0000010000000000  |
| ZP-CSI-RS subframe configuration $I_{\text{ZP-CSI-RS}}$             |   | 2   |
| Number of EPDCCH Sets   |   | 2 (Note 2)  |
| EPDCCH Subframe Monitoring pattern <i>subframePatternConfig-r11</i> |   | 1111111110 1111111101 1111111011<br>1111110111 (Note 3) |
| PDSCH TM  |   | TM9   |
| Note 1:   | The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . However, CFI is set to 1.  |   |
| Note 2:   | The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests. |   |
| Note 3:   | EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by <i>subframePatternConfig-r11</i> . Legacy PDCCH is not scheduled.                |   |

For the parameters specified in Table 8.10.4.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.4.2.1-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.4.2.1-2: Minimum performance Localized EPDCCH with TM9 and 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 FDD          | OP.7 FDD     | EVA5                  | 2 x 4 Low                                    | 1               | 6.5      |
| 2           | 10 MHz    | 8 ECCE            | R.58 FDD          | OP.7 FDD     | EVA5                  | 2 x 4 Low                                    | 1               | -1.5     |

#### 8.10.4.2.2 TDD

The parameters specified in Table 8.10.4.2.2-1 are valid for all TDD TM9 localized ePDCCH tests unless otherwise stated.

**Table 8.10.4.2.2-1: Test Parameters for Localized EPDCCH with TM9 and 4Rx**

| Parameter                      | Unit       | Value        |    |
|--------------------------------|------------|--------------|----|
| Number of PDCCH symbols        | symbols    | 1 (Note 1)   |    |
| EPDCCH starting symbol         | symbols    | 2 (Note 1)   |    |
| PHICH duration                 |            | Normal       |    |
| Unused RE-s and PRB-s          |            | OCNG         |    |
| Cell ID                        |            | 0            |    |
| Downlink power allocation      | $\rho_A$   | dB           | 0  |
|                                | $\rho_B$   | dB           | 0  |
|                                | $\sigma$   | dB           | -3 |
|                                | $\delta$   | dB           | 0  |
| $N_{oc}$ at antenna port       | dBm/15 kHz | -98          |    |
| Cyclic prefix                  |            | Normal       |    |
| Subframe Configuration         |            | Non-MBSFN    |    |
| Precoder Update Granularity    | PRB        | 1            |    |
|                                | ms         | 1            |    |
| Beamforming Pre-Coder          |            | Annex B.4.5  |    |
| Cell Specific Reference Signal |            | Port 0 and 1 |    |

|   |   |   |
|---|---|---|
| CSI-RS Reference Signal   |   | Port 15 and 16  |
| CSI-RS reference signal resource configuration                      |   | 0   |
| CSI reference signal subframe configuration $l_{\text{CSI-RS}}$     |   | 0   |
| ZP-CSI-RS configuration bitmap                                      |   | 0000010000000000  |
| ZP-CSI-RS subframe configuration $l_{\text{ZP-CSI-RS}}$             |   | 0   |
| Number of EPDCCH Sets   |   | 2 (Note 2)  |
| EPDCCH Subframe Monitoring pattern <i>subframePatternConfig-r11</i> |   | 1100011000 1100010000 1100011000<br>1100001000 1100011000 1000011000<br>1100011000 (Note 3) |
| PDSCH TM  |   | TM9   |
| TDD UL/DL Configuration   |   | 0   |
| TDD Special Subframe  |   | 1 (Note 4)  |
| Note 1:   | The starting symbol for EPDCCH is signalled with <i>epdcch-StartSymbol-r11</i> . However, CFI is set to 1.  |   |
| Note 2:   | The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests. |   |
| Note 3:   | EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by <i>subframePatternConfig-r11</i> . Legacy PDCCH is not scheduled.                |   |
| Note 4:   | Demodulation performance is averaged over normal and special subframe.  |   |

For the parameters specified in Table 8.10.4.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.10.4.2.2-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.10.4.2.2-2: Minimum performance Localized EPDCCH with TM9 and 4Rx Antenna ports**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 2 ECCE            | R.57 TDD          | OP.7 TDD     | EVA5                  | 2 x 4 Low                                    | 1               | 6.0      |
| 2           | 10 MHz    | 8 ECCE            | R.58 TDD          | OP.7 TDD     | EVA5                  | 2 x 4 Low                                    | 1               | -2.1     |

## 8.11 Demodulation (UE supporting coverage enhancement)

The requirements for UE DL Category M1 in this sub-clause are defined based on the simulation results with UE DL Category M1 unless otherwise stated.

The requirements for UE DL Category M2 in this sub-clause are defined based on the simulation results with UE DL Category M2 unless otherwise stated.

The requirements of UE DL Category M1 in this sub-clause are applicable for UE DL Category M2, UE DL Category 1bis and Category 0, as specified in the applicability rule in the sub-clause 8.1.2.8A.

The requirements of UE DL Category M2 in this sub-clause are applicable for UE DL Category 1bis and Category 0, as specified in the applicability rule in the sub-clause 8.1.2.8A.

### 8.11.1 PDSCH

#### 8.11.1.1 FDD and half-duplex FDD (Fixed Reference Channel)

The parameters specified in Table 8.11.1.1-1 are valid for FDD and half-duplex FDD tests unless otherwise stated.

**Table 8.11.1.1-1: Common Test Parameters (FDD and half-duplex FDD)**

| Parameter  | Unit         | CE Mode A  | CE Mode B  |
|--|--------------|--|--|
| Inter-TTI Distance   |              | 1  | 1  |
| Number of HARQ processes per component carrier   | Processes    | 8 or 10 (Note 2)   | 2  |
| Maximum number of HARQ transmission  |              | 4  | 4  |
| Redundancy version coding sequence $r_{vidx}$ (Note 1)   |              | {0, 2, 3, 1} for QPSK and 16QAM  | {0,0,0,0,2,2,2,2,3,3,3,3,1,1,1,1...} for QPSK  |
| Number of OFDM symbols for PDCCH per component carrier   | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths    | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths    |
| Cyclic Prefix  |              | Normal   | Normal   |
| Beamforming Precoder for MPDCCH  |              | Annex B.4.4  | Annex B.4.4  |
| Precoder update granularity for MPDCCH   |              | Frequency domain: 1 PRB<br>Time domain: identical during the hopping period (interval-FDD for CE Mode A) | Frequency domain: 1 PRB<br>Time domain: identical during the hopping period (interval-FDD for CE Mode B) |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)  |              | 1111111111   | 1111111111   |
| Note 1: $r_{vidx}$ is defined in TS 36.213 [6] Table 7.1.7.1-2.<br>Note 2: For UE supporting ce-pdsch-tenProcesses-r13, the number of HARQ processes are set to 10, otherwise, it is set to 8. |              |  |  |

8.11.1.1.1 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

8.11.1.1.1.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.11.1.1.1-2, with the addition of the parameters in Table 8.11.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.11.1.1.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter                            | Unit      | Test 1       |             |
|--------------------------------------|-----------|--------------|-------------|
| Downlink power allocation            | $\rho_A$  | dB           | -3          |
|                                      | $\rho_B$  | dB           | -3 (Note 1) |
|                                      | $\sigma$  | dB           | 0           |
|                                      | $\delta$  | dB           | 3           |
| $N_{oc}$ at antenna port             | dBm/15kHz | -98          |             |
| Precoding granularity                | PRB       | 6            |             |
| PMI delay (Note 2)                   | ms        | 10           |             |
| Reporting interval                   | ms        | 10           |             |
| Reporting mode                       |           | PUCCH 1-1    |             |
| Physical channel for CQI reporting   |           | PUSCH(Note4) |             |
| cqi-pmi-ConfigIndex                  |           | 12           |             |
| CodeBookSubsetRestriction bitmap     |           | 001111       |             |
| PDSCH transmission mode              |           | 6            |             |
| Coverage enhancement mode            |           | CE Mode A    |             |
| OFDM starting symbol (startSymbolBR) |           | 2            |             |

|   |    |          |
|---|----|----------|
| Maximum number of repetitions (mpdcch-NumRepetition)  |    | 1        |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |    | Disabled |
| MPDCCH transmission duration  | ms | 1        |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS)   |    | 1        |
| Narrowband for MPDCCH (mpdcch_Narrowband)   |    | 1        |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), This reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5.</p> <p>Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |    |          |

**Table 8.11.1.1.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth and MCS     | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-------------|-----------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|             |                       |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1           | 10MHz<br>16QAM<br>1/2 | R.79 FDD          | OP.2 FDD     | EPA5                  | 2x1 Low                                      | 70%                                | 8.6      |

#### 8.11.1.1.1.2 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with CRS assistance information

The requirements are specified in Table 8.11.1.1.1.2-2, with the addition of parameters in Table 8.11.1.1.1.2-1. In Table 8.11.1.1.1.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single-layer spatial multiplexing TM6 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.11.1.1.1.2-1: Test Parameters**

| Parameter                 | Unit      | Cell 1 | Cell 2      | Cell 3      |             |
|---------------------------|-----------|--------|-------------|-------------|-------------|
| Downlink power allocation | $\rho_A$  | dB     | -3          | -3          | -3          |
|                           | $\rho_B$  | dB     | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
|                           | $\sigma$  | dB     | 0           | 0           | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98    | N/A         | N/A         |             |
| $\hat{E}_s/N_{oc}$        | dB        | N/A    | 11.75       | 5.69        |             |
| BW <sub>Channel</sub>     | MHz       | 10     | 10          | 10          |             |

|   |        |                   |                              |                              |    |
|---|--------|-------------------|------------------------------|------------------------------|----|
| Cyclic prefix   |        | Normal            | Normal                       | Normal                       |    |
| Subframe Configuration  |        | Non-MBSFN         | Non-MBSFN                    | Non-MBSFN                    |    |
| Cell ID   |        | 0                 | 1                            | 6                            |    |
| Cell-specific reference signals   |        | Antenna ports 0,1 |                              |                              |    |
| Number of control OFDM symbols (CFI)  |        | 2                 | 2                            | 2                            |    |
| PDSCH transmission mode   |        | 6                 | N/A                          | N/A                          |    |
| Coverage enhancement mode   |        | CE Mode A         | N/A                          | N/A                          |    |
| OFDM starting symbol (startSymbolBR)  |        | 2                 | N/A                          | N/A                          |    |
| Maximum number of repetitions (mpdcch-NumRepetition)  |        | 1                 | N/A                          | N/A                          |    |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |        | Disabled          | N/A                          | N/A                          |    |
| MPDCCH transmission duration  | ms     | 1                 | N/A                          | N/A                          |    |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_UESS)  |        | 1                 | N/A                          | N/A                          |    |
| Precoding granularity   | PRB    | 6                 | N/A                          | N/A                          |    |
| PMI delay (Note 2)  | ms     | 10                | N/A                          | N/A                          |    |
| Reporting interval  | ms     | 10                | N/A                          | N/A                          |    |
| Reporting mode  |        | PUCCH 1-1         | N/A                          | N/A                          |    |
| Physical channel for CQI reporting  |        | PUSCH(Note4)      |                              |                              |    |
| CodeBookSubsetRestriction bitmap  |        | 001111            | N/A                          | N/A                          |    |
| Time offset relative to Cell 1  | μs     | N/A               | 3                            | -1                           |    |
| Frequency shift relative to Cell 1  | Hz     | N/A               | 300                          | -100                         |    |
| Interference model  |        | N/A               | As specified in clause B.5.3 | As specified in clause B.5.3 |    |
| Probability of occurrence of transmission in interference cells   | %      | N/A               | 10                           | 10                           |    |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %                 | N/A                          | 80                           | 80 |
|   | Rank 2 | %                 | N/A                          | 20                           | 20 |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF#(n-4). This reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5.</p> |        |                   |                              |                              |    |

Table 8.11.1.1.1.2-2: Minimum performance for PDSCH

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.79 FDD          | OP.1 FDD     | N/A    | N/A    | EPA5                           | EPA5   | EPA5   | 2x1 Low   | 70                                 | 12.5              | M2          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc}</math> of cell 1.</p> |                   |              |        |        |                                |        |        |   |                                    |                   |             |

### 8.11.1.1.1.3 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port with CRS assistance information

The requirements are specified in Table 8.11.1.1.1.3-2, with the addition of parameters in Table 8.11.1.1.1.3-1. In Table 8.11.1.1.1.3-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single-layer spatial multiplexing TM6 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

**Table 8.11.1.1.1.3-1: Test Parameters**

| Parameter   |          | Unit      | Cell 1                | Cell 2                       | Cell 3                       |
|---|----------|-----------|-----------------------|------------------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | -6                    | -6                           | -6                           |
|   | $\rho_B$ | dB        | -6 (Note 1)           | -6 (Note 1)                  | -6 (Note 1)                  |
|   | $\sigma$ | dB        | 3                     | 3                            | 3                            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                   | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$  |          | dB        | N/A                   | 10.45                        | 4.6                          |
| $BW_{Channel}$  |          | MHz       | 10                    | 10                           | 10                           |
| Cyclic prefix   |          |           | Normal                | Normal                       | Normal                       |
| Subframe Configuration  |          |           | Non-MBSFN             | Non-MBSFN                    | Non-MBSFN                    |
| Cell ID   |          |           | 0                     | 1                            | 6                            |
| Cell-specific reference signals                                     |          |           | Antenna ports 0,1,2,3 |                              |                              |
| Number of control OFDM symbols (CFI)                                |          |           | 2                     | 2                            | 2                            |
| PDSCH transmission mode   |          |           | 6                     | N/A                          | N/A                          |
| Coverage enhancement mode   |          |           | CE Mode A             | N/A                          | N/A                          |
| OFDM starting symbol (startSymbolBR)                                |          |           | 2                     | N/A                          | N/A                          |
| Maximum number of repetitions (mpdcch-NumRepetition)                |          |           | 1                     | N/A                          | N/A                          |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)                      |          |           | Disabled              | N/A                          | N/A                          |
| MPDCCH transmission duration  |          | ms        | 1                     | N/A                          | N/A                          |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_UESS)    |          |           | 1                     | N/A                          | N/A                          |
| Precoding granularity   |          | PRB       | 6                     | N/A                          | N/A                          |
| PMI delay (Note 2)  |          | ms        | 10                    | N/A                          | N/A                          |
| Reporting interval  |          | ms        | 10                    | N/A                          | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1             | N/A                          | N/A                          |
| Physical channel for CQI reporting                                  |          |           | PUSCH(Note4)          |                              |                              |
| CodeBookSubsetRestriction bitmap                                    |          |           | 001111                | N/A                          | N/A                          |
| Time offset relative to Cell 1                                      |          | $\mu$ s   | N/A                   | 3                            | -1                           |
| Frequency shift relative to Cell 1                                  |          | Hz        | N/A                   | 300                          | -100                         |
| Interference model  |          |           | N/A                   | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells     |          | %         | N/A                   | 20                           | 20                           |
| Probability of occurrence of transmission rank in interfering cells | Rank 1   | %         | N/A                   | 80                           | 80                           |
|   | Rank 2   | %         | N/A                   | 20                           | 20                           |

Note 1:  $P_B = 1$ .

Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF#(n-4). This reported PMI cannot be applied at the eNB downlink before SF#(n+4).

Note 3: For each test, DC subcarrier puncturing shall be considered.

Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5.

**Table 8.11.1.1.1.3-2: Minimum performance for PDSCH**

| Test Number | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|-------------|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|             |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1           | R.95 FDD          | OP.1 FDD     | N/A    | N/A    | EPA5                           | EPA5   | EPA5   | 4x1 Low   | 70                                 | 11.4              | M2          |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  
 Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.  
 Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of cell 1.

8.11.1.1.2 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

8.11.1.1.2.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a MPDCCH with DCI format 6-1A, the requirements are specified in Table 8.11.1.1.2.1-2 with the addition of the parameters in Table 8.11.1.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8.

**Table 8.11.1.1.2.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer)**

| parameter   | Unit      | Test 1            | Test 2            | Test 3            |
|---|-----------|-------------------|-------------------|-------------------|
| Downlink power allocation   | $\rho_A$  | dB                | 0                 | 0                 |
|   | $\rho_B$  | dB                | 0 (Note 1)        | 0 (Note 1)        |
|   | $\sigma$  | dB                | -3                | -3                |
|   | $\delta$  | dB                | 0                 | 0                 |
| Beamforming model   |           | Annex B.4.1       | Annex B.4.1       | Annex B.4.1       |
| Cell-specific reference signals   |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98 (Note 6)      | -98 (Note 6)      | -98 (Note 6)      |
| Symbols for unused PRBs   |           | OCNG (Note 3)     | OCNG (Note 3)     | OCNG (Note 3)     |
| Number of allocated resource blocks (Note 2)                                | PRB       | 6                 | 6                 | 6                 |
| Simultaneous transmission   |           | No                | No                | No                |
| PDSCH transmission mode   |           | 9                 | 9                 | 9                 |
| Coverage enhancement mode   |           | CE Mode A         | CE Mode A         | CE Mode A         |
| OFDM starting symbol (startSymbolBR)  |           | 2                 | 2                 | 2                 |
| Maximum number of repetitions for PDSCH ( $pdsch-maxNumRepetitionCEmodeA$ ) |           | 16                | 16                | Not configured    |
| PDSCH repetition number   |           | 8                 | 4                 | 2                 |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)                              |           | Enabled           | Enabled           | Enabled           |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)                       |           | 1                 | 1                 | 1                 |



|   |    |    |    |    |
|---|----|----|----|----|
| Frequency hopping interval (interval-FDD)   | ms | 8  | 2  | 1  |
| MPDCCH transmission duration (mpdcch-NumRepetition)   | ms | 8  | 2  | 1  |
| MPDCCH repetition number  |    | 8  | 2  | 1  |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)  |    | 2  | 2  | 2  |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS)   |    | 4  | 8  | 10 |
| Narrowband for MPDCCH (mpdcch_Narrowband)   |    | 7  | 7  | 7  |
| MPDCCH aggregation level  |    | 24 | 24 | 24 |
| Note 1: $P_B = 1$ .   |    |    |    |    |
| Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.  |    |    |    |    |
| Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |    |    |    |    |
| Note 4: For each test, DC subcarrier puncturing shall be considered.  |    |    |    |    |
| Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.   |    |    |    |    |

**Table 8.11.1.1.2.1-2: Minimum performance for CDM-multiplexed DM RS (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10MHz QPSK 1/3    | R.80 FDD          | OP.2 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | -2.0     | M1          |
| 2           | 10MHz QPSK 1/3    | R.80-1 FDD        | OP.2 FDD     | EPA5                  | 2x2 Low                                      | 70                                 | -4.0     | ≥1          |
| 3           | 10MHz QPSK 1/3    | R.80-2 FDD        | OP.2 FDD     | EPA5                  | 2x4 Low                                      | 70                                 | -4.0     | ≥1          |

8.11.1.1.2.2 (Void)

8.11.1.1.2.3 (Void)

8.11.1.1.3 Transmit diversity performance (Cell-Specific Reference Symbols)

8.11.1.1.3.1 Minimum Requirement 2 Tx Antenna Port supporting narrowband transmission

The requirements are specified in Table 8.11.1.1.3.1-2, with the addition of the parameters in Table 8.11.1.1.3.1-1 and Table 8.11.1.1.3.1-1a, and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.11.1.1.3.1-1: Test Parameters for Transmit diversity performance (FRC)**

| Parameter                 | Unit      | Test 1 (Note 3) | Test 2 (Note 3) | Test 2a (Note 3) | Test 3 (Note 3) | Test 4 (Note 3) |
|---------------------------|-----------|-----------------|-----------------|------------------|-----------------|-----------------|
| Downlink power allocation | $\rho_A$  | dB              | -3              | -3               | -3              | -3              |
|                           | $\rho_B$  | dB              | -3 (Note 1)     | -3 (Note 1)      | -3 (Note 1)     | -3 (Note 1)     |
|                           | $\sigma$  | dB              | 0               | 0                | 0               | 0               |
|                           | $\delta$  | dB              | 3               | 3                | 3               | 3               |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98             | -98             | -98              | -98             | -98             |

|  |    |                |                |                |                |                |
|--|----|----------------|----------------|----------------|----------------|----------------|
| Coverage enhancement mode  |    | CE Mode B      | CE Mode A      | CE Mode A      | CE Mode B      | CE Mode B      |
| PDSCH transmission mode  |    | 2              | 2              | 2              | 2              | 2              |
| OFDM starting symbol (startSymbolBR)   |    | 2              | 2              | 2              | 2              | 2              |
| Maximum number of repetitions (for PDSCH ( <i>pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB</i> ))   |    | Not configured | Not configured | Not configured | Not configured | Not configured |
| PDSCH repetition number  |    | 64             | 1              | 1              | 32             | 16             |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)   |    | Enabled        | Disabled       | Disabled       | Enabled        | Enabled        |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)  |    | 1              | N/A            | N/A            | 1              | 1              |
| Frequency hopping interval (interval-FDD)  | ms | 16             | N/A            | N/A            | 8              | 4              |
| MPDCCH transmission duration (mPDCCH-NumRepetition)  | ms | 64             | 1              | 1              | 32             | 8              |
| MPDCCH repetition number   |    | 64             | 1              | 1              | 32             | 8              |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)   |    | 4              | N/A            | N/A            | 4              | 4              |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS)  |    | 2.5            | 1              | 1              | 2.5            | 4              |
| Narrowband for MPDCCH (mpdcch_Narrowband)  |    | 7              | 0              | 0              | 7              | 7              |
| MPDCCH aggregation level   |    | 24             | 8              | 8              | 24             | 24             |
| CRS muting outside UE RF bandwidth (crs-IntfMitigEnabled)  |    | Disabled       | Disabled       | Enabled        | Disabled       | Disabled       |
| Number of PRBs for CRS transmission (crs-IntfMitigNumPRBs)   |    | N/A            | N/A            | 6              | N/A            | N/A            |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 3: Test 1, test 3 and test 4 are applicable for UE supporting CE Mode B. Test 2 is applicable for UE not supporting CE Mode B. Test 2a is applicable for UE not supporting CE Mode B and UE capable of ce-CRS-IntfMitig.</p> <p>Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |    |                |                |                |                |                |

**Table 8.11.1.1.3.1-1a: Test Parameters for Transmit diversity performance (FRC)**

| Parameter                            |          | Unit       | Test 5      | Test 6      |
|--------------------------------------|----------|------------|-------------|-------------|
| Downlink power allocation            | $\rho_A$ | dB         | -3          | -3          |
|                                      | $\rho_B$ | dB         | -3 (Note 1) | -3 (Note 1) |
|                                      | $\sigma$ | dB         | 0           | 0           |
|                                      | $\delta$ | dB         | 3           | 3           |
| $N_{oc}$ at antenna port             |          | dBm/15 kHz | -98         | -98         |
| Coverage enhancement mode            |          |            | CE Mode A   | CE Mode A   |
| PDSCH transmission mode              |          |            | 2           | 2           |
| OFDM starting symbol (startSymbolBR) |          |            | 2           | 2           |

|   |    |                |                |
|---|----|----------------|----------------|
| Maximum number of repetitions (for PDSCH ( <i>pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB</i> ))  |    | Not configured | Not configured |
| PDSCH repetition number   |    | 1              | 1              |
| Frequency hopping ( <i>mpdcch-pdsch-HoppingConfig</i> )   |    | Disabled       | Disabled       |
| Frequency hopping offset ( <i>mpdcch-pdsch-HoppingOffset</i> )  |    | N/A            | N/A            |
| Frequency hopping interval (interval-FDD)   | ms | N/A            | N/A            |
| MPDCCH transmission duration ( <i>mPDCCH-NumRepetition</i> )  | ms | 4              | 1              |
| MPDCCH repetition number  |    | 4              | 1              |
| Number of narrowbands for frequency hopping ( <i>mpdcch-pdsch-HoppingNB</i> )   |    | N/A            | N/A            |
| Starting subframe configuration for MPDCCH ( <i>mpdcch_startSF_UESS</i> )   |    | 1              | 1              |
| Narrowband for MPDCCH ( <i>mpdcch_Narrowband</i> )  |    | 0              | 0              |
| MPDCCH aggregation level  |    | 8              | 8              |
| CRS muting outside UE RF bandwidth ( <i>crs-IntfMitigEnabled</i> )  |    | Disabled       | Disabled       |
| Activation of 64QAM for non-repeated PDSCH in CE Mode A ( <i>ce-PDSCH-64QAM-Config</i> )  |    | Disabled       | Enabled        |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 3: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> <p>Note 4: Test 6 is applicable for UE capable of ce-PDSCH-64QAM.</p> |    |                |                |

Table 8.11.1.1.3.1-2: Minimum performance Transmit Diversity (FRC)

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |           | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|-----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB)  |             |
| 1           | 10MHz QPSK 1/10   | R.81 FDD          | OP.2 FDD     | ETU1                  | 2x1 Low                                      | 70                                 | -<br>13.5 | M1          |
| 2           | 10MHz 16QAM 1/2   | R.79 FDD          | OP.2 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.4       | M1          |
| 2a          | 10MHz 16QAM 1/2   | R.79 FDD          | OP.2 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.6       | M1          |
| 3           | 10MHz QPSK 1/10   | R.81-1 FDD        | OP.2 FDD     | ETU1                  | 2x2 Low                                      | 70                                 | -<br>13.3 | $\geq 1$    |
| 4           | 10MHz QPSK 1/10   | R.81-2 FDD        | OP.2 FDD     | ETU1                  | 2x4 Low                                      | 70                                 | -<br>13.3 | $\geq 1$    |
| 5           | 10MHz QPSK 1/3    | R.103 FDD         | OP.2 FDD     | EPA200                | 2x1 Low                                      | 70                                 | 3.8       | M1          |
| 6           | 10MHz 64QAM 0.4   | R.104 FDD         | OP.2 FDD     | EPA5                  | 2x1 Low                                      | 70                                 | 12.9      | M1          |

## 8.11.1.1.3.2

## Minimum Requirement 2 Tx Antenna Port supporting wideband transmission

The requirements are specified in Table 8.11.1.1.3.2-2, with the addition of the parameters in Table 8.11.1.1.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

Table 8.11.1.1.3.2-1: Test Parameters for Transmit diversity performance (FRC)

| Parameter   |          | Unit           | Test 1         | Test 2         | Test 2a<br>(Note 4) | Test 3         | Test 4         |
|---|----------|----------------|----------------|----------------|---------------------|----------------|----------------|
| Downlink power allocation   | $\rho_A$ | dB             | -3             | -3             | -3                  | -3             | -3             |
|   | $\rho_B$ | dB             | -3 (Note 1)    | -3 (Note 1)    | -3 (Note 1)         | -3 (Note 1)    | -3 (Note 1)    |
|   | $\sigma$ | dB             | 0              | 0              | 0                   | 0              | 0              |
|   | $\delta$ | dB             | 3              | 3              | 3                   | 3              | 3              |
| $N_{oc}$ at antenna port  |          | dBm/15kHz<br>Z | -98            | -98            | -98                 | -98            | -98            |
| Coverage enhancement mode   |          |                | CE Mode A      | CE Mode B      | CE Mode B           | CE Mode A      | CE Mode A      |
| PDSCH transmission mode   |          |                | 2              | 2              | 2                   | 2              | 2              |
| OFDM starting symbol (startSymbolBR)  |          |                | 2              | 2              | 2                   | 2              | 2              |
| Maximum number of repetitions for PDSCH (pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB)                               |          |                | Not configured | Not configured | Not configured      | Not configured | Not configured |
| PDSCH repetition number   |          |                | 8              | 32             | 32                  | 4              | 2              |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |          |                | Enabled        | Enabled        | Enabled             | Disabled       | Disabled       |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)   |          |                | 5              | 5              | 5                   | N/A            | N/A            |
| Frequency hopping interval (interval-FDD)   |          | ms             | 4              | 16             | 16                  | N/A            | N/A            |
| Maximum number of MPDCCH repetitions (mpdcch-NumRepetition)   |          |                | 16             | 64             | 64                  | 8              | 2              |
| MPDCCH transmission duration  |          | ms             | 16             | 64             | 64                  | 8              | 2              |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)  |          |                | 2              | 2              | 2                   | N/A            | N/A            |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS)   |          |                | 2              | 2              | 2                   | 2.5            | 5              |
| Narrowband for MPDCCH (mpdcch_Narrowband)   |          |                | 0              | 0              | 0                   | 0              | 0              |
| MPDCCH aggregation level  |          |                | 24             | 24             | 24                  | 24             | 24             |
| CRS muting outside UE RF bandwidth (crs-IntfMitigEnabled)   |          |                | Disabled       | Disabled       | Enabled             | Disabled       | Disabled       |
| Number of PRBs for CRS transmission (crs-IntfMitigNumPRBs)  |          |                | N/A            | N/A            | 24                  | N/A            | N/A            |
| Note 1: $P_B = 1$ .   |          |                |                |                |                     |                |                |
| Note 2: For each test, DC subcarrier puncturing shall be considered.  |          |                |                |                |                     |                |                |
| Note 3: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. |          |                |                |                |                     |                |                |
| Note 4: Test 2a is applicable for UE supporting CE Mode B and UE capable of ce-CRS-IntfMitig.                                       |          |                |                |                |                     |                |                |

Table 8.11.1.1.3.2-2: Minimum performance Transmit Diversity (FRC)

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |

|    |                 |            |          |      |         |    |       |    |
|----|-----------------|------------|----------|------|---------|----|-------|----|
| 1  | 10MHz QPSK 1/3  | R.90 FDD   | OP.2 FDD | EPA5 | 2x1 Low | 70 | -5.4  | M2 |
| 2  | 10MHz QPSK 1/10 | R.91 FDD   | OP.2 FDD | ETU1 | 2x1 Low | 70 | -13.1 | M2 |
| 2a | 10MHz QPSK 1/10 | R.91 FDD   | OP.2 FDD | ETU1 | 2x1 Low | 70 | -12.9 | M2 |
| 3  | 10MHz QPSK 1/2  | R.92-1 FDD | OP.2 FDD | EPA5 | 2x2 Low | 70 | -4.8  | ≥1 |
| 4  | 10MHz QPSK 1/2  | R.92-2 FDD | OP.2 FDD | EPA5 | 2x4 Low | 70 | -4.9  | ≥1 |

8.11.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.11.1.2-1 are valid for all TDD tests unless otherwise stated.

Table 8.11.1.2-1: Common Test Parameters (TDD)

| Parameter  | Unit         | CE Mode A | CE Mode B  |
|--|--------------|-----------|--|
| Uplink downlink configuration (Note 1)   |              |           | 1  |
| Special subframe configuration (Note 2)  |              |           | 4  |
| Cyclic prefix  |              |           | Normal   |
| Cell ID  |              |           | 0  |
| Inter-TTI Distance   |              |           | 1  |
| Number of HARQ processes per component carrier   | Processes    |           | 7  |
| Maximum number of HARQ transmission  |              |           | 4  |
| Redundancy version coding sequence $r_{v_{idx}}$ (Note 3)  |              |           | {0, 2, 3, 1} for QPSK and 16QAM  |
| Number of OFDM symbols for PDCCH per component carrier   | OFDM symbols |           | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths    |
| ACK/NACK feedback mode   |              |           | Multiplexing   |
| Beamforming Precoder for MPDCCH  |              |           | Annex B.4.4  |
| Precoder update granularity for MPDCCH   |              |           | Frequency domain: 1 PRB<br>Time domain: identical during the hopping period (interval-TDD for CE Mode A) |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)  |              |           | 1011110111   |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4].<br>Note 3: $r_{v_{idx}}$ is defined in TS 36.213 [6] Table 7.1.7.1-2. |              |           |  |

## 8.11.1.2.1 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

## 8.11.1.2.1.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.11.1.2.1.1-2, with the addition of the parameters in Table 8.11.1.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.11.1.2.1.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter   | Unit      | Test 1         |             |
|---|-----------|----------------|-------------|
| Downlink power allocation   | $\rho_A$  | dB             | -3          |
|   | $\rho_B$  | dB             | -3 (Note 1) |
|   | $\sigma$  | dB             | 0           |
|   | $\delta$  | dB             | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98            |             |
| Precoding granularity   | PRB       | 6              |             |
| PMI delay (Note 2)  | ms        | 10 or 11       |             |
| Reporting interval  | ms        | 5              |             |
| Reporting mode  |           | PUCCH 1-1      |             |
| cqi-pmi-ConfigIndex   |           | 4              |             |
| CodeBookSubsetRestriction bitmap  |           | 001111         |             |
| ACK/NACK feedback mode  |           | Multiplexing   |             |
| Physical channel for CQI reporting  |           | PUSCH (Note 3) |             |
| PDSCH transmission mode   |           | 6              |             |
| Coverage enhancement mode   |           | CE Mode A      |             |
| OFDM starting symbol (startSymbolBR)  |           | 2              |             |
| Maximum number of repetitions (mpdcch-NumRepetition)  |           | 1              |             |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |           | Disabled       |             |
| MPDCCH transmission duration  | ms        | 1              |             |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS)   |           | 1              |             |
| Narrowband for MPDCCH (mpdcch_Narrowband)   |           | 1              |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.<br>Note 4: For each test, DC subcarrier puncturing shall be considered.<br>Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. |           |                |             |

**Table 8.11.1.2.1-1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth and MCS     | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          |
|-------------|-----------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|
|             |                       |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1           | 10MHz<br>16QAM<br>1/2 | R.79 TDD          | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70%                                | 11.4     |

#### 8.11.1.2.1.2 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with CRS assistance information

The requirements are specified in Table 8.11.1.2.1.2-2, with the addition of parameters in Table 8.11.1.2.1.2-1. In Table 8.11.1.2.1.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single-layer spatial multiplexing TM6 performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.11.1.2.1.2-1: Test Parameters**

| Parameter   | Unit      | Cell 1 (Option 1) | Cell 2      | Cell 3      |
|---|-----------|-------------------|-------------|-------------|
| Uplink downlink Configuration                                     |           | 1                 | 1           | 1           |
| Special subframe configuration                                    |           | 4                 | 4           | 4           |
| Downlink power allocation   | $\rho_A$  | dB                | -3          | -3          |
|   | $\rho_B$  | dB                | -3 (Note 1) | -3 (Note 1) |
|   | $\sigma$  | dB                | 0           | 0           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98               | N/A         | N/A         |
| $\hat{E}_s/N_{oc}$  | dB        | N/A               | 11.75       | 5.69        |
| $BW_{Channel}$  | MHz       | 10                | 10          | 10          |
| Cyclic prefix   |           | Normal            | Normal      | Normal      |
| Subframe Configuration  |           | Non-MBSFN         | Non-MBSFN   | Non-MBSFN   |
| Cell ID   |           | 0                 | 1           | 6           |
| Cell-specific reference signals                                   |           | Antenna ports 0,1 |             |             |
| Number of control OFDM symbols (CFI)                              |           | 2                 | 2           | 2           |
| PDSCH transmission mode   |           | 6                 | N/A         | N/A         |
| Coverage enhancement mode   |           | CE Mode A         | N/A         | N/A         |
| OFDM starting symbol (startSymbolBR)                              |           | 2                 | N/A         | N/A         |
| Maximum number of repetitions (mpdcch-NumRepetition)              |           | 1                 | N/A         | N/A         |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)                    |           | Disabled          | N/A         | N/A         |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)             |           | N/A               | N/A         | N/A         |
| Frequency hopping interval (interval-TDD)                         | ms        | N/A               | N/A         | N/A         |
| MPDCCH transmission duration                                      | ms        | 1                 | N/A         | N/A         |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_U ESS) |           | 1                 | N/A         | N/A         |
| Precoding granularity   | PRB       | 6                 | N/A         | N/A         |
| PMI delay (Note 2)  | ms        | 10 or 11          | N/A         | N/A         |
| Reporting interval  | ms        | 5                 | N/A         | N/A         |
| Reporting mode  |           | PUCCH 1-1         | N/A         | N/A         |

|   |        |               |              |                              |                              |
|---|--------|---------------|--------------|------------------------------|------------------------------|
| Physical channel for CQI reporting  |        |               | PUSCH(Note4) |                              |                              |
| CodeBookSubsetRestriction bitmap  |        |               | 001111       | N/A                          | N/A                          |
| Time Offset relative to Cell 1  |        | $\mu\text{s}$ | N/A          | 3                            | -1                           |
| Frequency shift relative to Cell 1  |        | Hz            | N/A          | 300                          | -100                         |
| Interference model  |        |               | N/A          | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission in interference cells   |        | %             | N/A          | 10                           | 10                           |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %             | N/A          | 80                           | 80                           |
|   | Rank 2 | %             | N/A          | 20                           | 20                           |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF #(n-4). This reported PMI cannot be applied at the eNB downlink before SF #(n+4).</p> <p>Note 3: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |               |              |                              |                              |

**Table 8.11.1.2.1.2-2: Minimum performance for PDSCH**

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.79 TDD          | OP.1 TDD     | N/A    | N/A    | EPA5                           | EPA5   | EPA5   | 2x1 Low   | 70                                 | 11.5              | M2          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc}</math> of cell 1.</p> |                   |              |        |        |                                |        |        |   |                                    |                   |             |

**8.11.1.2.1.3 Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port with CRS assistance information**

The requirements are specified in Table 8.11.1.2.1.3-2, with the addition of parameters in Table 8.11.1.2.1.3-1. In Table 8.11.1.2.1.3-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the closed loop single-layer spatial multiplexing TM6 performance under assumption that UE applies CRS interference mitigation in the scenario with 4 CRS antenna ports in the serving and aggressor cells.

**Table 8.11.1.2.1.3-1: Test Parameters**

| Parameter                      | Unit      | Cell 1 | Cell 2      | Cell 3      |
|--------------------------------|-----------|--------|-------------|-------------|
| Uplink downlink Configuration  |           | 1      | 1           | 1           |
| Special subframe configuration |           | 4      | 4           | 4           |
| Downlink power allocation      | $\rho_A$  | dB     | -6          | -6          |
|                                | $\rho_B$  | dB     | -6 (Note 1) | -6 (Note 1) |
|                                | $\sigma$  | dB     | 3           | 3           |
| $N_{oc}$ at antenna port       | dBm/15kHz | -98    | N/A         | N/A         |



|   |        |                       |                              |                              |    |
|---|--------|-----------------------|------------------------------|------------------------------|----|
| $\hat{E}_s/N_{oc}$  | dB     | N/A                   | 10.45                        | 4.6                          |    |
| BW <sub>Channel</sub>   | MHz    | 10                    | 10                           | 10                           |    |
| Cyclic prefix   |        | Normal                | Normal                       | Normal                       |    |
| Subframe Configuration  |        | Non-MBSFN             | Non-MBSFN                    | Non-MBSFN                    |    |
| Cell ID   |        | 0                     | 1                            | 6                            |    |
| Cell-specific reference signals   |        | Antenna ports 0,1,2,3 |                              |                              |    |
| Number of control OFDM symbols (CFI)  |        | 2                     | 2                            | 2                            |    |
| PDSCH transmission mode   |        | 6                     | N/A                          | N/A                          |    |
| Coverage enhancement mode   |        | CE Mode A             | N/A                          | N/A                          |    |
| OFDM starting symbol (startSymbolBR)  |        | 2                     | N/A                          | N/A                          |    |
| Maximum number of repetitions (mpdcch-NumRepetition)  |        | 1                     | N/A                          | N/A                          |    |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |        | Disabled              | N/A                          | N/A                          |    |
| MPDCCH transmission duration  | ms     | 1                     | N/A                          | N/A                          |    |
| Starting subframe configuration for MPDCCH (mpdcch_startSF_UESS)  |        | 1                     | N/A                          | N/A                          |    |
| Precoding granularity   | PRB    | 6                     | N/A                          | N/A                          |    |
| PMI delay (Note 2)  | ms     | 10 or 11              | N/A                          | N/A                          |    |
| Reporting interval  | ms     | 5                     | N/A                          | N/A                          |    |
| Reporting mode  |        | PUCCH 1-1             | N/A                          | N/A                          |    |
| Physical channel for CQI reporting  |        | PUSCH(Note4)          |                              |                              |    |
| CodeBookSubsetRestriction bitmap  |        | 001111                | N/A                          | N/A                          |    |
| Time Offset relative to Cell 1  | μs     | N/A                   | 3                            | -1                           |    |
| Frequency shift relative to Cell 1  | Hz     | N/A                   | 300                          | -100                         |    |
| Interference model  |        | N/A                   | As specified in clause B.5.3 | As specified in clause B.5.3 |    |
| Probability of occurrence of transmission in interference cells   | %      | N/A                   | 20                           | 20                           |    |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1 | %                     | N/A                          | 80                           | 80 |
|   | Rank 2 | %                     | N/A                          | 20                           | 20 |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF #n based on PMI estimation at a downlink SF not later than SF#(n-4). This reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQACK on PUSCH in uplink subframe SF#8 and #3.</p> |        |                       |                              |                              |    |

Table 8.11.1.2.1.3-2: Minimum performance for PDSCH

| Test Number  | Reference Channel | OCNG Pattern |        |        | Propagation Conditions (Note1) |        |        | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value                    |                   | UE Category |
|--|-------------------|--------------|--------|--------|--------------------------------|--------|--------|---|------------------------------------|-------------------|-------------|
|  |                   | Cell 1       | Cell 2 | Cell 3 | Cell 1                         | Cell 2 | Cell 3 |   | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) |             |
| 1  | R.95 TDD          | OP.1 TDD     | N/A    | N/A    | EPA5                           | EPA5   | EPA5   | 4x1 Low   | 70                                 | 11.1              | M2          |
| <p>Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.</p> <p>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.</p> <p>Note 3: SNR corresponds to <math>\hat{E}_s/N_{oc}</math> of cell 1.</p> |                   |              |        |        |                                |        |        |   |                                    |                   |             |

## 8.11.1.2.2 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

## 8.11.1.2.2.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 6-1A, the requirements are specified in Table 8.11.1.2.2.1-2 with the addition of the parameters in Table 8.11.1.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8.

**Table 8.11.1.2.2.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer)**

| Parameter   |          | Unit      | Test 1            | Test 2            | Test 3            |
|---|----------|-----------|-------------------|-------------------|-------------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0                 | 0                 | 0                 |
|   | $\rho_B$ | dB        | 0 (Note 1)        | 0 (Note 1)        | 0 (Note 1)        |
|   | $\sigma$ | dB        | -3                | -3                | -3                |
|   | $\delta$ | dB        | 0                 | 0                 | 0                 |
| Cell-specific reference signals   |          |           | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| Beamforming model   |          |           | Annex B.4.1       | Annex B.4.1       | Annex B.4.1       |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98               | -98               | -98               |
| Symbols for unused PRBs   |          |           | OCNG (Note 3)     | OCNG (Note 3)     | OCNG (Note 3)     |
| Number of allocated resource blocks (Note 2)  |          | PRB       | 6                 | 6                 | 6                 |
| Simultaneous transmission   |          |           | No                | No                | No                |
| PDSCH transmission mode   |          |           | 9                 | 9                 | 9                 |
| Coverage enhancement mode   |          |           | CE Mode A         | CE Mode A         | CE Mode A         |
| OFDM starting symbol (startSymbolBR)  |          |           | 2                 | 2                 | 2                 |
| Maximum number of repetitions for PDSCH ( <i>pdsch-maxNumRepetitionCEmodeA</i> )  |          |           | Not configured    | Not configured    | Not configured    |
| Frequency hopping ( <i>mpdcch-pdsch-HoppingConfig</i> )   |          |           | Enabled           | Enabled           | Enabled           |
| PDSCH repetition number   |          |           | 8                 | 4                 | 2                 |
| Frequency hopping offset ( <i>mpdcch-pdsch-HoppingOffset</i> )  |          |           | 1                 | 1                 | 1                 |
| Frequency hopping interval ( <i>interval-TDD</i> )  |          | ms        | 10                | 1                 | 1                 |
| MPDCCH transmission duration ( <i>mPDCCH-NumRepetition</i> )  |          | ms        | 8                 | 2                 | 1                 |
| MPDCCH repetition number  |          |           | 8                 | 2                 | 1                 |
| Number of narrowbands for frequency hopping ( <i>mpdcch-pdsch-HoppingNB</i> )   |          |           | 2                 | 2                 | 2                 |
| Starting subframe configuration for MPDCCH ( <i>mpdcch_startSF_U ESS</i> )  |          |           | 10                | 20                | 20                |
| Narrowband for MPDCCH ( <i>mpdcch_Narrowband</i> )  |          |           | 7                 | 7                 | 7                 |
| MPDCCH aggregation level  |          |           | 24                | 24                | 24                |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.</p> <p>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 4: For each test, DC subcarrier puncturing shall be considered.</p> |          |           |                   |                   |                   |

Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.

**Table 8.11.1.2.2.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10MHz QPSK 1/3    | R.80 TDD          | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | -2.5     | M1          |
| 2           | 10MHz QPSK 1/3    | R.80-1 TDD        | OP.2 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | -3.6     | ≥1          |
| 3           | 10MHz QPSK 1/3    | R.80-2 TDD        | OP.2 TDD     | EPA5                  | 2x4 Low                                      | 70                                 | -3.7     | ≥1          |

### 8.11.1.2.3 Transmit diversity performance (Cell-Specific Reference Symbols)

#### 8.11.1.2.3.1 Minimum Requirement 2 Tx Antenna Port supporting narrowband transmission

The requirements are specified in Table 8.11.1.2.3.1-2, with the addition of the parameters in Table 8.11.1.2.3.1-1 and Table 8.11.1.2.3.1-1a, and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.11.1.2.3.1-1: Test Parameters for Transmit diversity performance (FRC)**

| Parameter   | Unit           | Test 1 (Note 3)  | Test 2 (Note 3)  | Test 2a (Note 3) | Test 3 (Note 3)  | Test 4 (Note 3)  |
|---|----------------|------------------|------------------|------------------|------------------|------------------|
| Downlink power allocation   | $\rho_A$       | dB               | -3               | -3               | -3               | -3               |
|   | $\rho_B$       | dB               | -3 (Note 1)      | -3 (Note 1)      | -3 (Note 1)      | -3 (Note 1)      |
|   | $\sigma$       | dB               | 0                | 0                | 0                | 0                |
|   | $\delta$       | dB               | 3                | 3                | 3                | 3                |
| $N_{oc}$ at antenna port  | dBm/15kHz<br>z | -98              | -98              | -98              | -98              | -98              |
| ACK/NACK feedback mode  |                | Multiplexin<br>g | Multiplexin<br>g | Multiplexin<br>g | Multiplexin<br>g | Multiplexin<br>g |
| PDSCH transmission mode   |                | 2                | 2                | 2                | 2                | 2                |
| Coverage enhancement mode   |                | CE Mode B        | CE Mode A        | CE Mode A        | CE Mode B        | CE Mode B        |
| PDSCH transmission mode   |                | 2                | 2                | 2                | 2                | 2                |
| OFDM starting symbol (startSymbolBR)  |                | 2                | 2                | 2                | 2                | 2                |
| Maximum number of repetitions (for PDSCH ( $pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB$ )) |                | Not configured   | Not configured   | Not configured   | Not configured   | Not configured   |
| PDSCH repetition number   |                | 64               | 1                | 1                | 32               | 16               |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |                | Enabled          | Disabled         | Disabled         | Enabled          | Enabled          |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)   |                | 1                | N/A              | N/A              | 1                | 1                |
| Frequency hopping interval (interval-TDD)   | ms             | 20               | N/A              | N/A              | 20               | 10               |
| MPDCCH transmission duration (mPDCCH-NumRepetition)   | ms             | 64               | 1                | 1                | 32               | 8                |

|  |  |          |          |         |          |          |
|--|--|----------|----------|---------|----------|----------|
| MPDCCH repetition number   |  | 64       | 1        | 1       | 32       | 8        |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)   |  | 4        | N/A      | N/A     | 4        | 4        |
| Starting subframe configuration for MPDCCH (mpdcch-startSF-U ESS)  |  | 8        | 1        | 1       | 8        | 10       |
| Narrowband for MPDCCH (mpdcch_Narrowband)  |  | 7        | 0        | 0       | 7        | 7        |
| MPDCCH aggregation level   |  | 24       | 8        | 8       | 24       | 24       |
| CRS muting outside UE RF bandwidth (crs-IntfMitigEnabled)  |  | Disabled | Disabled | Enabled | Disabled | Disabled |
| Number of PRBs for CRS transmission (crs-IntfMitigNumPRBs)   |  | N/A      | N/A      | 6       | N/A      | N/A      |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 3: Test 1, test 3 and test 4 are applicable for UE supporting CE Mode B. Test 2 is applicable for UE not supporting CE Mode B. Test 2a is applicable for UE not supporting CE Mode B and UE capable of ce-CRS-IntfMitig.</p> <p>Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |  |          |          |         |          |          |

**Table 8.11.1.2.3.1-1a: Test Parameters for Transmit diversity performance (FRC)**

| Parameter   |          | Unit      | Test 5         | Test 6         |
|---|----------|-----------|----------------|----------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3             | -3             |
|   | $\rho_B$ | dB        | -3 (Note 1)    | -3 (Note 1)    |
|   | $\sigma$ | dB        | 0              | 0              |
|   | $\delta$ | dB        | 3              | 3              |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98            | -98            |
| ACK/NACK feedback mode  |          |           | Multiplexing   | Multiplexing   |
| PDSCH transmission mode   |          |           | 2              | 2              |
| Coverage enhancement mode   |          |           | CE Mode A      | CE Mode A      |
| PDSCH transmission mode   |          |           | 2              | 2              |
| OFDM starting symbol (startSymbolBR)  |          |           | 2              | 2              |
| Maximum number of repetitions (for PDSCH ( $pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB$ )) |          |           | Not configured | Not configured |
| PDSCH repetition number   |          |           | 1              | 1              |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |          |           | Disabled       | Disabled       |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)   |          |           | N/A            | N/A            |
| Frequency hopping interval (interval-TDD)   |          | ms        | N/A            | N/A            |
| MPDCCH transmission duration (mPDCCH-NumRepetition)   |          | ms        | 4              | 1              |
| MPDCCH repetition number  |          |           | 4              | 1              |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)  |          |           | N/A            | N/A            |
| Starting subframe configuration for MPDCCH (mpdcch-startSF-U ESS)   |          |           | 1              | 1              |
| Narrowband for MPDCCH (mpdcch_Narrowband)   |          |           | 0              | 0              |
| MPDCCH aggregation level  |          |           | 8              | 8              |
| CRS muting outside UE RF bandwidth (crs-IntfMitigEnabled)   |          |           | Disabled       | Disabled       |

|  |  |          |         |
|--|--|----------|---------|
| Activation of 64QAM for non-repeated PDSCH in CE Mode A (ce-PDSCH-64QAM-Config)  |  | Disabled | Enabled |
| Note 1: $P_B = 1$ .<br>Note 2: For each test, DC subcarrier puncturing shall be considered.<br>Note 3: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.<br>Note 4: Test 6 is applicable for UE capable of ce-PDSCH-64QAM. |  |          |         |

Table 8.11.1.2.3.1-2: Minimum performance Transmit Diversity (FRC)

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10MHz QPSK 1/10   | R.81 TDD          | OP.2 TDD     | ETU1                  | 2x1 Low                                      | 70                                 | -14.0    | M1          |
| 2           | 10MHz 16QAM 1/2   | R.79 TDD          | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.6      | M1          |
| 2a          | 10MHz 16QAM 1/2   | R.79 TDD          | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 9.8      | M1          |
| 3           | 10MHz QPSK 1/10   | R.81-1 TDD        | OP.2 TDD     | ETU1                  | 2x2 Low                                      | 70                                 | -13.3    | $\geq 1$    |
| 4           | 10MHz QPSK 1/10   | R.81-2 TDD        | OP.2 TDD     | ETU1                  | 2x4 Low                                      | 70                                 | -13.3    | $\geq 1$    |
| 5           | 10MHz QPSK 1/3    | R.103 TDD         | OP.2 TDD     | EPA200                | 2x1 Low                                      | 70                                 | 3.5      | M1          |
| 6           | 10MHz 64QAM 0.4   | R.104 TDD         | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | 13.5     | M1          |

## 8.11.1.2.3.2 Minimum Requirement 2 Tx Antenna Port supporting wideband transmission

The requirements are specified in Table 8.11.1.2.3.2-2, with the addition of the parameters in Table 8.11.1.2.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

Table 8.11.1.2.3.2-1: Test Parameters for Transmit diversity performance (FRC)

| Parameter   |          | Unit      | Test 1         | Test 2         | Test 2a (Note 4) | Test 3         | Test 4         |
|---|----------|-----------|----------------|----------------|------------------|----------------|----------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3             | -3             | -3               | -3             | -3             |
|   | $\rho_B$ | dB        | -3 (Note 1)    | -3 (Note 1)    | -3 (Note 1)      | -3 (Note 1)    | -3 (Note 1)    |
|   | $\sigma$ | dB        | 0              | 0              | 0                | 0              | 0              |
|   | $\delta$ | dB        | 3              | 3              | 3                | 3              | 3              |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98            | -98            | -98              | -98            | -98            |
| ACK/NACK feedback mode  |          |           | Multiplexing   | Multiplexing   | Multiplexing     | Multiplexing   | Multiplexing   |
| PDSCH transmission mode   |          |           | 2              | 2              | 2                | 2              | 2              |
| Coverage enhancement mode   |          |           | CE Mode A      | CE Mode B      | CE Mode B        | CE Mode A      | CE Mode A      |
| OFDM starting symbol (startSymbolBR)  |          |           | 2              | 2              | 2                | 2              | 2              |
| Maximum number of repetitions for PDSCH (pdsch-maxNumRepetitionCEmodeA/pdsch-maxNumRepetitionCEmodeB) |          |           | Not configured | Not configured | Not configured   | Not configured | Not configured |
| PDSCH repetition number   |          |           | 8              | 32             | 32               | 4              | 2              |
| Frequency hopping (mpdcch-pdsch-HoppingConfig)  |          |           | Enabled        | Enabled        | Enabled          | Disabled       | Disabled       |
| Frequency hopping offset (mpdcch-pdsch-HoppingOffset)   |          |           | 5              | 5              | 5                | N/A            | N/A            |

|  |    |          |          |         |          |          |
|--|----|----------|----------|---------|----------|----------|
| Frequency hopping interval (interval-TDD)                            | ms | 5        | 20       | 20      | N/A      | N/A      |
| Maximum number of repetitions (mpdcch-NumRepetition)                 |    | 16       | 32       | 32      | 4        | 2        |
| MPDCCH transmission duration   | ms | 16       | 32       | 32      | 4        | 2        |
| Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB) |    | 2        | 2        | 2       | N/A      | N/A      |
| Starting subframe configuration for MPDCCH (mpdcch-startSF-U ESS)    |    | 5        | 8        | 8       | 8        | 10       |
| Narrowband for MPDCCH (mpdcch_Narrowband)                            |    | 0        | 0        | 0       | 0        | 0        |
| MPDCCH aggregation level   |    | 24       | 24       | 24      | 24       | 24       |
| CRS muting outside UE RF bandwidth (crs-IntfMitigEnabled)            |    | Disabled | Disabled | Enabled | Disabled | Disabled |
| Number of PRBs for CRS transmission (crs-IntfMitigNumPRBs)           |    | N/A      | N/A      | 24      | N/A      | N/A      |

Note 1:  $P_b = 1$ .

Note 2: For each test, DC subcarrier puncturing shall be considered.

Note 3: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.

Note 4: Test 2a is applicable for UE supporting CE Mode B and UE capable of ce-CRS-IntfMitig.

**Table 8.11.1.2.3.2-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                   |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10MHz QPSK 1/3    | R.90 TDD          | OP.2 TDD     | EPA5                  | 2x1 Low                                      | 70                                 | -5.6     | M2          |
| 2           | 10MHz QPSK 1/10   | R.91 TDD          | OP.2 TDD     | ETU1                  | 2x1 Low                                      | 70                                 | -13.6    | M2          |
| 2a          | 10MHz QPSK 1/10   | R.91 TDD          | OP.2 TDD     | ETU1                  | 2x1 Low                                      | 70                                 | -13.4    | M2          |
| 3           | 10MHz QPSK 1/2    | R.92-1 TDD        | OP.2 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | -4.9     | $\geq 1$    |
| 4           | 10MHz QPSK 1/2    | R.92-2 TDD        | OP.2 TDD     | EPA5                  | 2x4 Low                                      | 70                                 | -5.0     | $\geq 1$    |

## 8.11.2 MPDCCH

The receiver characteristics of the MPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (P<sub>m-dsg</sub>).

### 8.11.2.1 FDD and half-duplex FDD

**Table 8.11.2.1-1: Test Parameters for MPDCCH (Category M1)**

| Parameter                            |          | Unit    | CE Mode A (Test 1) | CE Mode B (Test 1) |
|--------------------------------------|----------|---------|--------------------|--------------------|
| OFDM starting symbol (startSymbolLC) |          | symbols | 2                  | 2                  |
| Unused RE-s and PRB-s                |          |         | OCNG               | OCNG               |
| Cell ID                              |          |         | 0                  | 0                  |
| Downlink power allocation            | $\rho_A$ | dB      | -3                 | 0                  |
|                                      | $\rho_B$ | dB      | -3                 | 0                  |
|                                      | $\sigma$ | dB      | 0                  | -3                 |
|                                      | $\delta$ | dB      | 3                  | 0                  |

|  |            |              |              |
|--|------------|--------------|--------------|
| $N_{oc}$ at antenna port   | dBm/15 kHz | -98          | -98          |
| Cyclic prefix  |            | Normal       | Normal       |
| Subframe Configuration   |            | Non-MBSFN    | Non-MBSFN    |
| Precoder Update Granularity  | PRB        | 1            | 1            |
|  | ms         | 4 (Note 2)   | 16 (Note 2)  |
| Beamforming Pre-Coder  |            | Annex B.4.4  | Annex B.4.4  |
| Cell Specific Reference Signal   |            | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set   |            | 4            | 2+4          |
| Transmission type  |            | Distributed  | Localized    |
| Frequency hopping  |            | Disabled     | Enabled      |
| Number of frequency hopping narrowbands  |            | N/A          | 4            |
| Frequency hopping offset   |            | N/A          | 1            |
| Frequency hopping interval   | ms         | N/A          | 16           |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-U ESS</i> ) (Note 3)   |            | 1.5          | 1.5          |
| Maximum number of repetitions ( <i>mpdcch-NumRepetition</i> )  |            | 32           | 64           |
| MPDCCH repetition number   |            | 32           | 64           |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )   |            | 1            | 7            |
| PDSCH TM   |            | TM2          | TM2          |
| DCI Format   |            | 6-1A         | 6-1B         |
| fdd-DownlinkOrTddSubframeBitmapBR  |            | 1111111111   | 1111111111   |
| <p>Note1: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.</p> <p>Note 3: For MPDCCH UE-specific search space the formula for the start subframe <math>k_0</math> is given in TS 36.213 [6] clause 9.1.5.</p> <p>Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |            |              |              |

**Table 8.11.2.1-2: Test Parameters for MPDCCH (Category ≥1)**

| Parameter   |          | Unit      | CE Mode A (Test 2) | CE Mode A (Test 3) | CE Mode B (Test 2) | CE Mode B (Test 3) |
|---|----------|-----------|--------------------|--------------------|--------------------|--------------------|
| OFDM starting symbol (startSymbolLC)  |          | symbols   | 2                  | 2                  | 2                  | 2                  |
| Unused RE-s and PRB-s   |          |           | OCNG               | OCNG               | OCNG               | OCNG               |
| Cell ID   |          |           | 0                  | 0                  | 0                  | 0                  |
| Downlink power allocation   | $\rho_A$ | dB        | -3                 | 0                  | 0                  | 0                  |
|   | $\rho_B$ | dB        | -3                 | 0                  | 0                  | 0                  |
|   | $\sigma$ | dB        | 0                  | -3                 | -3                 | -3                 |
|   | $\delta$ | dB        | 3                  | 0                  | 0                  | 0                  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                | -98                | -98                | -98                |
| Cyclic prefix   |          |           | Normal             | Normal             | Normal             | Normal             |
| Subframe Configuration  |          |           | Non-MBSFN          | Non-MBSFN          | Non-MBSFN          | Non-MBSFN          |
| Precoder Update Granularity   | PRB      |           | 1                  | 1                  | 1                  | 1                  |
|   | ms       |           | 4(Note 2)          | 4(Note 2)          | 16 (Note 2)        | 16 (Note 2)        |
| Beamforming Pre-Coder   |          |           | Annex B.4.4        | Annex B.4.4        | Annex B.4.4        | Annex B.4.4        |
| Cell Specific Reference Signal  |          |           | Port 0 and 1       | Port 0 and 1       | Port 0 and 1       | Port 0 and 1       |
| Number of PRB per MPDCCH Set  |          |           | 4                  | 4                  | 2+4                | 2+4                |
| Transmission type   |          |           | Distributed        | Distributed        | Localized          | Localized          |
| Frequency hopping   |          |           | Disabled           | Disabled           | Enabled            | Enabled            |
| Number of frequency hopping narrowbands   |          |           | N/A                | N/A                | 4                  | 4                  |
| Frequency hopping offset  |          |           | N/A                | N/A                | 1                  | 1                  |
| Frequency hopping interval  |          | ms        | N/A                | N/A                | 8                  | 2                  |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-U ESS</i> ) <sup>Note 3</sup> |          |           | 1.5                | 1.5                | 1.5                | 1.5                |

|  |  |            |            |            |            |
|--|--|------------|------------|------------|------------|
| Maximum number of repetitions( <i>mPDCCH-NumRepetition</i> )   |  | 8          | 2          | 32         | 8          |
| MPDCCH repetition number   |  | 8          | 2          | 32         | 8          |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )   |  | 1          | 1          | 7          | 7          |
| PDSCH TM   |  | TM2        | TM2        | TM2        | TM2        |
| DCI Format   |  | 6-1A       | 6-1A       | 6-1B       | 6-1B       |
| fdd-DownlinkOrTddSubframeBitmapBR  |  | 1111111111 | 1111111111 | 1111111111 | 1111111111 |
| <p>Note 1: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.</p> <p>Note 3: For MPDCCH UE-specific search space the formula for the start subframe <math>k_0</math> is given in TS 36.213 [6] clause 9.1.5.</p> <p>Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |  |            |            |            |            |

### 8.11.2.1.1 CE Mode A

For the parameters specified in Table 8.11.2.1-1 and 8.11.2.1-2 the average probability of a missed downlink scheduling grant (P<sub>m-dsg</sub>) shall be below the specified value in Table 8.11.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.2.1.1-1: Minimum performance CE Mode A MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|------------------------|----------|-------------|
|             |           |                   |                   |              |                       |  | P <sub>m-dsg</sub> (%) | SNR (dB) |             |
| 1           | 10 MHz    | 16 ECCE           | R.82 FDD          | OP.2 FDD     | EPA5                  | 2 x 1 Low                                    | 1                      | -4.8     | M1          |
| 2           | 10 MHz    | 16 ECCE           | R.82 FDD          | OP.2 FDD     | EPA5                  | 2 x 2 Low                                    | 1                      | -6.5     | ≥1          |
| 3           | 10 MHz    | 16 ECCE           | R.82 FDD          | OP.2 FDD     | EPA5                  | 2 x 4 Low                                    | 1                      | -6.5     | ≥1          |

### 8.11.2.1.2 CE Mode B

For the parameters specified in Table 8.11.2.1-1 and 8.11.2.1-2 the average probability of a missed downlink scheduling grant (P<sub>m-dsg</sub>) shall be below the specified value in Table 8.11.2.1.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.2.1.2-1: Minimum performance CE Mode B MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|------------------------|----------|-------------|
|             |           |                   |                   |              |                       |  | P <sub>m-dsg</sub> (%) | SNR (dB) |             |
| 1           | 10 MHz    | 24 ECCE           | R.83 FDD          | OP.2 FDD     | ETU1                  | 2 x 1 Low                                    | 1                      | -12      | M1          |
| 2           | 10 MHz    | 24 ECCE           | R.83 FDD          | OP.2 FDD     | ETU1                  | 2 x 2 Low                                    | 1                      | -13.2    | ≥1          |
| 3           | 10 MHz    | 24 ECCE           | R.83 FDD          | OP.2 FDD     | ETU1                  | 2 x 4 Low                                    | 1                      | -12.8    | ≥1          |



## 8.11.2.1.3 CE Mode A with TM9 interference model

The requirements are specified in Table 8.11.2.1.3-2, with the addition of parameters in Table 8.11.2.1.3-1. In Table 8.11.2.1.3-2, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the MPDCCH performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

Table 8.11.2.1.3-1: Test Parameters for MPDCCH

| Parameter  |          | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|--|----------|-----------|----------------------|---------------------------------|---------------------------------|
| OFDM starting symbol (startSymbolLC)   |          | symbols   | 2                    | 2                               | 2                               |
| Unused RE-s and PRB-s  |          |           | OCNG                 | N/A                             | N/A                             |
| Cell ID  |          |           | 0                    | 1                               | 6                               |
| Downlink power allocation  | $\rho_A$ | dB        | -3                   | -3                              | -3                              |
|  | $\rho_B$ | dB        | -3                   | -3                              | -3                              |
|  | $\sigma$ | dB        | 0                    | 0                               | 0                               |
|  | $\delta$ | dB        | 3                    | 3                               | 3                               |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  |                                 |                                 |
| $\hat{E}_s/N_{oc}$   |          | dB        | N/A                  | 11.75                           | 5.69                            |
| BWChannel  |          | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |          |           | Normal               | Normal                          | Normal                          |
| Subframe Configuration   |          |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Precoder Update Granularity  | PRB      |           | 1                    | N/A                             | N/A                             |
|  | ms       |           | 4 (Note 2)           | N/A                             | N/A                             |
| Beamforming Pre-Coder  |          |           | Annex B. 4.4         | N/A                             | N/A                             |
| Number of PRB per MPDCCH Set   |          |           | 4                    | N/A                             | N/A                             |
| Transmission type  |          |           | Distributed          | N/A                             | N/A                             |
| Frequency hopping  |          |           | Disabled             | N/A                             | N/A                             |
| Number of frequency hopping narrowbands  |          |           | N/A                  | N/A                             | N/A                             |
| Frequency hopping offset   |          |           | N/A                  | N/A                             | N/A                             |
| Frequency hopping interval   |          | ms        | 4                    | N/A                             | N/A                             |
| Value of G in MPDCCH start subframe (mpdcch-startSF-U ESS) (Note 3)  |          |           | 1.5                  | N/A                             | N/A                             |
| Maximum number of repetitions  |          |           | 1                    | N/A                             | N/A                             |
| MPDCCH narrowband (mpdcch-Narrowband)  |          |           | 1                    | N/A                             | N/A                             |
| PDSCH TM   |          |           | TM2                  | N/A                             | N/A                             |
| DCI Format   |          |           | 6-1A                 | N/A                             | N/A                             |
| fdd-DownlinkOrTddSubframeBitmapBR  |          |           | 1111111111           | N/A                             | N/A                             |
| Interference model   |          |           | N/A                  | As specified in<br>clause B.5.4 | As specified in<br>clause B.5.4 |
| Probability of occurrence of transmission in interference cells  |          | %         | N/A                  | 10                              | 10                              |
| Probability of occurrence of PDSCH transmission rank in interfering cells  | Rank 1   | %         | N/A                  | 70                              | 70                              |
|  | Rank 2   | %         | N/A                  | 30                              | 30                              |
| Time offset relative to Cell 1   |          | $\mu$ s   | N/A                  | 2                               | 3                               |
| Frequency shift relative to Cell 1   |          | Hz        | N/A                  | 200                             | 300                             |
| Note 1: For each test, DC subcarrier puncturing shall be considered.   |          |           |                      |                                 |                                 |
| Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval                       |          |           |                      |                                 |                                 |
| Note 3: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5. |          |           |                      |                                 |                                 |

Table 8.11.2.1.3-2: Minimum performance CE Mode A MPDCCH

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 16 ECCE           | R.82 FDD          | OP.2 FDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 15.4              |
| Note 1: The OCNG pattern applies for Cell 1.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. |                   |                   |                       |                                 |        |        |   |                 |                   |

## 8.11.2.1.4 CE Mode A with CRS interference model

The requirements are specified in Table 8.11.2.1.4-2, with the addition of parameters in Table 8.11.2.1.4-1. In Table 8.11.2.1.4-2, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the MPDCCH performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

Table 8.11.2.1.4-1: Test Parameters for MPDCCH

| Parameter   |          | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|---|----------|-----------|----------------------|------------------------------|------------------------------|
| OFDM starting symbol (startSymbolLC)  |          | symbols   | 2                    | 2                            | 2                            |
| Unused RE-s and PRB-s   |          |           | OCNG                 | N/A                          | N/A                          |
| Cell ID   |          |           | 0                    | 1                            | 6                            |
| Downlink power allocation   | $\rho_A$ | dB        | -3                   | -3                           | -3                           |
|   | $\rho_B$ | dB        | -3                   | -3                           | -3                           |
|   | $\sigma$ | dB        | 0                    | 0                            | 0                            |
|   | $\delta$ | dB        | 3                    | 3                            | 3                            |
| Cell-specific reference signals   |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$  |          | dB        | N/A                  | 15.81                        | 10.5                         |
| $BW_{Channel}$  |          | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix   |          |           | Normal               | Normal                       | Normal                       |
| Subframe Configuration  |          |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Precoder Update Granularity   |          | PRB       | 1                    | N/A                          | N/A                          |
|   |          | ms        | 4                    | N/A                          | N/A                          |
| Beamforming Pre-Coder   |          |           | Annex B. 4.4         | N/A                          | N/A                          |
| Number of PRB per MPDCCH Set  |          |           | 4                    | N/A                          | N/A                          |
| Transmission type   |          |           | Distributed          | N/A                          | N/A                          |
| Frequency hopping   |          |           | Disabled             | N/A                          | N/A                          |
| Number of frequency hopping narrowbands                                     |          |           | N/A                  | N/A                          | N/A                          |
| Frequency hopping offset  |          |           | N/A                  | N/A                          | N/A                          |
| Frequency hopping interval  |          | ms        | 4                    | N/A                          | N/A                          |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-UESS</i> ) (Note 3) |          |           | 1.5                  | N/A                          | N/A                          |
| Maximum number of repetitions   |          |           | 1                    | N/A                          | N/A                          |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )                              |          |           | 1                    | N/A                          | N/A                          |
| PDSCH TM  |          |           | TM2                  | N/A                          | N/A                          |
| DCI Format  |          |           | 6-1A                 | N/A                          | N/A                          |
| fdd-DownlinkOrTddSubframeBitmapBR   |          |           | 1111111111           | N/A                          | N/A                          |
| Interference model  |          |           | N/A                  | As specified in clause B.6.5 | As specified in clause B.6.5 |

|  |               |     |     |     |
|--|---------------|-----|-----|-----|
| Time offset relative to Cell 1   | $\mu\text{s}$ | N/A | 2   | 3   |
| Frequency shift relative to Cell 1   | Hz            | N/A | 200 | 300 |
| Note 1: For each test, DC subcarrier puncturing shall be considered.<br>Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval<br>Note 3: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5. |               |     |     |     |

Table 8.11.2.1.4-2: Minimum performance CE Mode A MPDCCH

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 4 ECCE            | R.96 FDD          | OP.2 FDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 15.8              |
| Note 1: The OCNG pattern applies for Cell 1.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.11.2.1.5 CE Mode A and CE Mode B when CRS-ChEstMPDCCH-Config is configured

For the parameters specified in Table 8.11.2.1.5-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.11.2.1.5-2 for CE Mode A and in Table 8.11.2.1.5-3 for CE Mode B. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.11.2.1.5-1: Test Parameters for MPDCCH (Category M1)

| Parameter  | Unit       | CE Mode A (Test 1) | CE Mode B (Test 1) |
|--|------------|--------------------|--------------------|
| OFDM starting symbol (startSymbolLC)   | symbols    | 2                  | 2                  |
| Unused RE-s and PRB-s  |            | OCNG               | OCNG               |
| Cell ID  |            | 0                  | 0                  |
| Downlink power allocation  | $\rho_A$   | dB                 | -3                 |
|  | $\rho_B$   | dB                 | -3                 |
|  | $\sigma$   | dB                 | 0                  |
|  | $\delta$   | dB                 | 3                  |
| $N_{oc}$ at antenna port   | dBm/15 kHz | -98                | -98                |
| Cyclic prefix  |            | Normal             | Normal             |
| Subframe Configuration   |            | Non-MBSFN          | Non-MBSFN          |
| Precoder Update Granularity  | PRB        | N/A                | Note 2             |
|  | ms         | N/A                | Note 2             |
| Beamforming Pre-Coder  |            | Note 2             | Note 2             |
| Cell Specific Reference Signal   |            | Port 0 and 1       | Port 0 and 1       |
| Number of PRB per MPDCCH Set   |            | 4                  | 2+4                |
| Transmission type  |            | Distributed        | Localized          |
| Frequency hopping  |            | Disabled           | Enabled            |
| Number of frequency hopping narrowbands                                      |            | N/A                | 4                  |
| Frequency hopping offset   |            | N/A                | 1                  |
| Frequency hopping interval   | ms         | N/A                | 16                 |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-U ESS</i> ) (Note 3) |            | 1.5                | 1.5                |
| Maximum number of repetitions ( <i>mpdcch-NumRepetition</i> )                |            | 16                 | 32                 |
| MPDCCH repetition number   |            | 16                 | 32                 |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )                               |            | 1                  | 7                  |
| PDSCH TM   |            | TM2                | TM2                |
| DCI Format   |            | 6-1A               | 6-1B               |
| fdd-DownlinkOrTddSubframeBitmapBR  |            | 1111111111         | 1111111111         |

|   |    |            |                |
|---|----|------------|----------------|
| mpdcch-crs-config   |    | Configured | Configured     |
| Power offset between CRS and DMRS antenna ports of MPDCCH   | dB | 0          | 0              |
| mpdcch-crs-localized-mapping-type   |    | N/A        | Not configured |
| Note 1: For each test, DC subcarrier puncturing shall be considered.  |    |            |                |
| Note 2: TS 36.211 6.8B.5.   |    |            |                |
| Note 3: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5.        |    |            |                |
| Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. |    |            |                |

**Table 8.11.2.1.5-2: Minimum performance CE Mode A MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|-------------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |             |
| 1           | 10 MHz    | 16 ECCE           | R.82 FDD          | OP.2 FDD     | EPA5                  | 2 x 1 Low                                    | 1               | -3.4     | M1          |

**Table 8.11.2.1.5-3: Minimum performance CE Mode B MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|-------------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |             |
| 1           | 10 MHz    | 24 ECCE           | R.83 FDD          | OP.2 FDD     | ETU1                  | 2 x 1 Low                                    | 1               | -9.5     | M1          |

#### 8.11.2.2.5 CE Mode A and CE Mode B when CRS-ChEstMPDCCH-Config is configured

For the parameters specified in Table 8.11.2.2.5-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.11.2.2.5-2 for CE Mode A and in Table 8.11.2.2.5-3 for CE Mode B. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.2.2.5-1: Test Parameters for MPDCCH (Category M1)**

| Parameter                               |          | Unit       | CE Mode A    | CE Mode B    |
|---|----------|------------|--------------|--------------|
| OFDM starting symbol (startSymbolLC)    |          | symbols    | 2            | 2            |
| Unused RE-s and PRB-s                   |          |            | OCNG         | OCNG         |
| Cell ID                                 |          |            | 0            | 0            |
| Downlink power allocation               | $\rho_A$ | dB         | -3           | 0            |
|   | $\rho_B$ | dB         | -3           | 0            |
|   | $\sigma$ | dB         | 0            | -3           |
|   | $\delta$ | dB         | 3            | 0            |
| $N_{oc}$ at antenna port                |          | dBm/15k Hz | -98          | -98          |
| Cyclic prefix                           |          |            | Normal       | Normal       |
| Subframe Configuration                  |          |            | Non-MBSFN    | Non-MBSFN    |
| Precoder Update Granularity             | PRB      |            | N/A          | Not e2       |
|   | ms       |            | N/A          | Note 2       |
| Beamforming Pre-Coder                   |          |            | Note 2       | Note 2       |
| Cell Specific Reference Signal          |          |            | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set            |          |            | 4            | 2+4          |
| Transmission type                       |          |            | Distributed  | Localized    |
| Frequency hopping                       |          |            | Disabled     | Enabled      |
| Number of frequency hopping narrowbands |          |            | N/A          | 4            |

|   |    |            |                |
|---|----|------------|----------------|
| Frequency hopping offset  |    | N/A        | 1              |
| Frequency hopping interval  | ms | N/A        | 20             |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-U ESS</i> ) (Note 4)  |    | 5          | 5              |
| Maximum number of repetitions ( <i>MPDCCH-NumRepetition</i> )   |    | 16         | 32             |
| MPDCCH repetition number  |    | 16         | 32             |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )  |    | 1          | 7              |
| PDSCH TM  |    | TM2        | TM2            |
| DCI Format  |    | 6-1A       | 6-1B           |
| TDD UL/DL Configuration   |    | 0          | 0              |
| TDD Special Subframe  |    | 1          | 1              |
| fdd-DownlinkOrTddSubframeBitmapBR   |    | 1000010000 | 1000010000     |
| mpdcch-crs-config   |    | Configured | Configured     |
| Power offset between CRS and DMRS antenna ports of MPDCCH   | dB | 0          | 0              |
| mpdcch-crs-localized-mapping-type   |    | N/A        | Not configured |
| Note 1: For each test, DC subcarrier puncturing shall be considered.  |    |            |                |
| Note 2: TS 36.211 6.8B.5  |    |            |                |
| Note 3: The special subframes are not supported by MPDCCH and are assumed as non- BL/CE DL subframes.                               |    |            |                |
| Note 4: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5.        |    |            |                |
| Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. |    |            |                |

Table 8.11.2.2.5-2: Minimum performance CE Mode A MPDCCH

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|-------------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |             |
| 1           | 10 MHz    | 16 ECCE           | R.82 TDD          | OP.2 TDD     | EPA5                  | 2 x 1 Low                                    | 1               | -4.1     | M1          |

Table 8.11.2.2.5-3: Minimum performance CE Mode B MPDCCH

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|-------------|
|             |           |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |             |
| 1           | 10 MHz    | 24 ECCE           | R.83 TDD          | OP.2 TDD     | ETU1                  | 2 x 1 Low                                    | 1               | -9.7     | M1          |

## 8.11.2.2 TDD

Table 8.11.2.2-1: Test Parameters for MPDCCH (Category M1)

| Parameter                            |          | Unit       | CE Mode A | CE Mode B |
|--------------------------------------|----------|------------|-----------|-----------|
| OFDM starting symbol (startSymbolLC) |          | symbols    | 2         | 2         |
| Unused RE-s and PRB-s                |          |            | OCNG      | OCNG      |
| Cell ID                              |          |            | 0         | 0         |
| Downlink power allocation            | $\rho_A$ | dB         | -3        | 0         |
|                                      | $\rho_B$ | dB         | -3        | 0         |
|                                      | $\sigma$ | dB         | 0         | -3        |
|                                      | $\delta$ | dB         | 3         | 0         |
| $N_{oc}$ at antenna port             |          | dBm/15 kHz | -98       | -98       |
| Cyclic prefix                        |          |            | Normal    | Normal    |
| Subframe Configuration               |          |            | Non-MBSFN | Non-MBSFN |

|   |     |              |              |
|---|-----|--------------|--------------|
| Precoder Update Granularity   | PRB | 1            | 1            |
|   | ms  | 5 (Note 2)   | 20 (Note 2)  |
| Beamforming Pre-Coder   |     | Annex B.4.4  | Annex B.4.4  |
| Cell Specific Reference Signal  |     | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set  |     | 4            | 2+4          |
| Transmission type   |     | Distributed  | Localized    |
| Frequency hopping   |     | Disabled     | Enabled      |
| Number of frequency hopping narrowbands   |     | N/A          | 4            |
| Frequency hopping offset  |     | N/A          | 1            |
| Frequency hopping interval  | ms  | N/A          | 20           |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-UESS</i> ) (Note 4)   |     | 5            | 5            |
| Maximum number of repetitions ( <i>mpdcch-NumRepetition</i> )   |     | 16           | 32           |
| MPDCCH repetition number  |     | 16           | 32           |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )  |     | 1            | 7            |
| PDSCH TM  |     | TM2          | TM2          |
| DCI Format  |     | 6-1A         | 6-1B         |
| TDD UL/DL Configuration   |     | 0            | 0            |
| TDD Special Subframe  |     | 1            | 1            |
| fdd-DownlinkOrTddSubframeBitmapBR   |     | 1000010000   | 1000010000   |
| Note 1: For each test, DC subcarrier puncturing shall be considered.  |     |              |              |
| Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.                             |     |              |              |
| Note 3: The special subframes are not supported by MPDCCH, and are assumed as non- BL/CE DL subframes.                              |     |              |              |
| Note 4: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5.        |     |              |              |
| Note 5: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. |     |              |              |

Table 8.11.2.2-2: Test Parameters for MPDCCH (Category  $\geq 1$ )

| Parameter  |          | Unit      | CE Mode A (Test 2) | CE Mode A (Test 3) | CE Mode B (Test 2) | CE Mode B (Test 3) |
|--|----------|-----------|--------------------|--------------------|--------------------|--------------------|
| OFDM starting symbol (startSymbolLC)   |          | symbols   | 2                  | 2                  | 2                  | 2                  |
| Unused RE-s and PRB-s  |          |           | OCNG               | OCNG               | OCNG               | OCNG               |
| Cell ID  |          |           | 0                  | 0                  | 0                  | 0                  |
| Downlink power allocation  | $\rho_A$ | -3        | -3                 | -3                 | 0                  | 0                  |
|  | $\rho_B$ | -3        | -3                 | -3                 | 0                  | 0                  |
|  | $\sigma$ | 0         | 0                  | 0                  | -3                 | -3                 |
|  | $\delta$ | 3         | 3                  | 3                  | 0                  | 0                  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                | -98                | -98                | -98                |
| Cyclic prefix  |          |           | Normal             | Normal             | Normal             | Normal             |
| Subframe Configuration   |          |           | Non-MBSFN          | Non-MBSFN          | Non-MBSFN          | Non-MBSFN          |
| Precoder Update Granularity  | PRB      |           | 1                  | 1                  | 1                  | 1                  |
|  | ms       |           | 5 (Note 2)         | 5 (Note 2)         | 20 (Note 2)        | 20 (Note 2)        |
| Beamforming Pre-Coder  |          |           | Annex B.4.4        | Annex B.4.4        | Annex B.4.4        | Annex B.4.4        |
| Cell Specific Reference Signal   |          |           | Port 0 and 1       | Port 0 and 1       | Port 0 and 1       | Port 0 and 1       |
| Number of PRB per MPDCCH Set   |          |           | 4                  | 4                  | 2+4                | 2+4                |
| Transmission type  |          |           | Distributed        | Distributed        | Localized          | Localized          |
| Frequency hopping  |          |           | Disabled           | Disabled           | Enabled            | Enabled            |
| Number of frequency hopping narrowbands  |          |           | N/A                | N/A                | 4                  | 4                  |
| Frequency hopping offset   |          |           | N/A                | N/A                | 1                  | 1                  |
| Frequency hopping interval   |          | ms        | N/A                | N/A                | 5                  | 5                  |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-UESS</i> ) <sup>Note 3</sup> |          |           | 5                  | 5                  | 5                  | 5                  |

|  |  |            |            |            |            |
|--|--|------------|------------|------------|------------|
| Maximum number of repetitions( <i>mPDCCH-NumRepetition</i> )   |  | 4          | 2          | 16         | 8          |
| MPDCCH repetition number   |  | 4          | 2          | 16         | 8          |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )   |  | 1          | 1          | 7          | 7          |
| PDSCH TM   |  | TM2        | TM2        | TM2        | TM2        |
| DCI Format   |  | 6-1A       | 6-1A       | 6-1B       | 6-1B       |
| fdd-DownlinkOrTddSubframeBitmapBR  |  | 1000010000 | 1000010000 | 1000010000 | 1000010000 |
| <p>Note 1: For each test, DC subcarrier puncturing shall be considered.</p> <p>Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.</p> <p>Note 3: For MPDCCH UE-specific search space the formula for the start subframe <math>k_0</math> is given in TS 36.213 [6] clause 9.1.5.</p> <p>Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate.</p> |  |            |            |            |            |

### 8.11.2.2.1 CE Mode A

For the parameters specified in Table 8.11.2.2-1 and 8.11.2.2-2 the average probability of a missed downlink scheduling grant (P<sub>m-dsg</sub>) shall be below the specified value in Table 8.11.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.2.2.1-1: Minimum performance CE Mode A MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|------------------------|----------|-------------|
|             |           |                   |                   |              |                       |  | P <sub>m-dsg</sub> (%) | SNR (dB) |             |
| 1           | 10 MHz    | 16 ECCE           | R.82 TDD          | OP.2 TDD     | EPA5                  | 2 x 1 Low                                    | 1                      | -5.3     | M1          |
| 2           | 10 MHz    | 16 ECCE           | R.82 TDD          | OP.2 TDD     | EPA5                  | 2 x 2 Low                                    | 1                      | -5.3     | ≥1          |
| 3           | 10 MHz    | 16 ECCE           | R.82 TDD          | OP.2 TDD     | EPA5                  | 2 x 4 Low                                    | 1                      | -6.8     | ≥1          |

### 8.11.2.2.2 CE Mode B

For the parameters specified in Table 8.11.2.2-1 and 8.11.2.2-2 the average probability of a missed downlink scheduling grant (P<sub>m-dsg</sub>) shall be below the specified value in Table 8.11.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.2.2.2-1: Minimum performance CE Mode B MPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-------------------|--------------|-----------------------|--|------------------------|----------|-------------|
|             |           |                   |                   |              |                       |  | P <sub>m-dsg</sub> (%) | SNR (dB) |             |
| 1           | 10 MHz    | 24 ECCE           | R.83 TDD          | OP.2 TDD     | ETU1                  | 2 x 1 Low                                    | 1                      | -10.1    | M1          |
| 2           | 10 MHz    | 24 ECCE           | R.83 TDD          | OP.2 TDD     | ETU1                  | 2 x 2 Low                                    | 1                      | -12.3    | ≥1          |
| 3           | 10 MHz    | 24 ECCE           | R.83 TDD          | OP.2 TDD     | ETU1                  | 2 x 4 Low                                    | 1                      | -12.8    | ≥1          |

## 8.11.2.2.3 CE Mode A with TM9 interference model

The requirements are specified in Table 8.11.2.2.3-2, with the addition of parameters in Table 8.11.2.2.3-1. In Table 8.11.2.2.3-2, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the MPDCCH performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

**Table 8.11.2.2.3-1: Test Parameters for MPDCCH (TM9 interference model)**

| Parameter  |          | Unit      | Cell 1               | Cell 2                          | Cell 3                          |
|--|----------|-----------|----------------------|---------------------------------|---------------------------------|
| OFDM starting symbol (startSymbolLC)   |          | symbols   | 2                    | 2                               | 2                               |
| Unused RE-s and PRB-s  |          |           | OCNG                 | N/A                             | N/A                             |
| Cell ID  |          |           | 0                    | 1                               | 6                               |
| Downlink power allocation  | $\rho_A$ | dB        | -3                   | -3                              | -3                              |
|  | $\rho_B$ | dB        | -3                   | -3                              | -3                              |
|  | $\sigma$ | dB        | 0                    | 0                               | 0                               |
|  | $\delta$ | dB        | 3                    | 3                               | 3                               |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  |                                 |                                 |
| $\bar{E}_s/N_{oc}$   |          | dB        | N/A                  | 11.75                           | 5.69                            |
| $BW_{Channel}$   |          | MHz       | 10                   | 10                              | 10                              |
| Cyclic Prefix  |          |           | Normal               | Normal                          | Normal                          |
| Subframe Configuration   |          |           | Non-MBSFN            | Non-MBSFN                       | Non-MBSFN                       |
| Precoder Update Granularity  | PRB      |           | 1                    | N/A                             | N/A                             |
|  | ms       |           | 4 (Note 2)           | N/A                             | N/A                             |
| Beamforming Pre-Coder  |          |           | Annex B. 4.4         | N/A                             | N/A                             |
| Number of PRB per MPDCCH Set   |          |           | 4                    | N/A                             | N/A                             |
| Transmission type  |          |           | Distributed          | N/A                             | N/A                             |
| Frequency hopping  |          |           | Disabled             | N/A                             | N/A                             |
| Number of frequency hopping narrowbands  |          |           | N/A                  | N/A                             | N/A                             |
| Frequency hopping offset   |          |           | N/A                  | N/A                             | N/A                             |
| Frequency hopping interval   |          | ms        | 4                    | N/A                             | N/A                             |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-UESS</i> ) (Note 3)  |          |           | 1.5                  | N/A                             | N/A                             |
| Maximum number of repetitions  |          |           | 1                    | N/A                             | N/A                             |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )   |          |           | 1                    | N/A                             | N/A                             |
| PDSCH TM   |          |           | TM2                  | N/A                             | N/A                             |
| DCI Format   |          |           | 6-1A                 | N/A                             | N/A                             |
| fdd-DownlinkOrTddSubframeBitmapBR  |          |           | 1000010000           | N/A                             | N/A                             |
| Interference model   |          |           | N/A                  | As specified in<br>clause B.5.4 | As specified in<br>clause B.5.4 |
| Probability of occurrence of transmission in interference cells  |          | %         | N/A                  | 10                              | 10                              |
| Probability of occurrence of PDSCH transmission rank in interfering cells  | Rank 1   | %         | N/A                  | 70                              | 70                              |
|  | Rank 2   | %         | N/A                  | 30                              | 30                              |
| Time offset relative to Cell 1   |          | $\mu$ s   | N/A                  | 2                               | 3                               |
| Frequency shift relative to Cell 1   |          | Hz        | N/A                  | 200                             | 300                             |
| Note 1: For each test, DC subcarrier puncturing shall be considered.   |          |           |                      |                                 |                                 |
| Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval                       |          |           |                      |                                 |                                 |
| Note 3: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5. |          |           |                      |                                 |                                 |



Table 8.11.2.2.3-2: Minimum performance CE Mode A MPDCCH

| Test Number  | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|--|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|  |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1  | 16 ECCE           | R.82 TDD          | OP.2 TDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 15.5              |
| Note 1: The OCNG pattern applies for Cell 1.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. |                   |                   |                       |                                 |        |        |   |                 |                   |

## 8.11.2.2.4 CE Mode A with CRS interference model

The requirements are specified in Table 8.11.2.2.4-2, with the addition of parameters in Table 8.11.2.2.4-1. In Table 8.11.2.2.4-2, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively. The CRS assistance information [7] is provided to the UE and includes information on Cell 2 and Cell 3.

The purpose of the test is to verify the MPDCCH performance under assumption that UE applies CRS interference mitigation in the scenario with 2 CRS antenna ports in the serving and aggressor cells.

Table 8.11.2.2.4-1: Test Parameters for MPDCCH (CRS interference model)

| Parameter  |          | Unit      | Cell 1               | Cell 2                       | Cell 3                       |
|--|----------|-----------|----------------------|------------------------------|------------------------------|
| OFDM starting symbol (startSymbolLC)   |          | symbols   | 2                    | 2                            | 2                            |
| Unused RE-s and PRB-s  |          |           | OCNG                 | N/A                          | N/A                          |
| Cell ID  |          |           | 0                    | 1                            | 6                            |
| Downlink power allocation  | $\rho_A$ | dB        | -3                   | -3                           | -3                           |
|  | $\rho_B$ | dB        | -3                   | -3                           | -3                           |
|  | $\sigma$ | dB        | 0                    | 0                            | 0                            |
|  | $\delta$ | dB        | 3                    | 3                            | 3                            |
| Cell-specific reference signals  |          |           | Antenna ports<br>0,1 | Antenna ports<br>0,1         | Antenna ports<br>0,1         |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98                  |                              |                              |
| $\hat{E}_s/N_{oc}$   |          | dB        | N/A                  | 15.81                        | 10.5                         |
| BW <sub>Channel</sub>  |          | MHz       | 10                   | 10                           | 10                           |
| Cyclic Prefix  |          |           | Normal               | Normal                       | Normal                       |
| Subframe Configuration   |          |           | Non-MBSFN            | Non-MBSFN                    | Non-MBSFN                    |
| Precoder Update Granularity  | PRB      |           | 1                    | N/A                          | N/A                          |
|  | ms       |           | 4                    | N/A                          | N/A                          |
| Beamforming Pre-Coder  |          |           | Annex B. 4.4         | N/A                          | N/A                          |
| Number of PRB per MPDCCH Set   |          |           | 4                    | N/A                          | N/A                          |
| Transmission type  |          |           | Distributed          | N/A                          | N/A                          |
| Frequency hopping  |          |           | Disabled             | N/A                          | N/A                          |
| Number of frequency hopping narrowbands                                      |          |           | N/A                  | N/A                          | N/A                          |
| Frequency hopping offset   |          |           | N/A                  | N/A                          | N/A                          |
| Frequency hopping interval   |          | ms        | 4                    | N/A                          | N/A                          |
| Value of G in MPDCCH start subframe ( <i>mpdcch-startSF-U ESS</i> ) (Note 3) |          |           | 1.5                  | N/A                          | N/A                          |
| Maximum number of repetitions  |          |           | 1                    | N/A                          | N/A                          |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )                               |          |           | 1                    | N/A                          | N/A                          |
| PDSCH TM   |          |           | TM2                  | N/A                          | N/A                          |
| DCI Format   |          |           | 6-1A                 | N/A                          | N/A                          |
| fdd-DownlinkOrTddSubframeBitmapBR  |          |           | 1000010000           | N/A                          | N/A                          |
| Interference model   |          |           | N/A                  | As specified in clause B.6.5 | As specified in clause B.6.5 |

|  |               |     |     |     |
|--|---------------|-----|-----|-----|
| Time offset relative to Cell 1   | $\mu\text{s}$ | N/A | 2   | 3   |
| Frequency shift relative to Cell 1   | Hz            | N/A | 200 | 300 |
| Note 1: For each test, DC subcarrier puncturing shall be considered.<br>Note 2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval<br>Note 3: For MPDCCH UE-specific search space the formula for the start subframe $k_0$ is given in TS 36.213 [6] clause 9.1.5. |               |     |     |     |

Table 8.11.2.2.4-2: Minimum performance CE Mode A MPDCCH

| Test Number   | Aggregation level | Reference Channel | OCNG Pattern (Note 1) | Propagation Conditions (Note 2) |        |        | Antenna Configuration and Correlation Matrix (Note 3) | Reference Value |                   |
|---|-------------------|-------------------|-----------------------|---------------------------------|--------|--------|---|-----------------|-------------------|
|   |                   |                   |                       | Cell 1                          | Cell 2 | Cell 3 |   | Pm-dsg (%)      | SNR (dB) (Note 4) |
| 1   | 4 ECCE            | R.96 TDD          | OP.2 FDD              | EPA5                            | EPA5   | EPA5   | 2x1 Low   | 1               | 16.2              |
| Note 1: The OCNG pattern applies for Cell 1, Cell 2 and Cell 3.<br>Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 4: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. |                   |                   |                       |                                 |        |        |   |                 |                   |

### 8.11.3 PBCH

The receiver characteristics of the PBCH are determined by the probability of miss-detection of the PBCH for single decoding interval (Pm-bch-s) and the probability of miss-detection of the PBCH for multiple decoding intervals (Pm-bch-m), which are defined as

$$P_{m-bch-s} = 1 - \frac{A_s}{B_s}$$

$$P_{m-bch-m} = 1 - \frac{A_m}{B_m}$$

The probability of miss-detection of the PBCH for single decoding interval (Pm-bch-s) is calculated under assumption of single PBCH TTI interval decoding.  $A_s$  is the number of correctly decoded MIB PDUs and  $B_s$  is the number of transmitted MIB PDUs (redundancy versions for the same MIB are not counted separately).

The probability of miss-detection of the PBCH for multiple decoding intervals (Pm-bch-m) is calculated over multiple PBCH TTI intervals under assumption of independent PBCH decoding over these intervals.  $A_m$  is the number of PBCH decoding intervals with at least one correctly decoded MIB PDU and  $B_m$  is the total number of PBCH decoding intervals. A multiple PBCH decoding interval has 1120 ms duration consisting of continuous PBCH TTIs during the test.

#### 8.11.3.1 FDD and half-duplex FDD

Table 8.11.3.1-1: Test Parameters for PBCH

| Parameter   |         | Unit      | Transmit diversity |
|---|---------|-----------|--------------------|
| Downlink power allocation                               | PBCH_RA | dB        | -3                 |
|   | PBCH_RB | dB        | -3                 |
| $N_{oc}$ at antenna port                                |         | dBm/15kHz | -98                |
| Cyclic prefix   |         |           | Normal             |
| Cell ID   |         |           | 0                  |
| Repetition of the physical broadcast channel (Note 1)   |         |           | Enabled            |
| Cyclic prefix   |         |           | Normal             |
| Note 1: as specified in Table 6.6.4-1 in TS 36.211 [4]. |         |           |                    |

### 8.11.3.1.1 Transmit diversity performance

For the parameters specified in Table 8.11.3.1-1 and Table 8.11.3.1.1-1, the averaged probability of a miss-detected PBCH (Pm-bchs and Pm-bch-m) shall be below the specified value in Table 8.11.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.3.1.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value for single PBCH TTI |          | Reference value for multiple PBCH TTI |          |
|-------------|-----------|-------------------|-----------------------|--|-------------------------------------|----------|---------------------------------------|----------|
|             |           |                   |                       |  | Pm-bchs (%)                         | SNR (dB) | Pm-bch-m (%)                          | SNR (dB) |
| 1           | 10 MHz    | R.22              | EPA1                  | 2 x 1 Low                                    | 1                                   | -1.9     | 1                                     | -12.6    |

### 8.11.3.2 TDD

**Table 8.11.3.2-1: Test Parameters for PBCH**

| Parameter   | Unit      | Transmit diversity |
|---|-----------|--------------------|
| Uplink downlink configuration (Note 1)                  |           | 1                  |
| Special subframe configuration (Note 2)                 |           | 4                  |
| Downlink power allocation                               | PBCH_RA   | -3                 |
|   | PBCH_RB   | -3                 |
| $N_{oc}$ at antenna port                                | dBm/15kHz | -98                |
| Cyclic prefix   |           | Normal             |
| Cell ID   |           | 0                  |
| Repetition of the physical broadcast channel (Note 3)   |           | Enabled            |
| Cyclic prefix   |           | Normal             |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].   |           |                    |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4].   |           |                    |
| Note 3: as specified in Table 6.6.4-2 in TS 36.211 [4]. |           |                    |

#### 8.11.3.2.1 Transmit diversity performance

For the parameters specified in Table 8.11.3.2-1 and Table 8.11.3.2.1-1, the averaged probability of a miss-detected PBCH (Pm-bchs and Pm-bch-m) shall be below the specified value in Table 8.11.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.11.3.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value for single PBCH TTI |          | Reference value for multiple PBCH TTI |          |
|-------------|-----------|-------------------|-----------------------|--|-------------------------------------|----------|---------------------------------------|----------|
|             |           |                   |                       |  | Pm-bchs (%)                         | SNR (dB) | Pm-bch-m (%)                          | SNR (dB) |
| 1           | 10 MHz    | R.22              | EPA1                  | 2 x 1 Low                                    | 1                                   | -2.8     | 1                                     | -12.9    |

## 8.12 Demodulation of Narrowband IoT

### 8.12.1 NPDSCH

8.12.1.1 Half-duplex FDD The parameters specified in Table 8.12.1.1-1 are valid for all half-duplex FDD tests unless otherwise stated.

**Table 8.12.1.1-1: Common Test Parameters**

| Parameter   | Unit      | Value   |
|---|-----------|---|
| Number of HARQ processes per component carrier (Note 2)   | Processes | 1 or 2  |
| Maximum number of HARQ transmission   |           | 4   |
| Cyclic Prefix   |           | Normal  |
| extraControlRegionSize-r13  |           | 3 for In-band and N/A for Standalone/Guard-band unless otherwise stated |
| downlinkBitmap-r13 and dl-Gap-r13   |           | Not configured  |
| dl-GapNonAnchor-r13 and downlinkBitmapNonAnchor-r13   |           | Not configured  |
| Unused REs or RB (Note 1)   |           | OCNG  |
| OCNG pattern  |           | NB.OP.1   |
| Note 1: For in-band mode, the REs for transmission of LTE signals including PDCCH, CRS should be filled by OCNG.      |           |   |
| Note 2: 1 is applicable for both UE Category NB1 and NB2; 2 is only applicable for UE Category NB2 if UE supports it. |           |   |

**Table 8.12.1.1-2: Test Parameters of related NPDCCH and NPUSCH format 2 configurations**

| Parameter  | Unit | Value  |
|--|------|--|
| DCI format   |      | DCI format N1  |
| scheduling delay field ( $I_{\text{Delay}}$ )              |      | For tests in 8.12.1.1.4: 1<br>For others: 1 for the first HARQ process;<br>2 for the second HARQ process if configured |
| $N_{\text{Rep}}^{\text{AN}}$ (ack-NACK-NumRepetitions-r13) |      | 1  |
| ACK/NACK resource field                                    |      | 0  |
| Reference channel for NPDCCH                               |      | R.NB.3 FDD for one NRS antenna port; R.NB.4 FDD for two NRS antenna ports  |
| $\alpha_{\text{offset}}$ (npdcch-Offset-USS-r13)           |      | 0  |

### 8.12.1.1.1 Minimum Requirements for In-band

The requirements are specified in Table 8.12.1.1.1-2, with the addition of the parameters in Table 8.12.1.1.1 -1 and the downlink physical channel setup according to Annex C.3.2 and C.3.6. The purpose of these tests is to verify the performance.

**Table 8.12.1.1.1-1: Test Parameters for NPDSCH under In-band**

| Parameter                               | Unit      | Test 1, 2 |
|---|-----------|-----------|
| Downlink power allocation of LTE signal | $\rho_A$  | dB        |
|   | $\rho_B$  | dB        |
|   | $\sigma$  | dB        |
| $N_{oc}$ at antenna port                | $N_{oc1}$ | dBm/15kHz |
|   | $N_{oc2}$ | dBm/15kHz |

|   |          |  |
|---|----------|--|
| LTE CRS port number (eutra-NumCRS-Ports-r13)  |          | 4  |
| NPDCCH repetition number  | subframe | 8 for Test 1; 16 for Test 2; 128 for Test 3. |
| $R_{\text{TRX}}$ ( <i>npdcch-NumRepetitions-r13</i> )   | subframe | 8 for Test 1; 16 for Test 2; 128 for Test 3. |
| $G$ ( <i>npdcch-startSF-USS-r13</i> )   |          | 4 for Test 1; 2 for Test 2; 1.5 for Test 3   |
| Note 1: $P_B = 1$ .<br>Note 2: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission;<br>Note 3: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |          |  |

**Table 8.12.1.1.1-2: Minimum performance under In-band with 2 NRS ports**

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Anchor       | R.NB.5 FDD        | 1                 | EPA5                  | 2x1 Low                                      | 70%                                | 6.9      | NB1, NB2    |
| 2           | 200kHz    | Anchor       | R.NB.5 FDD        | 32                | EPA5                  | 2x1 Low                                      | 70%                                | -4.8     | NB1, NB2    |
| 3           | 200kHz    | Non-anchor   | R.NB.5-1 FDD      | 256               | ETU1                  | 2x1 Low                                      | 70%                                | -9.8     | NB1, NB2    |

8.12.1.1.2 Minimum Requirements for Standalone/Guard-band

The requirements are specified in Table 8.12.1.1.2-2, with the addition of the parameters in Table 8.12.1.1.2 -1 and the downlink physical channel setup according to Annex C.3.6. The purpose of these tests is to verify the performance.

**Table 8.12.1.1.2-1: Test Parameters for NPDSCH under Standalone/Guard-band**

| Parameter  | Unit      |                                | Test 1, 2    |
|--|-----------|--------------------------------|--------------|
| $N_{oc}$ at antenna port   | $N_{oc1}$ | dBm/15kHz                      | -93 (Note 1) |
|  | $N_{oc2}$ | dBm/15kHz                      | -99 (Note 2) |
| NPDCCH repetition number   | subframe  | 32 for Test 1; 256 for Test 2. |              |
| $R_{\text{TRX}}$ ( <i>npdcch-NumRepetitions-r13</i> )  | subframe  | 64 for Test 1; 512 for Test 2. |              |
| $G$ ( <i>npdcch-startSF-USS-r13</i> )  |           | 1.5                            |              |
| Note 1: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission;<br>Note 2: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |           |                                |              |

**Table 8.12.1.1.2-2: Minimum performance for NPDSCH under Standalone/Guard-band with 1 NRS port**

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation condition | Number of NRS ports | Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|---------------------|-----------------------|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |                     |                       | Fraction of Maximum Throughput (%) | SNR (dB) |             |

|   |        |                    |                  |     |      |   |     |     |               |             |
|---|--------|--------------------|------------------|-----|------|---|-----|-----|---------------|-------------|
| 1 | 200kHz | Anch<br>or         | R.NB.6<br>FDD    | 32  | EPA5 | 1 | 1x1 | 70% | -<br>3.4      | NB1,<br>NB2 |
| 2 | 200kHz | Non-<br>anch<br>or | R.NB.6-<br>1 FDD | 256 | ETU1 | 1 | 1x1 | 70% | -<br>10.<br>2 | NB1,<br>NB2 |

### 8.12.1.1.3 Minimum Requirements for Standalone for UE Category NB2

The requirements are specified in Table 8.12.1.1.3-2, with the addition of the parameters in Table 8.12.1.1.3-1 and the downlink physical channel setup according to Annex C.3.6. The purpose of these tests is to verify the NPDSCH performance.

**Table 8.12.1.1.3-1: Test Parameters for NPDSCH under Standalone**

| Parameter                                      | Unit   |           | Test 1       |
|--|--|-----------|--------------|
| $N_{oc}$ at antenna port                       | $N_{oc1}$  | dBm/15kHz | -93 (Note 1) |
|  | $N_{oc2}$  | dBm/15kHz | -96 (Note 2) |
| NPDCCH repetition number                       | subframe   |           | 4 for Test 1 |
| $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> ) | subframe   |           | 8 for Test 1 |
| $G$ ( <i>npdcch-startSF-USS-r13</i> )          |  |           | 1.5          |
| Note 1:  | This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission; |           |              |
| Note 2:  | This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |           |              |

**Table 8.12.1.1.3-2: Minimum performance for NPDSCH under Standalone with 1 NRS port**

| Test number | Bandwidth | Carrier Type   | Reference Channel | Repetition number | Propagation condition | Number of NRS ports | Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|----------------|-------------------|-------------------|-----------------------|---------------------|-----------------------|------------------------------------|----------|-------------|
|             |           |                |                   |                   |                       |                     |                       | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Non-anch<br>or | R.NB.7<br>FDD     | 1                 | EPA5                  | 1                   | 1x1                   | 70%                                | 9.4      | NB2         |

### 8.12.1.1.4 Minimum Requirements for Standalone for UE with multiple TBs interleaved transmission

The requirements are specified in Table 8.12.1.1.4-2, with the addition of the parameters in Table 8.12.1.1.4-1 and the downlink physical channel setup according to Annex C.3.6. The purpose of these tests is to verify NPDSCH performance when multiple TBs with interleaved transmission are scheduled by one DCI as specified in TS 36.213[6].

These requirements are applicable for UE of UE-Category-NB NB2 supporting multiple TBs scheduling with interleaved transmission when multiple TBs are scheduled.

**Table 8.12.1.1.4-1: Test Parameters for NPDSCH under Standalone**

| Parameter                                      | Unit      |           | Test 1         |
|--|-----------|-----------|----------------|
| $N_{oc}$ at antenna port                       | $N_{oc1}$ | dBm/15kHz | -93 (Note 1)   |
|  | $N_{oc2}$ | dBm/15kHz | -99 (Note 2)   |
| NPDCCH repetition number                       | subframe  |           | 128 for Test 1 |
| $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> ) | subframe  |           | 128 for Test 1 |

|  |  |             |
|--|--|-------------|
| $G$ ( <i>nPDCCH-startSF-USS-r13</i> )  |  | 1.5         |
| Two HARQ processes ( <i>twoHARQ-ProcessesConfig-r14</i> )  |  | true        |
| Multiple TBs scheduling ( <i>multiTB-Config-r16</i> )  |  | interleaved |
| Note 1: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission;<br>Note 2: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |  |             |

**Table 8.12.1.1.4-2: Minimum performance for NPDSCH under Standalone with 1 NRS port**

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation condition | Number of NRS ports | Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|---------------------|-----------------------|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |                     |                       | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Non-anchor   | R.NB.8 FDD        | 32                | ETU1                  | 1                   | 1x1                   | 70%                                | -6.0     | NB2         |

8.12.1.2 TDD

**Table 8.12.1.2-1: Common Test Parameters**

| Parameter   | Unit      | Value  |
|---|-----------|--|
| Uplink downlink configuration (Note 1)  |           | 4  |
| Special subframe configuration (Note 2)   |           | 4  |
| Number of HARQ processes per component carrier (Note 4)   | Processes | 1 or 2   |
| Maximum number of HARQ transmission   |           | 4  |
| Cyclic Prefix   |           | Normal   |
| extraControlRegionSize-r13  |           | 2 for In-band, N/A for Standalone/Guard-band unless otherwise stated |
| downlinkBitmap-r13 and dl-Gap-r13   |           | Not configured   |
| dl-GapNonAnchor-r13 and downlinkBitmapNonAnchor-r13   |           | Not configured   |
| Unused REs or RB (Note 3)   |           | OCNG   |
| OCNG pattern  |           | NB.OP.1  |
| Note 1: As specified in Table 4.2-2 in TS 36.211 [4]<br>Note 2: As specified in Table 4.2-1 in TS 36.211 [4]<br>Note 3: For in-band mode, the REs for transmission of LTE signals including PDCCH, CRS should be filled by OCNG.<br>Note 4: 1 is applicable for both UE Category NB1 and NB2; 2 is only applicable for UE Category NB2 if UE supports it. |           |  |

**Table 8.12.1.2-2: Test Parameters of related NPDCCH and NPUSCH format 2 configurations**

| Parameter  | Unit | Value         |
|------------|------|---------------|
| DCI format |      | DCI format N1 |

|   |  |  |
|---|--|--|
| scheduling delay field<br>( $I_{Delay}$ )             |  | 1 for the first HARQ process;<br>2 for the second HARQ process if configured |
| $N_{Rep}^{AN}$ ( <i>ack-NACK-NumRepetitions-r13</i> ) |  | 1  |
| ACK/NACK resource field                               |  | 0  |
| Reference channel for NPDCCH                          |  | R.NB.3 TDD for one NRS antenna port; R.NB.4 TDD for two NRS antenna ports    |
| $\alpha_{offset}$ ( <i>npdcch-Offset-USS-r13</i> )    |  | 0  |

8.12.1.2.1 Minimum Requirements for In-band

The requirements are specified in Table 8.12.1.2.1-2, with the addition of the parameters in Table 8.12.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2 and C.3.6. The purpose of these tests is to verify the performance.

**Table 8.12.1.2.1-1: Test Parameters for NPDSCH under In-band**

| Parameter   | Unit      | Test 1, 2                                    |
|---|-----------|--|
| Downlink power allocation of LTE signal   | $\rho_A$  | dB   |
|   | $\rho_B$  | dB   |
|   | $\sigma$  | dB   |
| $N_{oc}$ at antenna port  | $N_{oc1}$ | dBm/15kHz                                    |
|   | $N_{oc2}$ | dBm/15kHz                                    |
| LTE CRS port number (eutra-NumCRS-Ports-r13)  |           | 4  |
| NPDCCH repetition number  | subframe  | 8 for Test 1; 16 for Test 2; 128 for Test 3. |
| $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> )  | subframe  | 8 for Test 1; 16 for Test 2; 128 for Test 3. |
| $G$ ( <i>npdcch-startSF-USS-r13</i> )   |           | 4  |
| Note 1: $P_B = 1$ .<br>Note 2: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission;<br>Note 3: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |           |  |

**Table 8.12.1.2.1-2: Minimum performance under In-band with 2 NRS ports**

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Anchored     | R.NB.5 TDD        | 1                 | EPA5                  | 2x1 Low                                      | 70%                                | 6.9      | NB1, NB2    |
| 2           | 200kHz    | Anchored     | R.NB.5 TDD        | 32                | EPA5                  | 2x1 Low                                      | 70%                                | -4.8     | NB1, NB2    |
| 3           | 200kHz    | Non-anchored | R.NB.5-1 TDD      | 256               | ETU1                  | 2x1 Low                                      | 70%                                | -9.8     | NB1, NB2    |



## 8.12.1.2.2 Minimum Requirements for Standalone/Guard-band

The requirements are specified in Table 8.12.1.2.2-2, with the addition of the parameters in Table 8.12.1.2.2-1 and the downlink physical channel setup according to Annex C.3.6. The purpose of these tests is to verify the performance.

**Table 8.12.1.2.2-1: Test Parameters for NPDSCH under Standalone/Guard-band**

| Parameter                                      | Unit   |           | Test 1, 2                      |
|--|--|-----------|--------------------------------|
| $N_{oc}$ at antenna port                       | $N_{oc1}$  | dBm/15kHz | -93 (Note 1)                   |
|  | $N_{oc2}$  | dBm/15kHz | -99 (Note 2)                   |
| NPDCCH repetition number                       |  | subframe  | 32 for Test 1; 256 for Test 2. |
| $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> ) |  | subframe  | 32 for Test 1; 256 for Test 2. |
| $G$ ( <i>nPDCCH-startSF-USS-r13</i> )          |  |           | 4                              |
| Note 1:  | This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission; |           |                                |
| Note 2:  | This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |           |                                |

**Table 8.12.1.2.2-2: Minimum performance for NPDSCH under Standalone/Guard-band with 1 NRS port**

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation condition | Number of NRS ports | Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|---------------------|-----------------------|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |                     |                       | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Anchor       | R.NB.6 TDD        | 32                | EPA5                  | 1                   | 1x1                   | 70%                                | -3.4     | NB1, NB2    |
| 2           | 200kHz    | Non-anchor   | R.NB.6-1 TDD      | 256               | ETU1                  | 1                   | 1x1                   | 70%                                | -10.2    | NB1, NB2    |

## 8.12.1.2.3 Minimum Requirements for Standalone for UE Category NB2

The requirements are specified in Table 8.12.1.2.3-2, with the addition of the parameters in Table 8.12.1.2.3-1 and the downlink physical channel setup according to Annex C.3.6. The purpose of these tests is to verify the NPDSCH performance.

**Table 8.12.1.2.3-1: Test Parameters for NPDSCH under Standalone**

| Parameter                                      | Unit   |           | Test 1       |
|--|--|-----------|--------------|
| $N_{oc}$ at antenna port                       | $N_{oc1}$  | dBm/15kHz | -93 (Note 1) |
|  | $N_{oc2}$  | dBm/15kHz | -96 (Note 2) |
| NPDCCH repetition number                       |  | subframe  | 4 for Test 1 |
| $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> ) |  | subframe  | 8 for Test 1 |
| $G$ ( <i>nPDCCH-startSF-USS-r13</i> )          |  |           | 4            |
| Note 1:  | This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission; |           |              |
| Note 2:  | This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission. |           |              |

Table 8.12.1.2.3-2: Minimum performance for NPDSCH under Standalone with 1 NRS port

| Test number | Bandwidth | Carrier Type | Reference Channel | Repetition number | Propagation condition | Number of NRS ports | Antenna Configuration | Reference value                    |          | UE Category |
|-------------|-----------|--------------|-------------------|-------------------|-----------------------|---------------------|-----------------------|------------------------------------|----------|-------------|
|             |           |              |                   |                   |                       |                     |                       | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 200kHz    | Non-anchor   | R.NB.7 TDD        | 1                 | EPA5                  | 1                   | 1x1                   | 70%                                | 9.4      | NB2         |

## 8.12.2 NPDCCH

The receiver characteristics of the NPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

### 8.12.2.1 Half-duplex FDD

The parameters specified in Table 8.12.2.1-1 and Table 8.12.2.1-2 are valid for all half-duplex FDD tests unless otherwise stated.

Table 8.12.2.1-1: Test Parameters for NPDCCH

| Parameter   | Unit      | Single antenna port              | Transmit diversity             |
|---|-----------|----------------------------------|--------------------------------|
| Narrowband physical layer Cell ID   |           | 0                                | 0                              |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98                              | -98                            |
| Cyclic prefix   |           | Normal                           | Normal                         |
| Number of CRS ports for in-band deployment mode   |           | 4                                | 4                              |
| NPDCCH starting position ( <i>euTraControlRegionSize-r13</i> ) (Note 1)                                 |           | 3                                | 3                              |
| Maximum number of repetitions $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> )                            |           | 128 for Test 1; 1024 for Test 2. | 64 for Test 1; 512 for Test 2. |
| NPDCCH start subframe $G$ ( <i>npdcch-startSF-USS-r13</i> )   |           | 2 for test 1, 1.5 for test 2     | 2 for test 1, 1.5 for test 2   |
| NPDCCH fractional period offset of starting subframe $\alpha_{offset}$ ( <i>npdcch-Offset-USS-r13</i> ) |           | 0                                | 0                              |
| NB-IoT downlink subframe bitmap for anchor carrier ( <i>downlinkBitmap-r13</i> )                        |           | Not configured                   | Not configured                 |
| NB-IoT downlink subframe bitmap for non-anchor carrier ( <i>downlinkBitmapNonAnchor-r13</i> )           |           | Not configured                   | Not configured                 |
| Downlink gap configuration for anchor carrier ( <i>dl-Gap-r13</i> )                                     |           | Not configured                   | Not configured                 |
| Downlink gap configuration for non-anchor carrier ( <i>dl-GapNonAnchor-r13</i> )                        |           | Not configured                   | Not configured                 |
| Unused REs or RBs (Note 1)  |           | OCNG                             | OCNG                           |
| OCNG pattern  |           | NB.OP.1                          | NB.OP.1                        |
| NOTE 1: Applicable only for in-band deployment mode.  |           |                                  |                                |

Table 8.12.2.1-2: Test Parameters of related NPDSCH and NPUSCH format 2 configurations

| Parameter | Unit | Value |
|-----------|------|-------|
|-----------|------|-------|

|   |           |   |
|---|-----------|---|
| Scheduling delay field<br>( $I_{\text{Delay}}$ )                    |           | 0   |
| NPDSCH Repetition number  |           | 1   |
| $N_{oc}$ at antenna port for NPDSCH                                 | dBm/15kHz | -98   |
| $N_{\text{Rep}}^{\text{AV}}$ ( <i>ack-NACK-NumRepetitions-r13</i> ) |           | 1   |
| ACK/NACK resource field   |           | 0   |
| Reference channel for NPDSCH  |           | R.NB.6 FDD and R.NB.6-1 FDD for one NRS antenna port; R.NB.5 FDD and R.NB.5-1 FDD for two NRS antenna ports |

### 8.12.2.1.1 Single-antenna performance

For the parameters specified in Table 8.12.2.1.1-1 the average probability of a missed downlink scheduling grant ( $P_{\text{m-dsg}}$ ) shall be below the specified value in Table 8.12.2.1.1-1. The downlink physical channel setup is in accordance with Annex C.3.6.

**Table 8.12.2.1.1-1: Minimum performance NPDCCH**

| Test number | Deployment mode        | Repetition number (R) | Carrier Type | Reference Channel | Propagation Condition | Number of NRS ports | Antenna Configuration | Reference value        |          | UE Category |
|-------------|------------------------|-----------------------|--------------|-------------------|-----------------------|---------------------|-----------------------|------------------------|----------|-------------|
|             |                        |                       |              |                   |                       |                     |                       | $P_{\text{m-dsg}}$ (%) | SNR (dB) |             |
| 1           | Stand-alone/Guard-band | 128                   | Anchor       | R.NB.3 FDD        | EPA5                  | 1                   | 1x1                   | 1                      | -4.9     | NB1, NB2    |
| 2           | Stand-alone/Guard-band | 1024                  | Non-anchor   | R.NB.3 FDD        | ETU1                  | 1                   | 1x1                   | 1                      | -11.4    | NB1, NB2    |

### 8.12.2.1.2 Transmit diversity performance

For the parameters specified in Table 8.12.2.1.2-1 the average probability of a missed downlink scheduling grant ( $P_{\text{m-dsg}}$ ) shall be below the specified value in Table 8.12.2.1.2-1. The downlink physical channel setup is in accordance with Annex C.3.6.

**Table 8.12.2.1.2-1: Minimum performance NPDCCH**

| Test number | Deployment mode | Repetition number (R) | Carrier Type | Reference Channel | Propagation Condition | Number of NRS ports | Antenna Configuration and correlation matrix | Reference value        |          | UE Category |
|-------------|-----------------|-----------------------|--------------|-------------------|-----------------------|---------------------|--|------------------------|----------|-------------|
|             |                 |                       |              |                   |                       |                     |  | $P_{\text{m-dsg}}$ (%) | SNR (dB) |             |
| 1           | In-band         | 64                    | Anchor       | R.NB.4 FDD        | EPA5                  | 2                   | 2x1 Low                                      | 1                      | -3.9     | NB1, NB2    |
| 2           | In-band         | 512                   | Non-anchor   | R.NB.4 FDD        | ETU1                  | 2                   | 2x1 Low                                      | 1                      | -10.0    | NB1, NB2    |

## 8.12.2.2 TDD

The parameters specified in Table 8.12.2.2-1 and Table 8.12.2.2-2 are valid for all TDD tests unless otherwise stated.

Table 8.12.2.2-1: Test Parameters for NPDCCH

| Parameter   | Unit      | Single antenna port                 | Transmit diversity                |
|---|-----------|-------------------------------------|-----------------------------------|
| Uplink downlink configuration (Note 1)  |           | 4                                   | 4                                 |
| Special subframe configuration (Note 2)   |           | 4                                   | 4                                 |
| Narrowband physical layer Cell ID   |           | 0                                   | 0                                 |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98                                 | -98                               |
| Cyclic prefix   |           | Normal                              | Normal                            |
| Number of CRS ports for in-band deployment mode   |           | 4                                   | 4                                 |
| NPDCCH starting position ( <i>extraControlRegionSize-r13</i> ) (Note 1)                                 |           | 2                                   | 2                                 |
| Maximum number of repetitions $R_{max}$ ( <i>npdcch-NumRepetitions-r13</i> )                            |           | 128 for Test 1;<br>1024 for Test 2. | 64 for Test 1;<br>512 for Test 2. |
| NPDCCH start subframe $G$ ( <i>npdcch-startSF-USS-r13</i> )   |           | 4                                   | 4                                 |
| NPDCCH fractional period offset of starting subframe $\alpha_{offset}$ ( <i>npdcch-Offset-USS-r13</i> ) |           | 0                                   | 0                                 |
| NB-IoT downlink subframe bitmap for anchor carrier ( <i>downlinkBitmap-r13</i> )                        |           | Not configured                      | Not configured                    |
| NB-IoT downlink subframe bitmap for non-anchor carrier ( <i>downlinkBitmapNonAnchor-r13</i> )           |           | Not configured                      | Not configured                    |
| Downlink gap configuration for anchor carrier ( <i>dl-Gap-r13</i> )                                     |           | Not configured                      | Not configured                    |
| Downlink gap configuration for non-anchor carrier ( <i>dl-GapNonAnchor-r13</i> )                        |           | Not configured                      | Not configured                    |
| Unused REs or RBs (Note 1)  |           | OCNG                                | OCNG                              |
| OCNG pattern  |           | NB.OP.1                             | NB.OP.1                           |
| NOTE 1: Applicable only for in-band deployment mode.  |           |                                     |                                   |

Table 8.12.2.2-2: Test Parameters of related NPDSCH and NPUSCH format 2 configurations

| Parameter   | Unit      | Value   |
|---|-----------|---|
| Scheduling delay field ( $I_{Delay}$ )                |           | 0   |
| NPDSCH Repetition number                              |           | 1   |
| $N_{oc}$ at antenna port for NPDSCH                   | dBm/15kHz | -98   |
| $N_{Rep}^{AV}$ ( <i>ack-NACK-NumRepetitions-r13</i> ) |           | 1   |
| ACK/NACK resource field                               |           | 0   |
| Reference channel for NPDSCH                          |           | R.NB.6 TDD and R.NB.6-1 TDD for one NRS antenna port; R.NB.5 TDD and R.NB.5-1 TDD for two NRS antenna ports |

### 8.12.2.2.1 Single-antenna performance

For the parameters specified in Table 8.12.2.2.1-1 the average probability of a missed downlink scheduling grant ( $P_{m-dsg}$ ) shall be below the specified value in Table 8.12.2.2.1-1. The downlink physical channel setup is in accordance with Annex C.3.6.

**Table 8.12.2.2.1-1: Minimum performance NPDCCH**

| Test number | Deployment mode        | Repetition number (R) | Carrier Type | Reference Channel | Propagation Condition | Number of NRS ports | Antenna Configuration | Reference value |          | UE Category |
|-------------|------------------------|-----------------------|--------------|-------------------|-----------------------|---------------------|-----------------------|-----------------|----------|-------------|
|             |                        |                       |              |                   |                       |                     |                       | $P_{m-dsg}$ (%) | SNR (dB) |             |
| 1           | Stand-alone/Guard-band | 128                   | Anchor       | R.NB.3 TDD        | EPA5                  | 1                   | 1x1                   | 1               | -4.9     | NB1, NB2    |
| 2           | Stand-alone/Guard-band | 1024                  | Non-anchor   | R.NB.3 TDD        | ETU1                  | 1                   | 1x1                   | 1               | -11.4    | NB1, NB2    |

### 8.12.2.2.2 Transmit diversity performance

For the parameters specified in Table 8.12.2.2.2-1 the average probability of a missed downlink scheduling grant ( $P_{m-dsg}$ ) shall be below the specified value in Table 8.12.2.2.2-1. The downlink physical channel setup is in accordance with Annex C.3.6.

**Table 8.12.2.2.2-1: Minimum performance NPDCCH**

| Test number | Deployment mode | Repetition number (R) | Carrier Type | Reference Channel | Propagation Condition | Number of NRS ports | Antenna Configuration and correlation matrix | Reference value |          | UE Category |
|-------------|-----------------|-----------------------|--------------|-------------------|-----------------------|---------------------|--|-----------------|----------|-------------|
|             |                 |                       |              |                   |                       |                     |  | $P_{m-dsg}$ (%) | SNR (dB) |             |
| 1           | In-band         | 64                    | Anchor       | R.NB.4 TDD        | EPA5                  | 2                   | 2x1 Low                                      | 1               | -3.9     | NB1, NB2    |
| 2           | In-band         | 512                   | Non-anchor   | R.NB.4 TDD        | ETU1                  | 2                   | 2x1 Low                                      | 1               | -10.0    | NB1, NB2    |

## 8.12.3 Demodulation of NPBCH

The receiver characteristics of the NPBCH are determined by the probability of miss-detection of the NPBCH ( $P_{m-bch}$ ), which is defined as

$$P_{m-bch} = 1 - \frac{A}{B}$$

For the performance with single a NPBCH TTI decoding, A is the number of correctly decoded MIB-NB PDUs and B is the number of transmitted MIB-NB PDUs.

For the performance with multiple NPBCH TTIs decoding, A is the number of 5120ms durations consisting of contiguous NPBCH TTIs where there is at least one correctly decoded MIB-NB PDU, and B is the number of 5120ms durations consisting of contiguous NPBCH TTIs during the test.

## 8.12.3.1 HD-FDD

Table 8.12.3.1-1: Test Parameters for NPBCH

| Parameter                 |          | Unit      | Single antenna port | Transmit diversity |
|---------------------------|----------|-----------|---------------------|--------------------|
| Downlink power allocation | NPBCH_RA | dB        | 0                   | -3                 |
|                           | NPBCH_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                 | -98                |
| Cyclic prefix             |          |           | Normal              | Normal             |
| Cell ID                   |          |           | 0                   | 0                  |

## 8.12.3.1.1 Single-antenna port performance with single NPBCH TTI

For the parameters specified in Table 8.12.3.1-1 the average probability of a miss-detecting NPBCH ( $P_{m-bch}$ ) shall be below the specified value in Table 8.12.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.6.

Table 8.12.3.1.1-1: Minimum performance NPBCH

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration | Reference value |          | UE Category |
|-------------|-----------|-------------------|-----------------------|-----------------------|-----------------|----------|-------------|
|             |           |                   |                       |                       | $P_{m-bch}$ (%) | SNR (dB) |             |
| 1           | 200 KHz   | R.NB1.1           | EPA1                  | 1 x 1                 | 1               | -2.0     | NB1, NB2    |

## 8.12.3.1.2 Transmit diversity performance

## 8.12.3.1.2.1 Minimum Requirement 2 Tx Antenna Port with multiple NPBCH TTIs

For the parameters specified in Table 8.12.3.1-1 the average probability of a miss-detected NPBCH ( $P_{m-bch}$ ) shall be below the specified value in Table 8.12.3.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.6.

Table 8.12.3.1.2.1-1: Minimum performance NPBCH

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          | UE Category |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|-------------|
|             |           |                   |                       |  | $P_{m-bch}$ (%) | SNR (dB) |             |
| 1           | 200 KHz   | R.NB1.2           | EPA1                  | 2 x 1 Low                                    | 1               | -11.5    | NB1, NB2    |

## 8.12.3.2 TDD

Table 8.12.3.2-1: Test Parameters for NPBCH TDD

| Parameter   |          | Unit      | Single antenna port | Transmit diversity |
|---|----------|-----------|---------------------|--------------------|
| Downlink power allocation                             | NPBCH_RA | dB        | 0                   | -3                 |
|   | NPBCH_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port                              |          | dBm/15kHz | -98                 | -98                |
| Cyclic prefix   |          |           | Normal              | Normal             |
| Cell ID   |          |           | 0                   | 0                  |
| Uplink downlink configuration (Note 1)                |          |           | 4                   | 4                  |
| Special subframe configuration (Note 2)               |          |           | 4                   | 4                  |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. |          |           |                     |                    |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. |          |           |                     |                    |

### 8.12.3.2.1 Single-antenna port performance with single NPBCH TTI

For the parameters specified in Table 8.12.3.2-1 the average probability of a miss-detecting NPBCH (P<sub>m-bch</sub>) shall be below the specified value in Table 8.12.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.6.

**Table 8.12.3.2.1-1: Minimum performance NPBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-----------------------|-----------------------|------------------------|----------|-------------|
|             |           |                   |                       |                       | P <sub>m-bch</sub> (%) | SNR (dB) |             |
| 1           | 200 KHz   | R.NB1.1           | EPA1                  | 1 x 1                 | 1                      | -2.0     | NB1, NB2    |

### 8.12.3.2.2 Transmit diversity performance

#### 8.12.3.2.2.1 Minimum Requirement 2 Tx Antenna Port with multiple NPBCH TTIs

For the parameters specified in Table 8.12.3.2-1 the average probability of a miss-detected NPBCH (P<sub>m-bch</sub>) shall be below the specified value in Table 8.12.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.6.

**Table 8.12.3.2.2.1-1: Minimum performance NPBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          | UE Category |
|-------------|-----------|-------------------|-----------------------|--|------------------------|----------|-------------|
|             |           |                   |                       |  | P <sub>m-bch</sub> (%) | SNR (dB) |             |
| 1           | 200 KHz   | R.NB1.2           | EPA1                  | 2 x 1 Low                                    | 1                      | -11.5    | NB1, NB2    |

## 8.13 Demodulation of PDSCH CA and DC(4 receiver antenna ports)

### 8.13.1 FDD (CA and DC)

The parameters specified in Table 8.13.1-1 are valid for all FDD CA and DC tests unless otherwise stated.

**Table 8.13.1-1: Common Test Parameters (FDD)**

| Parameter  | Unit         | Value  |
|--|--------------|--|
| Inter-TTI Distance                                     |              | 1  |
| Number of HARQ processes per component carrier         | Processes    | 8  |
| Maximum number of HARQ transmission                    |              | 4  |
| Redundancy version coding sequence                     |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cyclic Prefix  |              | Normal   |
| Cell_ID  |              | 0  |
| Cross carrier scheduling                               |              | Not configured   |

#### 8.13.1.1 Closed-loop spatial multiplexing performance

##### 8.13.1.1.1 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

The purpose of these tests is to verify the closed loop rank-two performance with frequency selective precoding.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.1.1.1-3, based on single carrier requirement specified in Table 8.13.1.1.1-2, with the addition of the parameters in Table 8.13.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.13.1.1.1-4, based on single carrier requirement specified in Table 8.13.1.1.1-2, with the addition of the parameters in Table 8.13.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.13.1.1.1-5, based on single carrier requirement specified in Table 8.13.1.1.1-2, with the addition of the parameters in Table 8.13.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.13.1.1.1-6, based on single carrier requirement specified in Table 8.13.1.1.1-2, with the addition of the parameters in Table 8.13.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.1.1.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit      | Value  |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs            |
| PMI delay (Note 2)  |          | ms        | 8  |
| Reporting interval  |          | ms        | 1  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>0011111111111111111111000000000000<br>0000 |
| CSI request field (Note 3)  |          |           | '10'   |
| PDSCH transmission mode   |          |           | 4  |
| Note 1: $P_B = 1$ .   |          |           |  |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).               |          |           |  |
| Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.   |          |           |  |
| Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for Tests in Table 8.13.1.1.1-3, and with PUCCH format 3 for Tests in Table 8.13.1.1.1-4, Table 8.13.1.1.1-5 and Table 8.13.1.1.1-6. |          |           |  |
| Note 5: The same PDSCH transmission mode is applied to each component carrier.  |          |           |  |

**Table 8.13.1.1.1-2: Single carrier performance for multiple CA configurations**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                    | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                 | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                 | 10.1     | 5.7    |



|        |            |            |          |      |         |         |    |      |     |
|--------|------------|------------|----------|------|---------|---------|----|------|-----|
| 15M Hz | R.14-7 FDD | R.14-7 FDD | OP.1 FDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.1 | 5.6 |
| 20M Hz | R.14-3 FDD | R.14-3 FDD | OP.1 FDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.3 | 5.6 |

**Table 8.13.1.1.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x10 MHz                  | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 2x20 MHz                  | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3         | 2x5 MHz                   | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4         | 15MHz+5MHz                | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5         | 10MHz+5MHz                | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.1.1.1-4: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 3x20MHz                   | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 20MHz+20MHz+15MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3         | 20MHz+20MHz+10MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4         | 20MHz+15MHz+15MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5         | 20MHz+15MHz+10MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 6         | 20MHz+10MHz+10MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 7         | 15MHz+15MHz+10MHz         | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 8         | 20MHz+10MHz+5MHz          | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 9         | 20MHz+15MHz+5MHz          | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 10        | 10MHz+10MHz+5MHz          | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 11        | 5MHz+5MHz+20MHz           | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 12        | 3x10MHz                   | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 13        | 5MHz+5MHz+10MHz           | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.1.1.1-5: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |

|   |                         |  |          |
|---|-------------------------|--|----------|
| 2   | 10MHz+20MHz+20MHz+20MHz | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 3   | 10MHz+10MHz+20MHz+20MHz | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 4   | 5MHz+10MHz+20MHz+20MHz  | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 5   | 5MHz+10MHz+10MHz+20MHz  | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 6   | 15+3x20MHz              | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 7   | 2x15+2x20MHz            | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 8   | 10+15+2x20MHz           | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 9   | 3x10+20MHz              | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 10  | 2x5+2x20MHz             | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 11  | 2x5+10+20MHz            | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| 12  | 4x10MHz                 | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 8$ |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                         |  |          |

**Table 8.13.1.1.1-6: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category  |
|---|---------------------------|--|--------------|
| 1   | 5x20MHz                   | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 2   | 15MHz+4x20MHz             | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 3   | 10MHz+4x20MHz             | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 4   | 2x10MHz+3x20MHz           | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 5   | 5MHz+10MHz+3x20MHz        | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 6   | 3x10MHz+2x20MHz           | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| 7   | 4x10MHz+20MHz             | As specified in Table 8.13.1.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, $\geq 11$ |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |              |

### 8.13.1.1.2 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.13.1.1.2-3 for 2DL CCs and Table 8.13.1.1.2-4 for 3DL CCs, based on single carrier requirement specified in Table 8.13.1.1.2-2, with the addition of the parameters in Table 8.13.1.1.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity transmission.

**Table 8.13.1.1.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Parameter                 | Unit     | Values      |
|---------------------------|----------|-------------|
| Downlink power allocation | $\rho_A$ | dB          |
|                           | $\rho_B$ | dB          |
|                           | $\sigma$ | dB          |
|                           |          | -6          |
|                           |          | -6 (Note 1) |
|                           |          | 3           |

|   |           |   |
|---|-----------|---|
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |
| Precoding granularity   | PRB       | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs   |
| PMI delay (Note 2)  | ms        | 8   |
| Reporting interval  | ms        | 1   |
| Reporting mode  |           | PUSCH 1-2   |
| CodeBookSubsetRestriction bitmap  |           | 00000000000000000000000000000000<br>00001111111111111111100000000<br>00000000   |
| PDSCH transmission mode   |           | 4   |
| ACK/NACK transmission   |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG   |
| CSI feedback  |           | Separate PUSCH feedbacks on the MCG and SCG   |
| Time offset between MCG CC and SCG CC   | $\mu$ s   | 0 for UE under test supporting synchronous dual connectivity; 334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 4) |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: The same PDSCH transmission mode is applied to each component carrier.</p> <p>Note 4: As defined in TS36.300 [11].</p> <p>Note 5: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.</p> |           |   |

**Table 8.13.1.1.2-2: Single carrier performance for multiple DC configurations**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-------------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                         | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                         |  |         |                                    | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.1     | 5.7    |
| 15M Hz       | R.14-7 FDD        | R.14-7 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.1     | 5.6    |
| 20M Hz       | R.14-3 FDD        | R.14-3 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.3     | 5.6    |

**Table 8.13.1.1.2-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity with 2 DL CCs**

| Test num. | Band-width combination | Requirement  | UE category |
|-----------|------------------------|--|-------------|
| 1         | 2x20 MHz               | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 5$    |
| 2         | 15+20 MHz              | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 5$    |
| 3         | 10+20MHz               | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | $\geq 5$    |

|   |           |  |    |
|---|-----------|--|----|
| 4   | 2x15 MHz  | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5 |
| 5   | 2x10 MHz  | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥3 |
| 6   | 15+5 MHz  | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥3 |
| 7   | 10+15 MHz | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.6. |           |  |    |

**Table 8.13.1.1.2-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity with 3DL CCs**

| Test num.   | Band-width combination | Requirement  | UE category |
|---|------------------------|--|-------------|
| 1   | 20+20+15MHz            | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 20+15+15MHz            | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3   | 3x20 MHz               | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4   | 20+20+10 MHz           | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5   | 20+15+10 MHz           | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 6   | 20+10+10 MHz           | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 7   | 15+15+10 MHz           | As specified in Table 8.13.1.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.6. |                        |  |             |

**8.13.1.1.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port with 256QAM**

The purpose of these tests is to verify the closed loop rank-two performance with frequency selective precoding with 256QAM under CA.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.1.1.3-3, based on single carrier requirement specified in Table 8.13.1.1.3-2, with the addition of the parameters in Table 8.13.1.1.3-1 and the downlink physical channel setup according to Annex C.3.2. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.1.1.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                        | Unit      | Value  |
|----------------------------------|-----------|--|
| Downlink power allocation        | $\rho_A$  | dB   |
|                                  | $\rho_B$  | dB   |
|                                  | $\sigma$  | dB   |
| $N_{oc}$ at antenna port         | dBm/15kHz | -98  |
| Precoding granularity            | PRB       | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs          |
| PMI delay (Note 2)               | ms        | 8  |
| Reporting interval               | ms        | 1  |
| Reporting mode                   |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap |           | 00000000000000000000000000000000<br>00111111111111111111000000000000<br>0000 |

|  |  |      |
|--|--|------|
| CSI request field (Note 3)   |  | '10' |
| PDSCH transmission mode  |  | 4    |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.<br>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for Tests in Table 8.13.1.1.3-3.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |  |      |

**Table 8.13.1.1.3-2: Single carrier performance for multiple CA configurations**

| Band - width | Reference channel |            | OCNG pattern | Propagation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-----------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                       | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                       |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 FDD        | R.72-1 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 23.4     | 19.3   |
| 10 MHz       | R.72 FDD          | R.72 FDD   | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.6     | 18.0   |
| 15M Hz       | R.72-2 FDD        | R.72-2 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.7     | 17.4   |
| 20M Hz       | R.72-3 FDD        | R.72-3 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.8     | 17.5   |

**Table 8.13.1.1.3-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x10 MHz                  | As specified in Table 8.13.1.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 2x20 MHz                  | As specified in Table 8.13.1.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3   | 2x5 MHz                   | As specified in Table 8.13.1.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4   | 15MHz+5MHz                | As specified in Table 8.13.1.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5   | 10MHz+5MHz                | As specified in Table 8.13.1.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**8.13.1.1.4 Minimum Requirement Four-Layer Spatial Multiplexing 4 Tx Antenna Port**

The purpose of these tests is to verify the closed loop rank-four performance with wideband precoding with 4Tx and 4Rx under CA.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.1.1.4-3, based on single carrier requirement specified in Table 8.13.1.1.4-2, with the addition of the parameters in Table 8.13.1.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.1.1.4-1: Test Parameters for Four-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                 | Unit     | Value       |
|---------------------------|----------|-------------|
| Downlink power allocation | $\rho_A$ | dB          |
|                           | $\rho_B$ | dB          |
|                           |          | -6 (Note 1) |

|  |          |           |   |
|--|----------|-----------|---|
|  | $\sigma$ | dB        | 0   |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98   |
| Cell-specific reference signals  |          |           | Antenna Ports 0,1,2,3   |
| Precoding granularity  |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs |
| PMI delay (Note 2)   |          | ms        | 8   |
| Reporting interval   |          | ms        | 1   |
| Reporting mode   |          |           | PUSCH 3-1   |
| CodeBookSubsetRestriction bitmap   |          |           | 0xFFFF000000000000  |
| CSI request field (Note 3)   |          |           | '10'  |
| PDSCH transmission mode  |          |           | 4   |
| PDSCH rank   |          |           | 4   |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.<br>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |          |           |   |

**Table 8.13.1.1.4-2: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.1     |
| 10MHz      | R.74 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.9     |
| 15MHz      | R.74-2 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.3     |
| 20MHz      | R.74-3 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.4     |

**Table 8.13.1.1.4-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement                               | UE category |
|---|---------------------------|---|-------------|
| 1   | 2x10 MHz                  | As specified in Table 8.13.1.1.4-2 per CC | $\geq 5$    |
| 2   | 2x20 MHz                  | As specified in Table 8.13.1.1.4-2 per CC | $\geq 5$    |
| 3   | 2x5 MHz                   | As specified in Table 8.13.1.1.4-2 per CC | $\geq 5$    |
| 4   | 15MHz+5MHz                | As specified in Table 8.13.1.1.4-2 per CC | $\geq 5$    |
| 5   | 10MHz+5MHz                | As specified in Table 8.13.1.1.4-2 per CC | $\geq 5$    |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |   |             |

### 8.13.1.2 Dual-Layer Spatial Multiplexing (User-Specific Reference Symbols)

#### 8.13.1.2.1 Minimum Requirement Dual-Layer Spatial Multiplexing 2 Tx Antenna Port

For CA with 2 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.1.2.1-3, based on single carrier requirement specified in Table 8.13.1.2.1-2, with the addition of the parameters in Table 8.13.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.1.2.1-4, based on single carrier requirement specified in Table

8.13.1.2.1-2, with the addition of the parameters in Table 8.13.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.1.2.1-5, based on single carrier requirement specified in Table 8.13.1.2.1-2, with the addition of the parameters in Table 8.13.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.1.2.1-6, based on single carrier requirement specified in Table 8.13.1.2.1-2, with the addition of the parameters in Table 8.13.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.1.2.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit                  | Values                                |
|---|----------|-----------------------|---------------------------------------|
| Downlink power allocation   | $\rho_A$ | dB                    | 0                                     |
|   | $\rho_B$ | dB                    | 0 (Note 1)                            |
|   | $\sigma$ | dB                    | -3                                    |
| Cell-specific reference signals   |          |                       | Antenna ports 0 and 1                 |
| Cell ID   |          |                       | 0                                     |
| CSI reference signals   |          |                       | Antenna ports 15,16                   |
| Beamforming model   |          |                       | Annex B.4.2                           |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          | Subframes             | 5 / 2                                 |
| CSI reference signal configuration  |          |                       | 8                                     |
| Zero-power CSI-RS configuration<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS bitmap}$  |          | Subframes /<br>bitmap | 3 /<br>0010000000000000               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz             | -98                                   |
| $\hat{E}_s / N_{oc}$  |          |                       | Reference Value in Table 8.13.1.2.1-2 |
| Symbols for unused PRBs   |          |                       | OCNG (Note 2)                         |
| Number of allocated resource blocks (Note 2)  |          | PRB                   | 50                                    |
| Simultaneous transmission   |          |                       | No                                    |
| PDSCH transmission mode   |          |                       | 9                                     |
| Note 1: $P_B = 1$   |          |                       |                                       |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                       |                                       |

**Table 8.13.1.2.1-2: Single carrier performance for multiple CA configurations**

| Band - width | Reference channel |            | OCNG pattern | Propagation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-----------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                       | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                       |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz         | R.51-2 FDD        | R.51-2 FDD | OP.1 FDD     | ETU5                  | 2x2 Low                                | 2x4 Low | 70                                 | 14.2     | 9.0    |
| 10 MHz       | R.51 FDD          | R.51 FDD   | OP.1 FDD     | ETU5                  | 2x2 Low                                | 2x4 Low | 70                                 | 13.7     | 8.8    |
| 15M Hz       | R.51-3 FDD        | R.51-3 FDD | OP.1 FDD     | ETU5                  | 2x2 Low                                | 2x4 Low | 70                                 | 13.6     | 8.7    |
| 20M Hz       | R.51-4 FDD        | R.51-4 FDD | OP.1 FDD     | ETU5                  | 2x2 Low                                | 2x4 Low | 70                                 | 14.3     | 8.8    |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.  
 Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1.

**Table 8.13.1.2. 1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x10 MHz                  | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 2x20 MHz                  | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3   | 2x5 MHz                   | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4   | 15MHz+5MHz                | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5   | 10MHz+5MHz                | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**Table 8.13.1.2.1-4: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 3x20MHz                   | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 20MHz+20MHz+15MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3   | 20MHz+20MHz+10MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4   | 20MHz+15MHz+15MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5   | 20MHz+15MHz+10MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 6   | 20MHz+10MHz+10MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 7   | 15MHz+15MHz+10MHz         | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 8   | 20MHz+10MHz+5MHz          | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 9   | 20MHz+15MHz+5MHz          | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 10  | 10MHz+10MHz+5MHz          | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 11  | 5MHz+5MHz+20MHz           | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 12  | 3x10MHz                   | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 13  | 5MHz+5MHz+10MHz           | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**Table 8.13.1.2.1-5: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |



|   |                         |  |    |
|---|-------------------------|--|----|
| 2   | 10MHz+20MHz+20MHz+20MHz | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 3   | 10MHz+10MHz+20MHz+20MHz | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 4   | 5MHz+10MHz+20MHz+20MHz  | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 5   | 5MHz+10MHz+10MHz+20MHz  | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 6   | 15+3x20MHz              | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 7   | 2x15+2x20MHz            | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 8   | 10+15+2x20MHz           | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 9   | 3x10+20MHz              | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 10  | 2x5+2x20MHz             | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 11  | 2x5+10+20MHz            | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| 12  | 4x10MHz                 | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8 |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                         |  |    |

**Table 8.13.1.2.1-6: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 5x20MHz                   | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 2   | 15MHz+4x20MHz             | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 3   | 10MHz+4x20MHz             | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 4   | 2x10MHz+3x20MHz           | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 5   | 5MHz+10MHz+3x20MHz        | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 6   | 3x10MHz+2x20MHz           | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 7   | 4x10MHz+20MHz             | As specified in Table 8.13.1.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| NOTE 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

### 8.13.1.3 Enhanced Performance Requirements Type A Closed-loop spatial multiplexing

#### 8.13.1.3.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols)

The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.13.1.3.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.1.3.1-3, based on single carrier requirement specified in Table 8.13.1.3.1-2, with the addition of the parameters in Table 8.13.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.1.3.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model for CA**

| Parameter  |          | Unit           | Cell 1  | Cell 2   |
|--|----------|----------------|---|--|
| Downlink power allocation  | $\rho_A$ | dB             | -3  | -3   |
|  | $\rho_B$ | dB             | -3 (Note 1)   | -3   |
|  | $\sigma$ | dB             | 0   | 0  |
| Cell-specific reference signals  |          |                | Antenna ports 0,1   | Antenna ports 0,1  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz<br>z | -98   | N/A  |
| DIP (Note 2)   |          | dB             | N/A   | -1.73  |
| Cell Id  |          |                | 0   | 1  |
| PDSCH transmission mode  |          |                | 6   | 4  |
| Interference model   |          |                | N/A   | As specified in clause B.5.3                               |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1   | %              | N/A   | 80   |
|  | Rank 2   | %              | N/A   | 20   |
| Precoding granularity  |          | PRB            | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 4)   |          | ms             | 8   | N/A  |
| Reporting interval   |          | ms             | 5   | N/A  |
| Reporting mode   |          |                | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap   |          |                | 1111  | N/A  |
| Physical channel for CQI reporting   |          |                | PUSCH (Note 7)  | N/A  |
| cqi-pmi-ConfigurationIndex   | FDD PCC  |                | 2   | N/A  |
|  | FDD SCC  |                | 3   | N/A  |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.</p> <p>Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 5: All cells are time-synchronous.</p> <p>Note 6: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.</p> <p>Note 7: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, SF#2, SF#6 and #7 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 SF#6 SF#0 and SF#1.</p> |          |                |   |  |

**Table 8.13.1.3.1-2: Single carrier performance for multiple CA configurations Enhanced Performance Requirement Type A**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.47-1 FDD        | R.47-1 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -3.0   |
| 10 MHz    | R.47 FDD          | R.47 FDD   | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.0                | -2.7   |
| 15MHz     | R.47-2 FDD        | R.47-2 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -2.9   |

|  |               |               |             |     |      |      |            |            |    |     |      |
|--|---------------|---------------|-------------|-----|------|------|------------|------------|----|-----|------|
| 20MHz  | R.47-3<br>FDD | R.47-3<br>FDD | OP.1<br>FDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | 1.1 | -2.8 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |               |               |             |     |      |      |            |            |    |     |      |
| Note 2: SINR corresponds to $\widehat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.           |               |               |             |     |      |      |            |            |    |     |      |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |               |               |             |     |      |      |            |            |    |     |      |

**Table 8.13.1.3.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x10 MHz                  | As specified in Table 8.13.1.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 2x20 MHz                  | As specified in Table 8.13.1.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3   | 2x5 MHz                   | As specified in Table 8.13.1.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4   | 15MHz+5MHz                | As specified in Table 8.13.1.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5   | 10MHz+5MHz                | As specified in Table 8.13.1.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

#### 8.13.1.4 Enhanced Performance Requirement Type A - Single-layer Spatial Multiplexing (User-Specific Reference Symbols)

##### 8.13.1.4.1 Minimum Requirement Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols)

The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.13.1.4.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.1.4.1-3, based on single carrier requirement specified in Table 8.13.1.4.1-2, with the addition of the parameters in Table 8.13.1.4.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.1.4.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model for CA**

| parameter   | Unit      | Cell 1              | Cell 2            |
|---|-----------|---------------------|-------------------|
| Downlink power allocation   | $\rho_A$  | dB                  | 0                 |
|   | $\rho_B$  | dB                  | 0 (Note 1)        |
|   | $\sigma$  | dB                  | -3                |
| Cell-specific reference signals                                       |           | Antenna ports 0,1   | Antenna ports 0,1 |
| CSI reference signals   |           | Antenna ports 15,16 | N/A               |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ | Subframes | 5 / 2               | N/A               |
| CSI reference signal configuration                                    |           | 0                   | N/A               |
| $N_{oc}$ at antenna port $z$  | dBm/15kHz | -98                 | N/A               |
| DIP (Note 2)  | dB        | N/A                 | -1.73             |

|  |         |     |   |  |
|--|---------|-----|---|--|
| BW <sub>Channel</sub>  |         | MHz | 10  | 10   |
| Cell Id  |         |     | 0   | 126  |
| PDSCH transmission mode  |         |     | 9   | 9  |
| Beamforming model  |         |     | As specified in clause B.4.3 (Note 4, 5)  | N/A  |
| Interference model   |         |     | N/A   | As specified in clause B.5.4                               |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1  |     | N/A   | 70   |
|  | Rank 2  |     | N/A   | 30   |
| Precoder update granularity  |         | PRB | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs                                   | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 5)   |         | Ms  | 8   | N/A  |
| Reporting interval   |         | Ms  | 5   | N/A  |
| Reporting mode   |         |     | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap   |         |     | 001111  | N/A  |
| Symbols for unused PRBs  |         |     | OCNG (Note 6)   | N/A  |
| Simultaneous transmission  |         |     | No simultaneous transmission on the other antenna port in (7 or 8) used for the input signal under test | N/A  |
| Physical channel for CQI reporting   |         |     | PUSCH(Note 8)   | N/A  |
| cqi-pmi-ConfigurationIndex   | FDD PCC |     | 4   | N/A  |
|  | FDD SCC |     | 5   | N/A  |
| <p>Note 1: <math>P_B = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 6: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 7: All cells are time-synchronous.</p> <p>Note 8: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3, SF#4, SF#8 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7, SF#8, SF#2 and #3.</p> <p>Note 9: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.</p> |         |     |   |  |

**Table 8.13.1.4.1-2: Single carrier performance for multiple CA configurations Enhanced Performance Requirement Type A, CDM-multiplexed DM RS**

| Band-width | Reference Channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and | Reference Value |
|------------|-------------------|--------------|------------------------|------------------------|-----------------|
|------------|-------------------|--------------|------------------------|------------------------|-----------------|

|        | 2Rx CC     | 4Rx CC     | Cell 1   | Cell 2 | Cell 1 | Cell 2 | Antenna Configuration (Note 3) |         | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|--------|------------|------------|----------|--------|--------|--------|--------------------------------|---------|------------------------------------|--------------------|--------|
|        |            |            |          |        |        |        | 2Rx CC                         | 4Rx CC  |                                    | 2Rx CC             | 4Rx CC |
| 5MHz   | R.76-1 FDD | R.76-4 FDD | OP.1 FDD | N/A    | EVA5   | EVA5   | 2x2 Low                        | 2x4 Low | 70                                 | -0.4               | -2.0   |
| 10 MHz | R.76 FDD   | R.76-5 FDD | OP.1 FDD | N/A    | EVA5   | EVA5   | 2x2 Low                        | 2x4 Low | 70                                 | 0.1                | -1.8   |
| 15MHz  | R.76-2 FDD | R.76-6 FDD | OP.1 FDD | N/A    | EVA5   | EVA5   | 2x2 Low                        | 2x4 Low | 70                                 | -0.2               | -1.9   |
| 20MHz  | R.76-3 FDD | R.76-7 FDD | OP.1 FDD | N/A    | EVA5   | EVA5   | 2x2 Low                        | 2x4 Low | 70                                 | -0.4               | -1.7   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.1.4.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x10 MHz                  | As specified in Table 8.13.1.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 2x20 MHz                  | As specified in Table 8.13.1.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 3         | 2x5 MHz                   | As specified in Table 8.13.1.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 4         | 15MHz+5MHz                | As specified in Table 8.13.1.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 5         | 10MHz+5MHz                | As specified in Table 8.13.1.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

### 8.13.2 TDD (CA and DC)

The parameters specified in Table 8.13.2-1 are valid for all TDD CA and DC tests unless otherwise stated.

**Table 8.13.2-1: Common Test Parameters (TDD)**

| Parameter  | Unit         | Value  |
|--|--------------|--|
| Uplink downlink configuration (Note 1)                 |              | 1  |
| Special subframe configuration (Note 2)                |              | 4  |
| Cyclic prefix  |              | Normal   |
| Cell ID  |              | 0  |
| Inter-TTI Distance                                     |              | 1  |
| Number of HARQ processes per component carrier         | Processes    | 7  |
| Maximum number of HARQ transmission                    |              | 4  |
| Redundancy version coding sequence                     |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |

|                          |   |                |
|--------------------------|---|----------------|
| Cross carrier scheduling |   | Not configured |
| Note 1:                  | as specified in Table 4.2-2 in TS 36.211 [4]. |                |
| Note 2:                  | as specified in Table 4.2-1 in TS 36.211 [4]. |                |

### 8.13.2.1 Closed-loop spatial multiplexing performance

#### 8.13.2.1.1 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

For CA with 2 DL CCs, the requirements are specified in Table 8.13.2.1.1-2A, based on single carrier requirement specified in Table 8.13.2.1.1-2, with the addition of the parameters in Table 8.13.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.13.2.1.1-3, based on single carrier requirement specified in Table 8.13.2.1.1-2, with the addition of the parameters in Table 8.13.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, the requirements are specified in Table 8.13.2.1.1-4, based on single carrier requirement specified in Table 8.13.2.1.1-2, with the addition of the parameters in Table 8.13.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, the requirements are specified in Table 8.13.2.1.1-5, based on single carrier requirement specified in Table 8.13.2.1.1-2, with the addition of the parameters in Table 8.13.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.2.1.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  | Unit      | Value   |
|--|-----------|---|
| Downlink power allocation  | $\rho_A$  | dB  |
|  | $\rho_B$  | dB  |
|  | $\sigma$  | dB  |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98   |
| Precoding granularity  | PRB       | 8   |
| PMI delay (Note 2)   | ms        | 10 or 11  |
| Reporting interval   | ms        | 1 or 4 (Note 3)   |
| Reporting mode   |           | PUSCH 1-2   |
| ACK/NACK feedback mode   |           | PUCCH format 1b with channel selection for Tests with 2CCs; PUCCH format 3 for Tests with more than 2 CCs |
| CodeBookSubsetRestriction bitmap   |           | 000000000000000000000000<br>0000111111111111111100000000<br>00000000                                      |
| CSI request field (Note 4)   |           | '10'  |
| PDSCH transmission mode  |           | 4   |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by high layers.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |           |   |

**Table 8.13.2.1.1-2: Single carrier performance for multiple CA configurations**

|                   |  |  |  |                 |
|-------------------|--|--|--|-----------------|
| Reference channel |  |  |  | Reference value |
|-------------------|--|--|--|-----------------|

| Band - width | OCNG pattern |            | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Fraction of maximum throughpu t (%) | SNR (dB) |        |     |
|--------------|--------------|------------|---------------------------|--|---------|-------------------------------------|----------|--------|-----|
|              | 2Rx CC       | 4Rx CC     |                           | 2Rx CC                                 | 4Rx CC  |                                     | 2Rx CC   | 4Rx CC |     |
| 1.4M Hz      | R.43-1 TDD   | R.43-1 TDD | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 11.0   | 8.1 |
| 3MHz         | R.43-2 TDD   | R.43-2 TDD | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 9.8    | 5.4 |
| 5MHz         | R.43-3 TDD   | R.43-3 TDD | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 10.0   | 5.9 |
| 10 MHz       | R.43-4 TDD   | R.43-4 TDD | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 10.5   | 6.3 |
| 15M Hz       | R.43-5 TDD   | R.43-5 TDD | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 10.6   | 6.2 |
| 20M Hz       | R.43 TDD     | R.43 TDD   | OP.1 TDD                  | EVA5                                   | 4x2 Low | 4x4 Low                             | 70       | 10.7   | 6.4 |

**Table 8.13.2.1.1-2A: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x20MHz                   | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 20MHz+15MHz               | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**Table 8.13.2.1.1-3: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 3x20MHz                   | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 20MHz+20MHz+15MHz         | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**Table 8.13.2.1.1-4: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 4x20MHz                   | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |
| 2   | 20MHz+20MHz+20MHz+15MHz   | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**Table 8.13.2.1.1-5: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num.  | CA Band-width combination | Requirement  | UE category |
|--|---------------------------|--|-------------|
| 1  | 5x20MHz                   | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| 2  | 15MHz+4x20MHz             | As specified in Table 8.13.2.1.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6 |                           |  |             |

8.13.2.1.2 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.13.2.1.2-3, for 2DL CCs, in Table 8.13.2.1.2-4 for 3DL CCs, and Table 8.13.2.1.2-5 for 4DL CCs, based on single carrier requirement specified in Table 8.13.2.1.2-2, with the addition of the parameters in Table 8.13.2.1.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity.

**Table 8.13.2.1.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Parameter   |          | Unit      | Value  |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs  |
| PMI delay (Note 2)  |          | ms        | 10 or 11   |
| Reporting interval  |          | ms        | 1 or 4 (Note 3)  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>000011111111111111111100000000<br>00000000   |
| PDSCH transmission mode   |          |           | 4  |
| ACK/NACK transmission   |          |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |
| CSI feedback  |          |           | Separate PUSCH feedbacks on the MCG and SCG  |
| Time offset between MCG CC and SCG CC   |          | $\mu$ s   | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 5) |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: The same PDSCH transmission mode is applied to each component carrier.<br>Note 5: As defined in TS36.300 [11].<br>Note 6: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured. |          |           |  |

**Table 8.13.2.1.1-2: Single carrier performance for multiple DC configurations**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.43-1 TDD        | R.43-1 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 11.0     | 8.1    |
| 3MHz         | R.43-2 TDD        | R.43-2 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.8      | 5.4    |
| 5MHz         | R.43-3 TDD        | R.43-3 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.0     | 5.9    |



|        |            |            |          |      |         |         |    |      |     |
|--------|------------|------------|----------|------|---------|---------|----|------|-----|
| 10 MHz | R.43-4 TDD | R.43-4 TDD | OP.1 TDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.5 | 6.3 |
| 15M Hz | R.43-5 TDD | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.6 | 6.2 |
| 20M Hz | R.43 TDD   | R.43 TDD   | OP.1 TDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.7 | 6.4 |

**Table 8.13.2.1.2-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.   | Band-width combination | Requirement  | UE category |
|---|------------------------|--|-------------|
| 1   | 2x20 MHz               | As specified in Table 8.13.2.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.6. |                        |  |             |

**Table 8.13.2.1.2-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.   | Band-width combination | Requirement  | UE category |
|---|------------------------|--|-------------|
| 1   | 3x20 MHz               | As specified in Table 8.13.2.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.6. |                        |  |             |

**Table 8.13.2.1.2-5: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num.   | Band-width combination | Requirement  | UE category |
|---|------------------------|--|-------------|
| 1   | 4x20 MHz               | As specified in Table 8.13.2.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |
| 2   | 15+20+20+20MHz         | As specified in Table 8.13.2.1.2-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.6. |                        |  |             |

### 8.13.2.1.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port with 256QAM

The purpose of these tests is to verify the closed loop rank-two performance with frequency selective precoding with 256QAM under CA.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.2.1.3-3, based on single carrier requirement specified in Table 8.13.2.1.3-2, with the addition of the parameters in Table 8.13.2.1.3-1 and the downlink physical channel setup according to Annex C.3.2. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.2.1.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                 | Unit      | Value |             |
|---------------------------|-----------|-------|-------------|
| Downlink power allocation | $\rho_A$  | dB    | -6          |
|                           | $\rho_B$  | dB    | -6 (Note 1) |
|                           | $\sigma$  | dB    | 3           |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |             |

|  |     |  |
|--|-----|--|
| Precoding granularity  | PRB | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs              |
| PMI delay (Note 2)   | ms  | 10 or 11   |
| Reporting interval   | ms  | 1 or 4 (Note 3)  |
| Reporting mode   |     | PUSCH 1-2  |
| ACK/NACK feedback mode   |     | PUCCH format 1b with channel selection for Tests with 2CCs                       |
| CodeBookSubsetRestriction bitmap   |     | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000 |
| CSI request field (Note 4)   |     | '10'   |
| PDSCH transmission mode  |     | 4  |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by high layers.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |     |  |

**Table 8.13.2.1.3-2: Single carrier performance for multiple CA configurations**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 TDD        | R.72-1 TDD | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 22.4     | 18.0   |
| 10 MHz       | R.72 TDD          | R.72 TDD   | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.4     | 17.5   |
| 15M Hz       | R.72-2 TDD        | R.72-2 TDD | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.5     | 17.1   |
| 20M Hz       | R.72-3 TDD        | R.72-3 TDD | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.6     | 17.2   |

**Table 8.13.2.1.3-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement  | UE category |
|---|---------------------------|--|-------------|
| 1   | 2x20MHz                   | As specified in Table 8.13.2.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2   | 20MHz+15MHz               | As specified in Table 8.13.2.1.3-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |  |             |

**8.13.2.1.4 Minimum Requirement Four-Layer Spatial Multiplexing 4 Tx Antenna Port**

The purpose of these tests is to verify the closed loop rank-four performance with wideband precoding with 4Tx and 4Rx under CA.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.2.1.4-3, based on single carrier requirement specified in Table 8.13.2.1.4-2, with the addition of the parameters in Table 8.13.2.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.2.1.4-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  | Unit      | Value   |             |
|--|-----------|---|-------------|
| Downlink power allocation  | $\rho_A$  | dB  | -6          |
|  | $\rho_B$  | dB  | -6 (Note 1) |
|  | $\sigma$  | dB  | 0           |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98   |             |
| Cell-specific reference signals  |           | Antenna ports 0,1,2,3   |             |
| PDSCH transmission mode  |           | 4   |             |
| PDSCH rank   |           | 4   |             |
| Precoding granularity  | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs |             |
| PMI delay  | ms        | 10 or 11  |             |
| Reporting interval   | ms        | 1 or 4  |             |
| Reporting mode   |           | PUSCH 3-1   |             |
| CodeBookSubsetRestriction bitmap   |           | 0xFFFF000000000000  |             |
| ACK/NACK feedback mode   |           | PUCCH format 1b with channel selection for Tests with 2CCs            |             |
| CSI request field (Note 4)   |           | '10'  |             |
| PDSCH transmission mode  |           | 4   |             |
| Uplink-Downlink Configuration  |           | 1   |             |
| Special subframe configuration   |           | 4   |             |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by high layers.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |           |   |             |

**Table 8.13.2.1.4-2: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 TDD        | OP.1 TDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.5     |
| 10MHz      | R.74 TDD          | OP.1 TDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.4     |
| 15MHz      | R.74-2 TDD        | OP.1 TDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.6     |
| 20MHz      | R.74-3 TDD        | OP.1 TDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.8     |

**Table 8.13.2.1.4-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.   | CA Band-width combination | Requirement                               | UE category |
|---|---------------------------|---|-------------|
| 1   | 2x20MHz                   | As specified in Table 8.13.2.1.4-2 per CC | $\geq 5$    |
| 2   | 20MHz+15MHz               | As specified in Table 8.13.2.1.4-2 per CC | $\geq 5$    |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                           |   |             |

## 8.13.2.2 Dual-Layer Spatial Multiplexing (User-Specific Reference Symbols)

### 8.13.2.2.1 Minimum Requirement Dual-Layer Spatial Multiplexing 2 Tx Antenna Port

For CA with 2 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.2.2.1-2A, based on single carrier requirement specified in Table 8.13.2.2.1-2, with the addition of the parameters in Table 8.13.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.2.2.1-3, based on single carrier requirement specified in Table 8.13.2.2.1-2, with the addition of the parameters in Table 8.13.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 4 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.2.2.1-4, based on single carrier requirement specified in Table 8.13.2.2.1-2, with the addition of the parameters in Table 8.13.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 5 DL CCs, for dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.13.2.2.1-5, based on single carrier requirement specified in Table 8.13.2.2.1-2, with the addition of the parameters in Table 8.13.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.2.2.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   | Unit                  | Values                                |            |
|---|-----------------------|---------------------------------------|------------|
| Downlink power allocation   | $\rho_A$              | dB                                    | 0          |
|   | $\rho_B$              | dB                                    | 0 (Note 1) |
|   | $\sigma$              | dB                                    | -3         |
| Cell-specific reference signals   |                       | Antenna ports 0 and 1                 |            |
| Cell ID   |                       | 0                                     |            |
| CSI reference signals   |                       | Antenna ports 15,16                   |            |
| Beamforming model   |                       | Annex B.4.2                           |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  | Subframes             | 5 / 4                                 |            |
| CSI reference signal configuration  |                       | 8                                     |            |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$<br>bitmap   | Subframes /<br>bitmap | 4 /<br>0010000000000000               |            |
| $N_{oc}$ at antenna port  | dBm/15kHz             | -98                                   |            |
| $\widehat{E}_s / N_{oc}$  |                       | Reference Value in Table 8.13.2.2.1-2 |            |
| Symbols for unused PRBs   |                       | OCNG (Note 2)                         |            |
| Number of allocated resource blocks<br>(Note 2)   | PRB                   | 50                                    |            |
| Simultaneous transmission   |                       | No                                    |            |
| PDSCH transmission mode   |                       | 9                                     |            |
| Note 1: $P_B = 1$   |                       |                                       |            |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |                       |                                       |            |

**Table 8.13.2.2.1-2: Single carrier performance for multiple CA configurations**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-------------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                         | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                         |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz         | R.51-2 TDD        | R.51-2 TDD | OP.1 TDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                 | 14.0     | 9.0    |
| 10 MHz       | R.51 TDD          | R.51 TDD   | OP.1 TDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                 | 13.9     | 9.1    |
| 15M Hz       | R.51-3 TDD        | R.51-3 TDD | OP.1 TDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                 | 13.9     | 9.2    |
| 20M Hz       | R.51-4 TDD        | R.51-4 TDD | OP.1 TDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                 | 14.1     | 9.3    |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.  
Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1.

**Table 8.13.2.2.1-2A: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x20MHz                   | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 20MHz+15MHz               | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.2.2.1-3: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 3x20MHz                   | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 20MHz+20MHz+15MHz         | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.2.2.1-4: Minimum performance (FRC) based on single carrier performance for CA with 4 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 4x20MHz                   | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |
| 2         | 20MHz+20MHz+20MHz+15MHz   | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥8          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.2.1.1-5: Minimum performance (FRC) based on single carrier performance for CA with 5 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 5x20MHz                   | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11      |

|  |               |  |        |
|--|---------------|--|--------|
| 2  | 15MHz+4x20MHz | As specified in Table 8.13.2.2.1-2 per CC depending on either 2Rx CC or 4Rx CC | 8, ≥11 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6 |               |  |        |

### 8.13.2.3 Enhanced Performance Requirements Type A Closed-loop spatial multiplexing

#### 8.13.2.3.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols)

The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.13.2.3.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.2.3.1-3, based on single carrier requirement specified in Table 8.13.2.3.1-2, with the addition of the parameters in Table 8.13.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.2.3.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model for CA**

| Parameter   |          | Unit      | Cell 1            | Cell 2                       |
|---|----------|-----------|-------------------|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | -3                | -3                           |
|   | $\rho_B$ | dB        | -3 (Note 1)       | -3                           |
|   | $\sigma$ | dB        | 0                 | 0                            |
| Cell-specific reference signals                                     |          |           | Antenna ports 0,1 | Antenna ports 0,1            |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98               | N/A                          |
| DIP (Note 2)  |          | dB        | N/A               | -1.73                        |
| $BW_{\text{Channel}}$   |          | MHz       | 10                | 10                           |
| Cell Id   |          |           | 0                 | 1                            |
| PDSCH transmission mode   |          |           | 6                 | N/A                          |
| Interference model  |          |           | N/A               | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1   | %         | N/A               | 80                           |
|   | Rank 2   | %         | N/A               | 20                           |
| Precoding granularity   |          | PRB       | 50                | 6                            |
| PMI delay (Note 4)  |          | ms        | 10 or 11          | N/A                          |
| Reporting interval  |          | ms        | 5                 | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1         | N/A                          |
| CodeBookSubsetRestriction bitmap                                    |          |           | 1111              | N/A                          |
| Physical channel for CQI reporting                                  |          |           | PUSCH (Note 7)    | N/A                          |
| cqi-pmi-ConfigurationIndex  | TDD PCC  |           | 3                 | N/A                          |
|   | TDD SCC  |           | 4                 | N/A                          |

|         |  |
|---------|--|
| Note 1: | $P_B = 1$  |
| Note 2: | The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |
| Note 3: | Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.   |
| Note 4: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 5: | All cells are time-synchronous.  |
| Note 6: | ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.   |
| Note 7: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, SF#4, SF#6 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 SF#8 SF#2 and SF#3. |

**Table 8.13.2.3.1-2: Single carrier performance for multiple CA configurations Enhanced Performance Requirement Type A**

| Band-width | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|------------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|            | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|            |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz       | R.47-1 TDD        | R.47-1 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -2.8   |
| 10 MHz     | R.47 TDD          | R.47 TDD   | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.3                | -2.5   |
| 15MHz      | R.47-2 TDD        | R.47-2 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.0                | -2.7   |
| 20MHz      | R.47-3 TDD        | R.47-3 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.3                | -2.3   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.2.3.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x20MHz                   | As specified in Table 8.13.2.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 20MHz+15MHz               | As specified in Table 8.13.2.3.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**8.13.2.4 Enhanced Performance Requirement Type A - Single-layer Spatial Multiplexing (User-Specific Reference Symbols)**

**8.13.2.4.1 Minimum Requirement Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols)**

The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined

in clause B.5.4. In 8.13.2.4.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For CA with 2 DL CCs, the requirements are specified in Table 8.13.2.4.1-3, based on single carrier requirement specified in Table 8.13.2.4.1-2, with the addition of the parameters in Table 8.13.2.4.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.2.4.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model for CA**

| parameter   |          | Unit      | Cell 1  | Cell 2                       |
|---|----------|-----------|---|------------------------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0   | 0                            |
|   | $\rho_B$ | dB        | 0 (Note 1)  | 0                            |
|   | $\sigma$ | dB        | -3  | -3                           |
| Cell-specific reference signals   |          |           | Antenna ports 0,1   | Antenna ports 0,1            |
| CSI reference signals   |          |           | Antenna ports 15,16   | N/A                          |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   |          | Subframes | 5 / 4   | N/A                          |
| CSI reference signal configuration  |          |           | 0   | N/A                          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   | N/A                          |
| DIP (Note 2)  |          | dB        | N/A   | -1.73                        |
| $BW_{\text{Channel}}$   |          | MHz       | 10  | 10                           |
| Cell Id   |          |           | 0   | 126                          |
| PDSCH transmission mode   |          |           | 9   | 9                            |
| Beamforming model   |          |           | As specified in clause B.4.3 (Note 4, 5)  | N/A                          |
| Interference model  |          |           | N/A   | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells   | Rank 1   |           | N/A   | 70                           |
|   | Rank 2   |           | N/A   | 30                           |
| Precoder update granularity   |          | PRB       | 50  | 6                            |
| PMI delay (Note 5)  |          | ms        | 10 or 11  | N/A                          |
| Reporting interval  |          | ms        | 5   | N/A                          |
| Reporting mode  |          |           | PUCCH 1-1   | N/A                          |
| CodeBookSubsetRestriction bitmap  |          |           | 001111  | N/A                          |
| Symbols for unused PRBs   |          |           | OCNG (Note 6)   | N/A                          |
| Simultaneous transmission   |          |           | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A                          |
| Physical channel for CQI reporting  |          |           | PUSCH(Note 8)   | N/A                          |
| cqi-pmi-ConfigurationIndex  | TDD PCC  |           | 3   | N/A                          |
|   | TDD SCC  |           | 4   | N/A                          |
| Note 1: $P_B = 1$   |          |           |   |                              |
| Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1. |          |           |   |                              |
| Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.  |          |           |   |                              |



|         |  |
|---------|--|
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI.   |
| Note 5: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.  |
| Note 7: | All cells are time-synchronous.  |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, SF#4, SF#6 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7, SF#8, SF#2 and #3. |
| Note 9: | ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.   |

**Table 8.13.2.4.1-2: Single carrier performance for multiple CA configurations Enhanced Performance Requirement Type A, CDM-multiplexed DM RS**

| Band-width | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|------------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|            | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|            |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz       | R.76-1 TDD        | R.76-4 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.6               | -2.4   |
| 10 MHz     | R.76 TDD          | R.76-5 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.1               | -2.1   |
| 15MHz      | R.76-2 TDD        | R.76-6 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.2               | -2.1   |
| 20MHz      | R.76-3 TDD        | R.76-7 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.4               | -2.1   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.2.4.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num. | CA Band-width combination | Requirement  | UE category |
|-----------|---------------------------|--|-------------|
| 1         | 2x20MHz                   | As specified in Table 8.13.2.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |
| 2         | 20MHz+15MHz               | As specified in Table 8.13.2.4.1-2 per CC depending on either 2Rx CC or 4Rx CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

### 8.13.3 TDD-FDD (CA and DC)

The parameters specified in Table 8.13.3-1 are valid for all the TDD FDD CA tests unless otherwise stated.

**Table 8.13.3-1: Common Test Parameters**

| Parameter   | Unit | Value |
|---|------|-------|
| Uplink downlink configuration (Note 1) for TDD CC only  |      | 1     |
| Special subframe configuration (Note 2) for TDD CC only |      | 4     |

|  |           |              |  |
|--|-----------|--------------|--|
| Inter-TTI Distance                                     |           |              | 1  |
| Maximum number of HARQ processes per component carrier | FDD PCell | Processes    | 8 for FDD and TDD CCs  |
|  | TDD PCell | Processes    | 11 for FDD CC; 7 for TDD CC  |
| Maximum number of HARQ transmission                    |           |              | 4  |
| Redundancy version coding sequence                     |           |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM  |
| Number of OFDM symbols for PDCCH per component carrier |           | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix  |           |              | Normal   |
| Cell_ID  |           |              | 0  |
| Cross carrier scheduling                               |           |              | Not configured   |
| ACK/NACK feedback mode                                 |           |              | PUCCH format 3   |
| Downlink HARQ-ACK timing                               | FDD PCell |              | As specified in Clause 7.3.3 in TS36.213 [6]   |
|  | TDD PCell |              | As specified in Clause 7.3.4 in TS36.213 [6]   |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].  |           |              |  |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4].  |           |              |  |

The applicability of their requirements are specified in Clause 8.1.2.6. The single carrier performance with different bandwidths for multiple CA configurations specified in Clause 8.13.3 cannot be applied for UE single carrier test.

### 8.13.3.1 Closed-loop spatial multiplexing performance 4Tx Antenna Port

#### 8.13.3.1.1 Minimum Requirement for FDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.1.1-4 based on single carrier requirement specified in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3, with the addition of the parameters in Table 8.13.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.13.3.1.1-5 based on single carrier requirement specified in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3, with the addition of the parameters in Table 8.13.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.13.3.1.1-6 based on single carrier requirement specified in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3, with the addition of the parameters in Table 8.13.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.13.3.1.1-7 based on single carrier requirement specified in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3, with the addition of the parameters in Table 8.13.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.1.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                 |          | Unit      | Value       |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -6          |
|                           | $\rho_B$ | dB        | -6 (Note 1) |
|                           | $\sigma$ | dB        | 3           |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |

|   |        |     |  |
|---|--------|-----|--|
| Precoding granularity   |        | PRB | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)  | FDD CC | ms  | 8  |
|   | TDD CC | ms  | 10 or 11   |
| Reporting interval  | FDD CC | ms  | 1  |
|   | TDD CC | ms  | 1 or 4 (Note 3)  |
| Reporting mode  |        |     | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |        |     | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000                   |
| CSI request field (Note 3)  |        |     | '10'   |
| PDSCH transmission mode   |        |     | 4  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> |        |     |  |

**Table 8.13.3.1.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.7    |
| 15M Hz       | R.14-7 FDD        | R.14-7 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.6    |
| 20M Hz       | R.14-3 FDD        | R.14-3 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.3     | 5.6    |

**Table 8.13.3.1.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.43-1 TDD        | R.43-1 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 11.0     | 8.1    |
| 3MHz         | R.43-2 TDD        | R.43-2 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.8      | 5.4    |
| 5MHz         | R.43-3 TDD        | R.43-3 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.0     | 5.9    |
| 10 MHz       | R.43-4 TDD        | R.43-4 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.5     | 6.3    |
| 15M Hz       | R.43-5 TDD        | R.43-5 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.6     | 6.2    |
| 20M Hz       | R.43 TDD          | R.43 TDD   | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.7     | 6.4    |

**Table 8.13.3.1.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.3.1.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| 9           | 10+15+20                   | 10+15  | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

**Table 8.13.3.1.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 4x20                       | 20      | 3x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20    | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15   | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 4           | 2x15+2x20                  | 2x15    | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 5           | 3x20+15                    | 2x20+15 | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 6           | 2x15+2x20                  | 2x15+20 | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 7           | 3x20+10                    | 2x20+10 | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 8           | 4x20                       | 3x20    | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 9           | 10+3x20                    | 10      | 3x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 10          | 2x10+2x20                  | 2x10    | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 11          | 2x10+20+15                 | 2x10    | 20+15  | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |
| 12          | 10+3x20                    | 10+20   | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8          |

|   |            |          |      |  |    |
|---|------------|----------|------|--|----|
| 13  | 10+15+2x20 | 10+15    | 2x20 | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8 |
| 14  | 10+15+2x20 | 10+15+20 | 20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥8 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |            |          |      |  |    |

**Table 8.13.3.1.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 2   | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 3   | 4x20+20                    | 4x20     | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 4   | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 5   | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 6   | 20+4x20                    | 20       | 4x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 7   | 10+4x20                    | 10       | 4x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 8   | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 9   | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 10  | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| 11  | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |          |        |  |             |

### 8.13.3.1.2 Minimum Requirement for TDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.1.2-4 based on single carrier requirement specified in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3, with the addition of the parameters in Table 8.13.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.13.3.1.2-5 based on single carrier requirement specified in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3, with the addition of the parameters in Table 8.13.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 4DL CCs, the requirements are specified in Table 8.13.3.1.2-6 based on single carrier requirement specified in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3, with the addition of the parameters in Table 8.13.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 5DL CCs, the requirements are specified in Table 8.13.3.1.2-7 based on single carrier requirement specified in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3, with the addition of the parameters in Table 8.13.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.1.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                 | Unit      | Value |
|---------------------------|-----------|-------|
| Downlink power allocation | $\rho_A$  | dB    |
|                           | $\rho_B$  | dB    |
|                           | $\sigma$  | dB    |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98   |

|   |        |     |  |
|---|--------|-----|--|
| Precoding granularity   |        | PRB | Widelband pre-coding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)  | FDD CC | ms  | 8  |
|   | TDD CC | ms  | 10 or 11   |
| Reporting interval  | FDD CC | ms  | 1  |
|   | TDD CC | ms  | 1 or 4 (Note 3)  |
| Reporting mode  |        |     | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |        |     | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000                     |
| CSI request field (Note 3)  |        |     | '10'   |
| PDSCH transmission mode   |        |     | TM4  |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> |        |     |  |

**Table 8.13.3.1.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.7    |
| 15M Hz       | R.14-7 FDD        | R.14-7 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.6    |
| 20M Hz       | R.14-3 FDD        | R.14-3 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.3     | 5.6    |

**Table 8.13.3.1.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.43-1 TDD        | R.43-1 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 11.0     | 8.1    |
| 3MHz         | R.43-2 TDD        | R.43-2 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.8      | 5.4    |
| 5MHz         | R.43-3 TDD        | R.43-3 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.0     | 5.9    |
| 10 MHz       | R.43-4 TDD        | R.43-4 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.5     | 6.3    |
| 15M Hz       | R.43-5 TDD        | R.43-5 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.6     | 6.2    |
| 20M Hz       | R.43 TDD          | R.43 TDD   | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.7     | 6.4    |

**Table 8.13.3.1.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 2x20                       | 20     | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 2   | 20+10                      | 10     | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 3   | 20+15                      | 15     | 20     | As defined in Table 8.13.3.1.1-2 and Table 8.13.3.1.1-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

**Table 8.13.3.1.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 3x20                       | 20     | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 2   | 20+20+15                   | 15     | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 3   | 20+20+10                   | 10     | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 4   | 3x20                       | 2x20   | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 5   | 20+20+15                   | 20+15  | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 6   | 20+20+10                   | 20+10  | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 7   | 20+10+10                   | 2x10   | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 8   | 10+15+20                   | 10     | 15+20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| 9   | 10+15+20                   | 10+15  | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

**Table 8.13.3.1.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |         |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|---------|--------|--|-------------|
|             | Total                      | FDD CC  | TDD CC |  |             |
| 1           | 4x20                       | 20      | 3x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 2           | 4x20                       | 2x20    | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 3           | 3x20+15                    | 20+15   | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 4           | 2x15+2x20                  | 2x15    | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 5           | 3x20+15                    | 2x20+15 | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 6           | 2x15+2x20                  | 2x15+20 | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 7           | 3x20+10                    | 2x20+10 | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 8           | 4x20                       | 3x20    | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |

|   |            |          |       |  |    |
|---|------------|----------|-------|--|----|
| 9   | 10+3x20    | 10       | 3x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 10  | 2x10+2x20  | 2x10     | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 11  | 2x10+20+15 | 2x10     | 20+15 | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 12  | 10+3x20    | 10+20    | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 13  | 10+15+2x20 | 10+15    | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 14  | 10+15+2x20 | 10+15+20 | 20    | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |            |          |       |  |    |

**Table 8.13.3.1.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 2   | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 3   | 4x20+20                    | 4x20     | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 4   | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 5   | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 6   | 20+4x20                    | 20       | 4x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 7   | 10+4x20                    | 10       | 4x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 8   | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 9   | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 10  | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| 11  | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |          |        |  |             |

### 8.13.3.2 Dual-Layer Spatial Multiplexing (User-Specific Reference Symbols)

#### 8.13.3.2.1 Minimum Requirement Dual-Layer Spatial Multiplexing 2 Tx Antenna Port for FDD PCell

The purpose of these tests is to verify dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C.

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.2.1-4 based on single carrier requirement specified in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3, with the addition of the parameters in Table 8.13.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.13.3.2.1-5 based on single carrier requirement specified in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3, with the addition of the parameters in Table 8.13.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 4DL CCs, the requirements are specified in Table 8.13.3.2.1-6 based on single carrier requirement specified in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3, with the addition of the parameters in Table 8.13.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 5DL CCs, the requirements are specified in Table 8.13.3.2.1-7 based on single carrier requirement specified in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3, with the addition of the parameters in Table 8.13.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.



**Table 8.13.3.2.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  |          | Unit               | Values                                |
|--|----------|--------------------|---------------------------------------|
| Downlink power allocation  | $\rho_A$ | dB                 | 0                                     |
|  | $\rho_B$ | dB                 | 0 (Note 1)                            |
|  | $\sigma$ | dB                 | -3                                    |
| Cell-specific reference signals  |          |                    | Antenna ports 0 and 1                 |
| Cell ID  |          |                    | 0                                     |
| CSI reference signals  |          |                    | Antenna ports 15,16                   |
| Beamforming model  |          |                    | Annex B.4.2                           |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$  | FDD CC   | Subframes          | 5 / 2                                 |
|  | TDD CC   |                    | 5 / 4                                 |
| CSI reference signal configuration   |          |                    | 8                                     |
| Zero-power CSI-RS configuration $l_{CSI-RS} / \text{ZeroPowerCSI-RS}$ bitmap   | FDD CC   | Subframes / bitmap | 3 / 0010000000000000                  |
|  | TDD CC   |                    | 4 / 0010000000000000                  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz          | -98                                   |
| $\hat{E}_s / N_{oc}$   | FDD CC   |                    | Reference Value in Table 8.13.3.2.1-2 |
|  | TDD CC   |                    | Reference Value in Table 8.13.3.2.1-3 |
| Symbols for unused PRBs  |          |                    | OCNG (Note 2)                         |
| Number of allocated resource blocks (Note 2)   |          | PRB                | 50                                    |
| Simultaneous transmission  |          |                    | No                                    |
| PDSCH transmission mode  |          |                    | 9                                     |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 3: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3. |          |                    |                                       |

**Table 8.13.3.2.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band - width  | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|---|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|   | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|   |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 5MHz  | R.51-2 FDD        | R.51-2 FDD | OP.1 FDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                  | 14.2     | 9.0    |
| 10 MHz  | R.51 FDD          | R.51 FDD   | OP.1 FDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                  | 13.7     | 8.8    |
| 15M Hz  | R.51-3 FDD        | R.51-3 FDD | OP.1 FDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                  | 13.6     | 8.7    |
| 20M Hz  | R.51-4 FDD        | R.51-4 FDD | OP.1 FDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                  | 14.3     | 8.8    |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1. |                   |            |              |                           |  |         |                                     |          |        |

**Table 8.13.3.2.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band - width | Reference channel | OCNG pattern | Propa- gation | Correlation matrix and antenna config. | Reference value     |          |
|--------------|-------------------|--------------|---------------|--|---------------------|----------|
|              |                   |              |               |  | Fraction of maximum | SNR (dB) |

|        | 2Rx CC     | 4Rx CC     |          | condition | 2Rx CC  | 4Rx CC  | throughput (%) | 2Rx CC | 4Rx CC |
|--------|------------|------------|----------|-----------|---------|---------|----------------|--------|--------|
| 5MHz   | R.51-2 TDD | R.51-2 TDD | OP.1 TDD | ETU5      | 2x2 Low | 2x4 Low | 70             | 14.0   | 9.0    |
| 10 MHz | R.51 TDD   | R.51 TDD   | OP.1 TDD | ETU5      | 2x2 Low | 2x4 Low | 70             | 13.9   | 9.1    |
| 15M Hz | R.51-3 TDD | R.51-3 TDD | OP.1 TDD | ETU5      | 2x2 Low | 2x4 Low | 70             | 13.9   | 9.2    |
| 20M Hz | R.51-4 TDD | R.51-4 TDD | OP.1 TDD | ETU5      | 2x2 Low | 2x4 Low | 70             | 14.1   | 9.3    |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.  
Note 3: SNR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1.

Table 8.13.3.2.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

Table 8.13.3.2.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |
| 9           | 10+15+20                   | 10+15  | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

Table 8.13.3.2.1-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 4x20                       | 20     | 3x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8          |

|   |            |          |       |  |    |
|---|------------|----------|-------|--|----|
| 2   | 4x20       | 2x20     | 2x20  | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 3   | 3x20+15    | 20+15    | 2x20  | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 4   | 2x15+2x20  | 2x15     | 2x20  | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 5   | 3x20+15    | 2x20+15  | 20    | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 6   | 2x15+2x20  | 2x15+20  | 20    | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 7   | 3x20+10    | 2x20+10  | 20    | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥8 |
| 8   | 4x20       | 3x20     | 20    | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 9   | 10+3x20    | 10       | 3x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 10  | 2x10+2x20  | 2x10     | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 11  | 2x10+20+15 | 2x10     | 20+15 | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 12  | 10+3x20    | 10+20    | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 13  | 10+15+2x20 | 10+15    | 2x20  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| 14  | 10+15+2x20 | 10+15+20 | 20    | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |            |          |       |  |    |

**Table 8.13.3.2.1-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 2   | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 3   | 4x20+20                    | 4x20     | 20     | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 4   | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 5   | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 6   | 20+4x20                    | 20       | 4x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 7   | 10+4x20                    | 10       | 4x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 8   | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 9   | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 10  | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| 11  | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |          |        |  |             |

### 8.13.3.2.2 Minimum Requirement Dual-Layer Spatial Multiplexing 2 Tx Antenna Port for TDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.2.2-4 based on single carrier requirement specified in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3, with the addition of the parameters in Table 8.13.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.13.3.2.2-5 based on single carrier requirement specified in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3, with the addition of the parameters in Table 8.13.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 4DL CCs, the requirements are specified in Table 8.13.3.2.2-6 based on single carrier requirement specified in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3, with the addition of the parameters in Table 8.13.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell and 5DL CCs, the requirements are specified in Table 8.13.3.2.2-7 based on single carrier requirement specified in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3, with the addition of the parameters in Table 8.13.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.2.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit               | Values                                |
|---|----------|--------------------|---------------------------------------|
| Downlink power allocation   | $\rho_A$ | dB                 | 0                                     |
|   | $\rho_B$ | dB                 | 0 (Note 1)                            |
|   | $\sigma$ | dB                 | -3                                    |
| Cell-specific reference signals   |          |                    | Antenna ports 0 and 1                 |
| Cell ID   |          |                    | 0                                     |
| CSI reference signals   |          |                    | Antenna ports 15,16                   |
| Beamforming model   |          |                    | Annex B.4.2                           |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   | FDD CC   | Subframes          | 5 / 2                                 |
|   | TDD CC   |                    | 5 / 4                                 |
| CSI reference signal configuration  |          |                    | 8                                     |
| Zero-power CSI-RS configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap   | FDD CC   | Subframes / bitmap | 3 / 0010000000000000                  |
|   | TDD CC   |                    | 4 / 0010000000000000                  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz          | -98                                   |
| $\hat{E}_s / N_{oc}$  | FDD CC   |                    | Reference Value in Table 8.13.3.2.2-2 |
|   | TDD CC   |                    | Reference Value in Table 8.13.3.2.2-3 |
| Symbols for unused PRBs   |          |                    | OCNG (Note 2)                         |
| Number of allocated resource blocks (Note 2)  |          | PRB                | 50                                    |
| Simultaneous transmission   |          |                    | No                                    |
| PDSCH transmission mode   |          |                    | 9                                     |
| Note 1: $P_B = 1$   |          |                    |                                       |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |          |                    |                                       |
| Note 3: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.  |          |                    |                                       |

**Table 8.13.3.2.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condition | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|-------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                         | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                         |  |         |                                     | 2Rx CC   | 4Rx CC |
| 5MHz         | R.51-2 FDD        | R.51-2 FDD | OP.1 FDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                  | 14.2     | 9.0    |
| 10 MHz       | R.51 FDD          | R.51 FDD   | OP.1 FDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                  | 13.7     | 8.8    |
| 15M Hz       | R.51-3 FDD        | R.51-3 FDD | OP.1 FDD     | ETU5                    | 2x2 Low                                | 2x4 Low | 70                                  | 13.6     | 8.7    |

|  |            |            |          |      |         |         |    |      |     |
|--|------------|------------|----------|------|---------|---------|----|------|-----|
| 20M Hz   | R.51-4 FDD | R.51-4 FDD | OP.1 FDD | ETU5 | 2x2 Low | 2x4 Low | 70 | 14.3 | 8.8 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |            |            |          |      |         |         |    |      |     |
| Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |            |            |          |      |         |         |    |      |     |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1.   |            |            |          |      |         |         |    |      |     |

**Table 8.13.3.2.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band - width   | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--|-------------------|------------|--------------|---------------------------|--|---------|------------------------------------|----------|--------|
|  | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|  |                   |            |              |                           |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz   | R.51-2 TDD        | R.51-2 TDD | OP.1 TDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                 | 14.0     | 9.0    |
| 10 MHz   | R.51 TDD          | R.51 TDD   | OP.1 TDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                 | 13.9     | 9.1    |
| 15M Hz   | R.51-3 TDD        | R.51-3 TDD | OP.1 TDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                 | 13.9     | 9.2    |
| 20M Hz   | R.51-4 TDD        | R.51-4 TDD | OP.1 TDD     | ETU5                      | 2x2 Low                                | 2x4 Low | 70                                 | 14.1     | 9.3    |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                   |            |              |                           |  |         |                                    |          |        |
| Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                   |            |              |                           |  |         |                                    |          |        |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1.   |                   |            |              |                           |  |         |                                    |          |        |

**Table 8.13.3.2.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 2x20                       | 20     | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 2   | 20+10                      | 10     | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 3   | 20+15                      | 15     | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

**Table 8.13.3.2.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 3x20                       | 20     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 2           | 20+20+15                   | 15     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 3           | 20+20+10                   | 10     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 4           | 3x20                       | 2x20   | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 5           | 20+20+15                   | 20+15  | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 6           | 20+20+10                   | 20+10  | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 7           | 20+10+10                   | 2x10   | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥5          |
| 8           | 10+15+20                   | 10     | 15+20  | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5          |

|   |          |       |    |  |    |
|---|----------|-------|----|--|----|
| 9   | 10+15+20 | 10+15 | 20 | As defined in Table 8.13.3.2.1-2 and Table 8.13.3.2.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |          |       |    |  |    |

**Table 8.13.3.2.2-6: Minimum performance for multiple CA configurations with 4DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 4x20                       | 20       | 3x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 2   | 4x20                       | 2x20     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 3   | 3x20+15                    | 20+15    | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 4   | 2x15+2x20                  | 2x15     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 5   | 3x20+15                    | 2x20+15  | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 6   | 2x15+2x20                  | 2x15+20  | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 7   | 3x20+10                    | 2x20+10  | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | ≥8          |
| 8   | 4x20                       | 3x20     | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 9   | 10+3x20                    | 10       | 3x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 10  | 2x10+2x20                  | 2x10     | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 11  | 2x10+20+15                 | 2x10     | 20+15  | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 12  | 10+3x20                    | 10+20    | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 13  | 10+15+2x20                 | 10+15    | 2x20   | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| 14  | 10+15+2x20                 | 10+15+20 | 20     | As defined in Table 8.13.3.1.2-2 and Table 8.13.3.1.2-3 per CC | ≥8          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |          |        |  |             |

**Table 8.13.3.2.2-7: Minimum performance for multiple CA configurations with 5DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |          |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|----------|--------|--|-------------|
|   | Total                      | FDD CC   | TDD CC |  |             |
| 1   | 15+4x20                    | 15+2x20  | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 2   | 2x15+3x20                  | 2x15+20  | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 3   | 4x20+20                    | 4x20     | 20     | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 4   | 3x20+2x20                  | 3x20     | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 5   | 2x20+3x20                  | 2x20     | 3x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 6   | 20+4x20                    | 20       | 4x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 7   | 10+4x20                    | 10       | 4x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 8   | 10+20+3x20                 | 10+20    | 3x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 9   | 2x10+3x20                  | 2x10     | 3x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 10  | 10+2x20+2x20               | 10+2x20  | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| 11  | 10+15+20+2x20              | 10+15+20 | 2x20   | As defined in Table 8.13.3.2.2-2 and Table 8.13.3.2.2-3 per CC | 8, ≥11      |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |          |        |  |             |

### 8.13.3.3 Enhanced Performance Requirements Type A Closed-loop spatial multiplexing

#### 8.13.3.3.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols) for FDD PCell

The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.13.3.3.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For TDD FDD CA with FDD PCell and with 2 DL CCs, the requirements are specified in Table 8.13.3.3.1-4, based on single carrier requirement specified in Table 8.13.3.3.1-2 and Table 8.13.3.3.1-3, with the addition of the parameters in Table 8.13.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.3.3.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model for CA**

| Parameter   |          | Unit      | Cell 1  | Cell 2   |
|---|----------|-----------|---|--|
| Downlink power allocation   | $\rho_A$ | dB        | -3  | -3   |
|   | $\rho_B$ | dB        | -3 (Note 1)   | -3   |
|   | $\sigma$ | dB        | 0   | 0  |
| Cell-specific reference signals                                     |          |           | Antenna ports 0,1   | Antenna ports 0,1  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   | N/A  |
| DIP (Note 2)  |          | dB        | N/A   | -1.73  |
| Cell Id   |          |           | 0   | 1  |
| PDSCH transmission mode   |          |           | 6   | 4  |
| Interference model  |          |           | N/A   | As specified in clause B.5.3                               |
| Probability of occurrence of transmission rank in interfering cells | Rank 1   | %         | N/A   | 80   |
|   | Rank 2   | %         | N/A   | 20   |
| Precoding granularity   |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 4)  | FDD CC   | ms        | 8   | N/A  |
|   | TDD CC   | ms        | 10 or 11  | N/A  |
| Reporting interval  |          | ms        | 5   | N/A  |
| Reporting mode  |          |           | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap                                    |          |           | 1111  | N/A  |
| Physical channel for CQI reporting                                  |          |           | PUSCH (Note 7)  | N/A  |
| cqi-pmi-ConfigurationIndex  | FDD PCC  |           | 4   | N/A  |
|   | TDD SCC  |           | 5   | N/A  |

Note 1:  $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to  $N_{oc}$  is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.

Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).

Note 5: All cells are time-synchronous.

Note 6: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.

Note 7: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3 for TDD CCs, and PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2 for FDD CCs.

**Table 8.13.3.3.1-2: Single carrier performance for Enhanced Performance Requirement Type A for FDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel |        | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |        | Reference Value                    |                    |        |
|-----------|-------------------|--------|--------------|--------|------------------------|--------|---|--------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |        |              |        |                        |        |   |        |                                    | 2Rx CC             | 4Rx CC |

|  |               |               |             |     |      |      |            |            |    |     |      |
|--|---------------|---------------|-------------|-----|------|------|------------|------------|----|-----|------|
| 5MHz   | R.47-1<br>FDD | R.47-1<br>FDD | OP.1<br>FDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | 0.8 | -3.0 |
| 10 MHz   | R.47<br>FDD   | R.47<br>FDD   | OP.1<br>FDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | 1.0 | -2.7 |
| 15MHz  | R.47-2<br>FDD | R.47-2<br>FDD | OP.1<br>FDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | 0.8 | -2.9 |
| 20MHz  | R.47-3<br>FDD | R.47-3<br>FDD | OP.1<br>FDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | 1.1 | -2.8 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |               |               |             |     |      |      |            |            |    |     |      |
| Note 2: SINR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                 |               |               |             |     |      |      |            |            |    |     |      |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |               |               |             |     |      |      |            |            |    |     |      |

**Table 8.13.3.3.1-3: Single carrier performance for Enhanced Performance Requirement Type A for TDD SCell (FRC)**

| Bandwidth  | Reference Channel |               | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |            | Reference Value                    |                    |        |
|--|-------------------|---------------|--------------|--------|------------------------|--------|---|------------|------------------------------------|--------------------|--------|
|  | 2Rx CC            | 4Rx CC        | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC     | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|  |                   |               |              |        |                        |        |   |            |                                    | 2Rx CC             | 4Rx CC |
| 5MHz   | R.47-1<br>TDD     | R.47-1<br>TDD | OP.1<br>TDD  | N/A    | EVA5                   | EVA5   | 2x2<br>Low  | 2x4<br>Low | 70                                 | 0.8                | -2.8   |
| 10 MHz   | R.47<br>TDD       | R.47<br>TDD   | OP.1<br>TDD  | N/A    | EVA5                   | EVA5   | 2x2<br>Low  | 2x4<br>Low | 70                                 | 1.3                | -2.5   |
| 15MHz  | R.47-2<br>TDD     | R.47-2<br>TDD | OP.1<br>TDD  | N/A    | EVA5                   | EVA5   | 2x2<br>Low  | 2x4<br>Low | 70                                 | 1.0                | -2.7   |
| 20MHz  | R.47-3<br>TDD     | R.47-3<br>TDD | OP.1<br>TDD  | N/A    | EVA5                   | EVA5   | 2x2<br>Low  | 2x4<br>Low | 70                                 | 1.3                | -2.3   |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |                   |               |              |        |                        |        |   |            |                                    |                    |        |
| Note 2: SINR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                 |                   |               |              |        |                        |        |   |            |                                    |                    |        |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |                   |               |              |        |                        |        |   |            |                                    |                    |        |

**Table 8.13.3.3.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 2x20                       | 20     | 20     | As defined in Table 8.13.3.3.1-2 and Table 8.13.3.3.1-3 per CC | ≥5          |
| 2   | 20+10                      | 10     | 20     | As defined in Table 8.13.3.3.1-2 and Table 8.13.3.3.1-3 per CC | ≥5          |
| 3   | 20+15                      | 15     | 20     | As defined in Table 8.13.3.3.1-2 and Table 8.13.3.3.1-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

### 8.13.3.3.2 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model (Cell-Specific Reference Symbols) for TDD PCell

The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.13.3.3.2-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.



For TDD FDD CA with TDD PCell with 2 DL CCs, the requirements are specified in Table 8.13.3.3.2-4, based on single carrier requirement specified in Table 8.13.3.3.2-2 and Table 8.13.3.3.2-3, with the addition of the parameters in Table 8.13.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.3.3.2-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model for CA**

| Parameter   |          | Unit      | Cell 1  | Cell 2   |
|---|----------|-----------|---|--|
| Downlink power allocation   | $\rho_A$ | dB        | -3  | -3   |
|   | $\rho_B$ | dB        | -3 (Note 1)   | -3   |
|   | $\sigma$ | dB        | 0   | 0  |
| Cell-specific reference signals                                     |          |           | Antenna ports 0,1   | Antenna ports 0,1  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98   | N/A  |
| DIP (Note 2)  |          | dB        | N/A   | -1.73  |
| Cell Id   |          |           | 0   | 1  |
| PDSCH transmission mode   |          |           | 6   | 4  |
| Interference model  |          |           | N/A   | As specified in clause B.5.3                               |
| Probability of occurrence of transmission rank in interfering cells | Rank 1   | %         | N/A   | 80   |
|   | Rank 2   | %         | N/A   | 20   |
| Precoding granularity   |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 4)  | FDD CC   | ms        | 8   | N/A  |
|   | TDD CC   | ms        | 10 or 11  | N/A  |
| Reporting interval  |          | ms        | 5   | N/A  |
| Reporting mode  |          |           | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap                                    |          |           | 1111  | N/A  |

Note 1:  $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to  $N_{oc}$  is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.

Note 4: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).

Note 5: All cells are time-synchronous.

Note 6: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.

**Table 8.13.3.3.2-2: Single carrier performance for Enhanced Performance Requirement Type A for FDD SCell (FRC)**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.47-1 FDD        | R.47-1 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -3.0   |
| 10 MHz    | R.47 FDD          | R.47 FDD   | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.0                | -2.7   |
| 15MHz     | R.47-2 FDD        | R.47-2 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -2.9   |
| 20MHz     | R.47-3 FDD        | R.47-3 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.1                | -2.8   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SINR corresponds to  $\widehat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.3.2-3: Single carrier performance for Enhanced Performance Requirement Type A for TDD PCell and SCell (FRC)**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.47-1 TDD        | R.47-1 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.8                | -2.8   |
| 10 MHz    | R.47 TDD          | R.47 TDD   | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.3                | -2.5   |
| 15MHz     | R.47-2 TDD        | R.47-2 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.0                | -2.7   |
| 20MHz     | R.47-3 TDD        | R.47-3 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 1.3                | -2.3   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\widehat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.3.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                            | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.13.3.2-2 and Table 8.13.3.2-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.13.3.2-2 and Table 8.13.3.2-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.13.3.2-2 and Table 8.13.3.2-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6

**8.13.3.4 Enhanced Performance Requirement Type A - Single-layer Spatial Multiplexing (User-Specific Reference Symbols)**

**8.13.3.4.1 Minimum Requirement Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols) for FDD PCell**

The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.13.3.4.1-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For TDD FDD CA with FDD PCell with 2 DL CCs, the requirements are specified in Table 8.13.3.4.1-4, based on single carrier requirement specified in Table 8.13.3.4.1-2 and Table 8.13.3.4.1-3, with the addition of the parameters in Table 8.13.3.4.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.3.4.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model for CA**

| parameter   |          | Unit      | Cell 1  | Cell 2   |
|---|----------|-----------|---|--|
| Downlink power allocation   | $\rho_A$ | dB        | 0   | 0  |
|   | $\rho_B$ | dB        | 0 (Note 1)  | 0  |
|   | $\sigma$ | dB        | -3  | -3   |
| Cell-specific reference signals   |          |           | Antenna ports 0,1   | Antenna ports 0,1  |
| CSI reference signals   |          |           | Antenna ports 15,16   | N/A  |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ | FDD CC   | Subframes | 5 / 2   | N/A  |
|   | TDD CC   |           | 5 / 4   | N/A  |
| CSI reference signal configuration  |          |           | 0   | N/A  |
| $N_{oc}$ at antenna port $z$  |          | dBm/15kHz | -98   | N/A  |
| DIP (Note 2)  |          | dB        | N/A   | -1.73  |
| Cell Id   |          |           | 0   | 126  |
| PDSCH transmission mode   |          |           | 9   | 9  |
| Beamforming model   |          |           | As specified in clause B.4.3 (Note 4, 5)  | N/A  |
| Interference model  |          |           | N/A   | As specified in clause B.5.4                               |
| Probability of occurrence of transmission rank in interfering cells                 | Rank 1   |           | N/A   | 70   |
|   | Rank 2   |           | N/A   | 30   |
| Precoder update granularity   |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs                                   | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 5)  | FDD CC   | Ms        | 8   | N/A  |
|   | TDD CC   |           | 10 or 11  | N/A  |
| Reporting interval  |          | Ms        | 5   | N/A  |
| Reporting mode  |          |           | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap  |          |           | 001111  | N/A  |
| Symbols for unused PRBs   |          |           | OCNG (Note 6)   | N/A  |
| Simultaneous transmission   |          |           | No simultaneous transmission on the other antenna port in (7 or 8) used for the input signal under test | N/A  |
| Physical channel for CQI reporting  |          |           | PUSCH(Note 8)   | N/A  |
| cqi-pmi-ConfigurationIndex  | FDD PCC  |           | 4   | N/A  |
|   | TDD SCC  |           | 5   | N/A  |

|         |  |
|---------|--|
| Note 1: | $P_B = 1$  |
| Note 2: | The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.  |
| Note 3: | The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.   |
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI.   |
| Note 5: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNB PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.  |
| Note 7: | All cells are time-synchronous.  |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3 for TDD CCs, and PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2 for FDD CCs. |
| Note 9: | ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.   |

**Table 8.13.3.4.1-2: Single carrier performance for Enhanced Performance Requirement Type A, CDM-multiplexed DM RS for FDD PCell (FRC)**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.76-1 FDD        | R.76-4 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.4               | -2.0   |
| 10 MHz    | R.76 FDD          | R.76-5 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | 0.1                | -1.8   |
| 15MHz     | R.76-2 FDD        | R.76-6 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.2               | -1.9   |
| 20MHz     | R.76-3 FDD        | R.76-7 FDD | OP.1 FDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.4               | -1.7   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SINR corresponds to  $\hat{E}_s / N_{oc}$  of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.3.4.1-3: Single carrier performance for Enhanced Performance Requirement Type A, CDM-multiplexed DM RS for TDD SCell (FRC)**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.76-1 TDD        | R.76-4 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.6               | -2.4   |
| 10 MHz    | R.76 TDD          | R.76-5 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.1               | -2.1   |
| 15MHz     | R.76-2 TDD        | R.76-6 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.2               | -2.1   |

|         |  |               |             |     |      |      |            |            |    |      |      |
|---------|--|---------------|-------------|-----|------|------|------------|------------|----|------|------|
| 20MHz   | R.76-3<br>TDD  | R.76-7<br>TDD | OP.1<br>TDD | N/A | EVA5 | EVA5 | 2x2<br>Low | 2x4<br>Low | 70 | -0.4 | -2.1 |
| Note 1: | The propagation conditions for Cell 1 and Cell 2 are statistically independent.              |               |             |     |      |      |            |            |    |      |      |
| Note 2: | SINR corresponds to $\widehat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.           |               |             |     |      |      |            |            |    |      |      |
| Note 3: | Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. |               |             |     |      |      |            |            |    |      |      |

**Table 8.13.3.4.1-4: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                                | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.13.3.4.1-2 and Table 8.13.3.4.1-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.13.3.4.1-2 and Table 8.13.3.4.1-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.13.3.4.1-2 and Table 8.13.3.4.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |        |        |  |             |

#### 8.13.3.4.2 Minimum Requirement Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model (User-Specific Reference Symbols) for TDD PCell

The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.13.3.4.2-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

For TDD FDD CA with TDD PCell with 2 DL CCs, the requirements are specified in Table 8.13.3.4.2-4, based on single carrier requirement specified in Table 8.13.3.4.2-2 and Table 8.13.3.4.2-3, with the addition of the parameters in Table 8.13.3.4.2-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.13.3.4.2-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model for CA**

| parameter   |          | Unit      | Cell 1              | Cell 2            |
|---|----------|-----------|---------------------|-------------------|
| Downlink power allocation   | $\rho_A$ | dB        | 0                   | 0                 |
|   | $\rho_B$ | dB        | 0 (Note 1)          | 0                 |
|   | $\sigma$ | dB        | -3                  | -3                |
| Cell-specific reference signals                                       |          |           | Antenna ports 0,1   | Antenna ports 0,1 |
| CSI reference signals   |          |           | Antenna ports 15,16 | N/A               |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ | FDD CC   | Subframes | 5 / 2               | N/A               |
|   | TDD CC   |           | 5 / 4               | N/A               |
| CSI reference signal configuration                                    |          |           | 0                   | N/A               |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                 | N/A               |
| DIP (Note 2)  |          | dB        | N/A                 | -1.73             |
| Cell Id   |          |           | 0                   | 126               |
| PDSCH transmission mode   |          |           | 9                   | 9                 |

|  |        |     |   |  |
|--|--------|-----|---|--|
| Beamforming model  |        |     | As specified in clause B.4.3 (Note 4, 5)  | N/A  |
| Interference model   |        |     | N/A   | As specified in clause B.5.4                               |
| Probability of occurrence of transmission rank in interfering cells  | Rank 1 |     | N/A   | 70   |
|  | Rank 2 |     | N/A   | 30   |
| Precoder update granularity  |        | PRB | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs                                   | 4 for 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 5)   | FDD CC | Ms  | 8   | N/A  |
|  | TDD CC |     | 10 or 11  | N/A  |
| Reporting interval   |        | Ms  | 5   | N/A  |
| Reporting mode   |        |     | PUCCH 1-1   | N/A  |
| CodeBookSubsetRestriction bitmap   |        |     | 001111  | N/A  |
| Symbols for unused PRBs  |        |     | OCNG (Note 6)   | N/A  |
| Simultaneous transmission  |        |     | No simultaneous transmission on the other antenna port in (7 or 8) used for the input signal under test | N/A  |
| Physical channel for CQI reporting   |        |     | PUSCH(Note 8)   | N/A  |
| cqi-pmi-ConfigurationIndex <sub>x</sub>  | FDD CC |     | 3   | N/A  |
|  | TDD CC |     | 4   | N/A  |
| <p>Note 1: <math>P_b = 1</math></p> <p>Note 2: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 6: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 7: All cells are time-synchronous.</p> <p>Note 8: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3 for TDD CCs, and PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2 for FDD CCs.</p> <p>Note 9: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for tests with 2 CCs.</p> |        |     |   |  |

**Table 8.13.3.4.2-2: Single carrier performance for Enhanced Performance Requirement Type A, CDM-multiplexed DM RS for FDD SCell (FRC)**

| Bandwidth | Reference Channel |        | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value |                    |
|-----------|-------------------|--------|--------------|--------|------------------------|--------|---|-----------------|--------------------|
|           | 2Rx CC            | 4Rx CC | Cell 1       | Cell 2 | Cell 1                 | Cell 2 |   | Fraction of     | SINR (dB) (Note 2) |

|        |            |            |          |     |      |      | 2Rx CC  | 4Rx CC  | Maximum Throughput (%) | 2Rx CC | 4Rx CC |
|--------|------------|------------|----------|-----|------|------|---------|---------|------------------------|--------|--------|
| 5MHz   | R.76-1 FDD | R.76-4 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | 2x2 Low | 2x4 Low | 70                     | -0.4   | -2.0   |
| 10 MHz | R.76 FDD   | R.76-5 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | 2x2 Low | 2x4 Low | 70                     | 0.1    | -1.8   |
| 15MHz  | R.76-2 FDD | R.76-6 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | 2x2 Low | 2x4 Low | 70                     | -0.2   | -1.9   |
| 20MHz  | R.76-3 FDD | R.76-7 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | 2x2 Low | 2x4 Low | 70                     | -0.4   | -1.7   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.3.4.2-3: Single carrier performance for Enhanced Performance Requirement Type A, CDM-multiplexed DM RS for TDD PCell (FRC)**

| Bandwidth | Reference Channel |            | OCNG Pattern |        | Propagation Conditions |        | Correlation Matrix and Antenna Configuration (Note 3) |         | Reference Value                    |                    |        |
|-----------|-------------------|------------|--------------|--------|------------------------|--------|---|---------|------------------------------------|--------------------|--------|
|           | 2Rx CC            | 4Rx CC     | Cell 1       | Cell 2 | Cell 1                 | Cell 2 | 2Rx CC  | 4Rx CC  | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) |        |
|           |                   |            |              |        |                        |        |   |         |                                    | 2Rx CC             | 4Rx CC |
| 5MHz      | R.76-1 TDD        | R.76-4 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.6               | -2.4   |
| 10 MHz    | R.76 TDD          | R.76-5 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.1               | -2.1   |
| 15MHz     | R.76-2 TDD        | R.76-6 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.2               | -2.1   |
| 20MHz     | R.76-3 TDD        | R.76-7 TDD | OP.1 TDD     | N/A    | EVA5                   | EVA5   | 2x2 Low   | 2x4 Low | 70                                 | -0.4               | -2.1   |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.  
 Note 2: SINR corresponds to  $\hat{E}_s/N_{oc}$  of Cell 1 as defined in clause 8.1.1.  
 Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.

**Table 8.13.3.4.2-4: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test number | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|-------------|----------------------------|--------|--------|--|-------------|
|             | Total                      | FDD CC | TDD CC |  |             |
| 1           | 2x20                       | 20     | 20     | As defined in Table 8.13.3.4.2-2 and Table 8.13.3.4.2-3 per CC | ≥5          |
| 2           | 20+10                      | 10     | 20     | As defined in Table 8.13.3.4.2-2 and Table 8.13.3.4.2-3 per CC | ≥5          |
| 3           | 20+15                      | 15     | 20     | As defined in Table 8.13.3.4.2-2 and Table 8.13.3.4.2-3 per CC | ≥5          |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6.

8.13.3.5 Closed-loop spatial multiplexing performance 4Tx Antenna Port for DC

8.13.3.5.1 Minimum Requirement for FDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD DC with FDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.5.1-4 based on single carrier requirement specified in Table 8.13.3.5.1-2 and Table 8.13.3.5.1-3, with the addition of the parameters in Table 8.13.3.5.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.5.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for DC**

| Parameter   |          | Unit      | Value  |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs   |
| PMI delay (Note 2)  | FDD CC   | ms        | 8  |
|   | TDD CC   | ms        | 10 or 11   |
| Reporting interval  | FDD CC   | ms        | 1  |
|   | TDD CC   | ms        | 1 or 4 (Note 3)  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 000000000000000000000000000000001111<br>11111111111110000000000000000000   |
| CSI request field (Note 3)  |          |           | '10'   |
| PDSCH transmission mode   |          |           | 4  |
| ACK/NACK transmission   |          |           | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |
| CSI feedback  |          |           | Separate PUSCH feedbacks on the MCG and SCG  |
| Time offset between MCG CC and SCG CC   |          | $\mu$ s   | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 6) |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> <p>Note 6: As defined in TS36.300 [11].</p> <p>Note 7: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.</p> |          |           |  |

**Table 8.13.3.5.1-2: Single carrier performance with different bandwidths for multiple DC configurations for FDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-------------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                         | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                         |  |         |                                    | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                    | 4x2 Low                                | 4x4 Low | 70                                 | 10.1     | 5.7    |



|        |            |            |          |      |         |         |    |      |     |
|--------|------------|------------|----------|------|---------|---------|----|------|-----|
| 15M Hz | R.14-7 FDD | R.14-7 FDD | OP.1 FDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.1 | 5.6 |
| 20M Hz | R.14-3 FDD | R.14-3 FDD | OP.1 FDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.3 | 5.6 |

**Table 8.13.3.5.1-3: Single carrier performance with different bandwidths for multiple DC configurations for TDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propagation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-----------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                       | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                       |  |         |                                    | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.43-1 TDD        | R.43-1 TDD | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 11.0     | 8.1    |
| 3MHz         | R.43-2 TDD        | R.43-2 TDD | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 9.8      | 5.4    |
| 5MHz         | R.43-3 TDD        | R.43-3 TDD | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 10.0     | 5.9    |
| 10 MHz       | R.43-4 TDD        | R.43-4 TDD | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 10.5     | 6.3    |
| 15M Hz       | R.43-5 TDD        | R.43-5 TDD | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 10.6     | 6.2    |
| 20M Hz       | R.43 TDD          | R.43 TDD   | OP.1 TDD     | EVA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 10.7     | 6.4    |

**Table 8.13.3.5.1-4: Minimum performance for multiple DC configurations with 2DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 2x20                       | 20     | 20     | As defined in Table 8.13.3.5.1-2 and Table 8.13.3.5.1-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

### 8.13.3.5.2 Minimum Requirement for TDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD DC with TDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.5.2-4 based on single carrier requirement specified in Table 8.13.3.5.2-2 and Table 8.13.3.5.2-3, with the addition of the parameters in Table 8.13.3.5.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.5.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for DC**

| Parameter                 | Unit      | Value  |
|---------------------------|-----------|--|
| Downlink power allocation | $\rho_A$  | -6   |
|                           | $\rho_B$  | -6 (Note 1)  |
|                           | $\sigma$  | 3  |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98  |
| Precoding granularity     | PRB       | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)        | FDD CC    | 8  |
|                           | TDD CC    | 10 or 11   |
| Reporting interval        | FDD CC    | 1  |

|   |        |    |  |
|---|--------|----|--|
|   | TDD CC | ms | 1 or 4 (Note 3)  |
| Reporting mode  |        |    | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |        |    | 000000000000000000000000000000001111<br>1111111111110000000000000000   |
| CSI request field (Note 3)  |        |    | '10'   |
| PDSCH transmission mode   |        |    | 4  |
| ACK/NACK transmission   |        |    | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG  |
| CSI feedback  |        |    | Separate PUSCH feedbacks on the MCG and SCG  |
| Time offset between MCG CC and SCG CC   |        | μs | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchronous dual connectivity (Note 6) |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Multiple CC-s under test are configured as the 1<sup>st</sup> set of serving cells by higher layers.</p> <p>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.</p> <p>Note 5: The same PDSCH transmission mode is applied to each component carrier.</p> <p>Note 6: As defined in TS36.300 [11].</p> <p>Note 7: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured.</p> |        |    |  |

**Table 8.13.3.5.2-2: Single carrier performance with different bandwidths for multiple DC configurations for FDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.14-4 FDD        | R.14-4 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.4     | 7.5    |
| 3MHz         | R.14-5 FDD        | R.14-5 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.1    |
| 5MHz         | R.14-6 FDD        | R.14-6 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.5      | 5.2    |
| 10 MHz       | R.14 FDD          | R.14 FDD   | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.7    |
| 15M Hz       | R.14-7 FDD        | R.14-7 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.1     | 5.6    |
| 20M Hz       | R.14-3 FDD        | R.14-3 FDD | OP.1 FDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.3     | 5.6    |

**Table 8.13.3.5.2-3: Single carrier performance with different bandwidths for multiple DC configurations for TDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 1.4M Hz      | R.43-1 TDD        | R.43-1 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 11.0     | 8.1    |
| 3MHz         | R.43-2 TDD        | R.43-2 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 9.8      | 5.4    |
| 5MHz         | R.43-3 TDD        | R.43-3 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.0     | 5.9    |
| 10 MHz       | R.43-4 TDD        | R.43-4 TDD | OP.1 TDD     | EVA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 10.5     | 6.3    |

|        |            |            |          |      |         |         |    |      |     |
|--------|------------|------------|----------|------|---------|---------|----|------|-----|
| 15M Hz | R.43-5 TDD | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.6 | 6.2 |
| 20M Hz | R.43 TDD   | R.43 TDD   | OP.1 TDD | EVA5 | 4x2 Low | 4x4 Low | 70 | 10.7 | 6.4 |

**Table 8.13.3.5.2-4: Minimum performance for multiple DC configurations with 2DL CCs (FRC)**

| Test number   | Aggregated Bandwidth (MHz) |        |        | Minimum performance requirement                                | UE Category |
|---|----------------------------|--------|--------|--|-------------|
|   | Total                      | FDD CC | TDD CC |  |             |
| 1   | 2x20                       | 20     | 20     | As defined in Table 8.13.3.5.2-2 and Table 8.13.3.5.2-3 per CC | ≥5          |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |                            |        |        |  |             |

### 8.13.3.6 Closed-loop spatial multiplexing performance 4Tx Antenna Port with 256QAM

#### 8.13.3.6.1 Minimum Requirement for FDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.6.1-4 based on single carrier requirement specified in Table 8.13.3.6.1-2 and Table 8.13.3.6.1-3, with the addition of the parameters in Table 8.13.3.6.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.6.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit      | Value  |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)  | FDD CC   | ms        | 8  |
|   | TDD CC   | ms        | 10 or 11   |
| Reporting interval  | FDD CC   | ms        | 1  |
|   | TDD CC   | ms        | 1 or 4 (Note 3)  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>00001111111111111111111100000000<br>00000000                   |
| CSI request field (Note 3)  |          |           | '10'   |
| PDSCH transmission mode   |          |           | 4  |
| Note 1: $P_B = 1$ .   |          |           |  |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |           |  |
| Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.   |          |           |  |
| Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.  |          |           |  |
| Note 5: The same PDSCH transmission mode is applied to each component carrier.  |          |           |  |

**Table 8.13.3.6.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propagation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-----------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                       | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                       |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 FDD        | R.72-1 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 23.4     | 19.3   |
| 10 MHz       | R.72 FDD          | R.72 FDD   | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.6     | 18.0   |
| 15M Hz       | R.72-2 FDD        | R.72-2 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.7     | 17.4   |
| 20M Hz       | R.72-3 FDD        | R.72-3 FDD | OP.1 FDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.8     | 17.5   |

**Table 8.13.3.6.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propagation condition | Correlation matrix and antenna config. |         | Reference value                    |          |        |
|--------------|-------------------|------------|--------------|-----------------------|--|---------|------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                       | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughput (%) | SNR (dB) |        |
|              |                   |            |              |                       |  |         |                                    | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 TDD        | R.72-1 TDD | OP.1 TDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 22.4     | 18.0   |
| 10 MHz       | R.72 TDD          | R.72 TDD   | OP.1 TDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.4     | 17.5   |
| 15M Hz       | R.72-2 TDD        | R.72-2 TDD | OP.1 TDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.5     | 17.1   |
| 20M Hz       | R.72-3 TDD        | R.72-3 TDD | OP.1 TDD     | EPA5                  | 4x2 Low                                | 4x4 Low | 70                                 | 21.6     | 17.2   |

**Table 8.13.3.6.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                                | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.13.3.6.1-2 and Table 8.13.3.6.1-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.13.3.6.1-2 and Table 8.13.3.6.1-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.13.3.6.1-2 and Table 8.13.3.6.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |        |        |  |             |

### 8.13.3.6.2 Minimum Requirement for TDD PCell

The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.6.2-4 based on single carrier requirement specified in Table 8.13.3.6.2-2 and Table 8.13.3.6.2-3, with the addition of the parameters in Table 8.13.3.6.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.6.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter   |          | Unit      | Value  |
|---|----------|-----------|--|
| Downlink power allocation   | $\rho_A$ | dB        | -6   |
|   | $\rho_B$ | dB        | -6 (Note 1)  |
|   | $\sigma$ | dB        | 3  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98  |
| Precoding granularity   |          | PRB       | Widelband pre-coding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2)  | FDD CC   | ms        | 8  |
|   | TDD CC   | ms        | 10 or 11   |
| Reporting interval  | FDD CC   | ms        | 1  |
|   | TDD CC   | ms        | 1 or 4 (Note 3)  |
| Reporting mode  |          |           | PUSCH 1-2  |
| CodeBookSubsetRestriction bitmap  |          |           | 00000000000000000000000000000000<br>000011111111111111111100000000<br>00000000                       |
| CSI request field (Note 3)  |          |           | '10'   |
| PDSCH transmission mode   |          |           | 4  |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.<br>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |          |           |  |

**Table 8.13.3.6.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 FDD        | R.72-1 FDD | OP.1 FDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 23.4     | 19.3   |
| 10 MHz       | R.72 FDD          | R.72 FDD   | OP.1 FDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.6     | 18.0   |
| 15M Hz       | R.72-2 FDD        | R.72-2 FDD | OP.1 FDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.7     | 17.4   |
| 20M Hz       | R.72-3 FDD        | R.72-3 FDD | OP.1 FDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.8     | 17.5   |

**Table 8.13.3.6.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band - width | Reference channel |            | OCNG pattern | Propa- gation condi- tion | Correlation matrix and antenna config. |         | Reference value                     |          |        |
|--------------|-------------------|------------|--------------|---------------------------|--|---------|-------------------------------------|----------|--------|
|              | 2Rx CC            | 4Rx CC     |              |                           | 2Rx CC                                 | 4Rx CC  | Fraction of maximum throughpu t (%) | SNR (dB) |        |
|              |                   |            |              |                           |  |         |                                     | 2Rx CC   | 4Rx CC |
| 5MHz         | R.72-1 TDD        | R.72-1 TDD | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 22.4     | 18.0   |
| 10 MHz       | R.72 TDD          | R.72 TDD   | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.4     | 17.5   |
| 15M Hz       | R.72-2 TDD        | R.72-2 TDD | OP.1 TDD     | EPA5                      | 4x2 Low                                | 4x4 Low | 70                                  | 21.5     | 17.1   |

|           |               |               |          |      |         |         |    |      |      |
|-----------|---------------|---------------|----------|------|---------|---------|----|------|------|
| 20M<br>Hz | R.72-3<br>TDD | R.72-3<br>TDD | OP.1 TDD | EPA5 | 4x2 Low | 4x4 Low | 70 | 21.6 | 17.2 |
|-----------|---------------|---------------|----------|------|---------|---------|----|------|------|

**Table 8.13.3.6.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                                | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.13.3.6.2-2 and Table 8.13.3.6.2-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.13.3.6.2-2 and Table 8.13.3.6.2-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.13.3.6.1-2 and Table 8.13.3.6.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |        |        |  |             |

### 8.13.3.7 Closed-loop spatial multiplexing performance 4Tx Antenna Port with Four layers

#### 8.13.3.7.1 Minimum Requirement for FDD PCell

The purpose of these tests is to verify the closed loop rank-four performance with wideband precoding with 4Tx and 4Rx under CA.

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.7.1-4 based on single carrier requirement specified in Table 8.13.3.7.1-2 and Table 8.13.3.7.1-3, with the addition of the parameters in Table 8.13.3.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.7.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter                        |          | Unit      | Value   |
|----------------------------------|----------|-----------|---|
| Downlink power allocation        | $\rho_A$ | dB        | -6  |
|                                  | $\rho_B$ | dB        | -6 (Note 1)   |
|                                  | $\sigma$ | dB        | 0   |
| $N_{oc}$ at antenna port         |          | dBm/15kHz | -98   |
| Cell-specific reference signals  |          |           | Antenna Ports 0,1,2,3   |
| Precoding granularity            |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs |
| PMI delay (Note 2)               | FDD CC   | ms        | 8   |
|                                  | TDD CC   | ms        | 10 or 11  |
| Reporting interval               | FDD CC   | ms        | 1   |
|                                  | TDD CC   | ms        | 1 or 4 (Note 3)   |
| Reporting mode                   |          |           | PUSCH 3-1   |
| CodeBookSubsetRestriction bitmap |          |           | 0xFFFF000000000000  |
| CSI request field (Note 3)       |          |           | '10'  |
| PDSCH transmission mode          |          |           | 4   |
| PDSCH rank                       |          |           | 4   |

|         |   |
|---------|---|
| Note 1: | $P_B = 1$ .   |
| Note 2: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 3: | Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.   |
| Note 4: | ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection   |
| Note 5: | The same PDSCH transmission mode is applied to each component carrier.  |

**Table 8.13.3.7.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-------------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                         |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 FDD        | OP.1 FDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.1     |
| 10MHz      | R.74 FDD          | OP.1 FDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.9     |
| 15MHz      | R.74-2 FDD        | OP.1 FDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.3     |
| 20MHz      | R.74-3 FDD        | OP.1 FDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.4     |

**Table 8.13.3.7.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-------------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                         |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 TDD        | OP.1 TDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.5     |
| 10MHz      | R.74 TDD          | OP.1 TDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.4     |
| 15MHz      | R.74-2 TDD        | OP.1 TDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.6     |
| 20MHz      | R.74-3 TDD        | OP.1 TDD     | EPA5                    | 4x4 Low                               | 70                                 | 14.8     |

**Table 8.13.3.7.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                                | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.13.3.7.1-2 and Table 8.13.3.7.1-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.13.3.7.1-2 and Table 8.13.3.7.1-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.13.3.7.1-2 and Table 8.13.3.7.1-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |        |        |  |             |

8.13.3.7.2 Minimum Requirement for TDD PCell

The purpose of these tests is to verify the closed loop rank-four performance with wideband precoding with 4Tx and 4Rx under CA.

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.13.3.7.2-4 based on single carrier requirement specified in Table 8.13.3.7.2-2 and Table 8.13.3.7.2-3, with the addition of the parameters in Table 8.13.3.7.2-1 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.13.3.7.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  |          | Unit      | Value   |
|--|----------|-----------|---|
| Downlink power allocation  | $\rho_A$ | dB        | -6  |
|  | $\rho_B$ | dB        | -6 (Note 1)   |
|  | $\sigma$ | dB        | 0   |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98   |
| Cell-specific reference signals  |          |           | Antenna Ports 0,1,2,3   |
| Precoding granularity  |          | PRB       | 25 for 5MHz CCs, 50 for 10MHz CCs, 75 for 15MHz and 100 for 20MHz CCs |
| PMI delay (Note 2)   | FDD CC   | ms        | 8   |
|  | TDD CC   | ms        | 10 or 11  |
| Reporting interval   | FDD CC   | ms        | 1   |
|  | TDD CC   | ms        | 1 or 4 (Note 3)   |
| Reporting mode   |          |           | PUSCH 3-1   |
| CodeBookSubsetRestriction bitmap   |          |           | 0xFFFFF00000000000  |
| CSI request field (Note 3)   |          |           | '10'  |
| PDSCH transmission mode  |          |           | 4   |
| PDSCH rank   |          |           | 4   |
| Note 1: $P_B = 1$ .<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 3: Multiple CC-s under test are configured as the 1 <sup>st</sup> set of serving cells by higher layers.<br>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. |          |           |   |

**Table 8.13.3.7.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.1     |
| 10MHz      | R.74 FDD          | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.9     |
| 15MHz      | R.74-2 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.3     |
| 20MHz      | R.74-3 FDD        | OP.1 FDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.4     |

**Table 8.13.3.7.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.74-1 TDD        | OP.1 TDD     | EPA5                  | 4x4 Low                               | 70                                 | 14.5     |



|       |            |          |      |         |    |      |
|-------|------------|----------|------|---------|----|------|
| 10MHz | R.74 TDD   | OP.1 TDD | EPA5 | 4x4 Low | 70 | 14.4 |
| 15MHz | R.74-2 TDD | OP.1 TDD | EPA5 | 4x4 Low | 70 | 14.6 |
| 20MHz | R.74-3 TDD | OP.1 TDD | EPA5 | 4x4 Low | 70 | 14.8 |

**Table 8.13.3.7.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz)  |        |        | Minimum performance requirement                                | UE Category |
|-------------|---|--------|--------|--|-------------|
|             | Total   | FDD CC | TDD CC |  |             |
| 1           | 2x20  | 20     | 20     | As defined in Table 8.13.3.7.2-2 and Table 8.13.3.7.2-3 per CC | ≥5          |
| 2           | 20+10   | 10     | 20     | As defined in Table 8.13.3.7.2-2 and Table 8.13.3.7.2-3 per CC | ≥5          |
| 3           | 20+15   | 15     | 20     | As defined in Table 8.13.3.7.2-2 and Table 8.13.3.7.2-3 per CC | ≥5          |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.6. |        |        |  |             |

## 8.14 Demodulation (UE supporting Short TTI)

The performance requirements specified in this clause are valid for UEs capable of short TTI.

### 8.14.1 Slot-PDSCH and Subslot-PDSCH

#### 8.14.1.1 FDD (Fixed Reference Channel)

The parameters specified in Table 8.14.1.1-1 are valid for FDD unless otherwise stated.

**Table 8.14.1.1-1: Common Test Parameters**

| Parameter                           | Unit  | Value   |
|-------------------------------------|---|---|
| Cyclic prefix                       |   | Normal  |
| Cell ID                             |   | 0   |
| Number of HARQ processes            | Processes   | 8 for Slot-PDSCH<br>8 for subslot-PDSCH with proc-Timeline=set1 (Note 1)<br>12 for subslot-PDSCH with proc-Timeline=set2 (Note 1) |
| Minimum Processing Time (Note 2)    |   | $X_p=4$ (proc-Timeline=set1)<br>$X_p=6$ (proc-Timeline=set2)  |
| Maximum number of HARQ transmission |   | 4   |
| Redundancy version coding sequence  |   | {0,1,2,3}   |
| Number of OFDM symbols for PDCCH    | OFDM symbols                                      | 2   |
| Note 1:                             | As specified in TS36.211 Table 8.1-2.             |   |
| Note 2:                             | Subslot-PDSCH only. As specified in TS36.213 7.3. |   |

#### 8.14.1.1.1 Open-loop spatial multiplexing performance

The requirements are specified in Table 8.14.1.1.1-3, with the addition of the parameters in Table 8.14.1.1.1-1 and Table 8.14.1.1.1-2, and the downlink physical channel setup according to Annex C.3.2.

**Table 8.14.1.1.1-1: Test Parameters for PDSCH**

| Parameter                                |          | Unit      | Test 1                   | Test 2                   |
|--|----------|-----------|--------------------------|--------------------------|
| Unused RE-s and PRB-s                    |          |           | OCNG                     | OCNG                     |
| Cell ID                                  |          |           | 0                        | 0                        |
| Downlink power allocation                | $\rho_A$ | dB        | -6                       | -6                       |
|  | $\rho_B$ | dB        | -6                       | -6                       |
|  | $\sigma$ | dB        | 0                        | 0                        |
| $N_{oc}$ at antenna port                 |          | dBm/15kHz | -98                      | -98                      |
| Subframe configuration                   |          |           | Non-MBSFN                | Non-MBSFN                |
| Cell specific reference signal           |          |           | Antenna ports<br>0,1,2,3 | Antenna ports<br>0,1,2,3 |
| DL TTI length                            |          |           | Slot                     | Subslot                  |
| Configured SPDCCH-PRB sets               |          |           | {Set 1, Set 2}           | {Set 1, Set 2}           |
| SPDCCH-PRB set used for DCI transmission |          |           | Set 1                    | Set 2                    |
| Used/Unused SPDCCH resource indication   |          |           | N/A                      | '10'                     |
| PDSCH transmission mode                  |          |           | TM3                      | TM3                      |
| DCI format                               |          |           | 7-1B                     | 7-1B                     |

**Table 8.14.1.1.1-2: SPDCCH-PRB set parameters**

| Parameter   | Unit | Set 1          | Set 2          |
|---|------|----------------|----------------|
| Reference symbol  |      | CRS            | CRS            |
| Transmission type   |      | Localized      | Localized      |
| Number of OFDM symbols  |      | 1              | 1              |
| Number of PRBs per SPDCCH-PRB set (Note 1)  |      | 16             | 16             |
| Rate Matching mode  |      | Mode 1         | Not configured |
| SPDCCH L1 Reuse Indication  |      | Not configured | {2, 0}         |
| Aggregation level   | SCCE | 2              | 2              |
| Note 1: The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 15} for Set 1, and PRB = {35, 36, ..., 49} for Set 2 |      |                |                |

**Table 8.14.1.1.1-3: Minimum performance Large Delay CDD (FRC)**

| Test num | Bandwidth and MCS    | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|----------|----------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|          |                      |                   |              |                       |  | Fraction of maximum Throughput (%) | SNR (dB) |             |
| 1        | 10 MHz<br>16QAM 0.5  | R.sTTI.1<br>FDD   | OP.1 FDD     | EVA30                 | 4x2 Low                                | 70                                 | 13.6     | $\geq 2$    |
| 2        | 10 MHz<br>16QAM 0.45 | R.sTTI.2<br>FDD   | OP.1 FDD     | EVA30                 | 4x2 Low                                | 70                                 | 11.6     | $\geq 2$    |

#### 8.14.1.1.2 Closed-loop spatial multiplexing performance (User-Specific Reference Signals)

The requirements are specified in Table 8.14.1.1.2-3, with the addition of the parameters in Table 8.14.1.1.2-1 and Table 8.14.1.1.2-2, and the downlink physical channel setup according to Annex C.3.2.

**Table 8.14.1.1.2-1: Test Parameters for PDSCH**

| Parameter                 |          | Unit | Test 1 | Test 2 |
|---------------------------|----------|------|--------|--------|
| Unused RE-s and PRB-s     |          |      | OCNG   | OCNG   |
| Cell ID                   |          |      | 0      | 0      |
| Downlink power allocation | $\rho_A$ | dB   | -3     | -3     |
|                           | $\rho_B$ | dB   | -3     | -3     |
|                           | $\sigma$ | dB   | 0      | 0      |

|  |           |                         |   |
|--|-----------|-------------------------|---|
| $N_{oc}$ at antenna port                 | dBm/15kHz | -98                     | -98   |
| CSI-RS signals                           |           | Antenna ports<br>15, 16 | Antenna ports<br>15, 16                                   |
| CSI-RS periodicity and subframe offset   |           | 5 / 2                   | 5 / 2   |
| CSI-RS configuration                     |           | 0                       | 0   |
| Zero-power CSI-RS configuration          |           | Not configured          | Not configured  |
| Subframe configuration                   |           | Non-MBSFN               | Non-MBSFN   |
| Precoder update granularity              | SREG      | 2                       | 2   |
|  | ms        | 1                       | 1   |
| Beamforming precoder                     |           | Annex B.4.2             | Annex B.4.2   |
| Cell specific reference signal           |           | 0, 1                    | 0, 1  |
| DL TTI length                            |           | Slot                    | Subslot   |
| DMRS position indicator                  |           | N/A                     | 0 for subslots<br>1,3, and 5<br>1 for subslots 2<br>and 4 |
| Configured SPDCCH-PRB sets               |           | {Set 1, Set 2}          | {Set 1, Set 2}  |
| SPDCCH-PRB set used for DCI transmission |           | Set 1                   | Set 2   |
| Used/Unused SPDCCH resource indication   |           | '10'                    | N/A   |
| PDSCH transmission mode                  |           | TM9                     | TM9   |
| DCI format                               |           | 7-1F                    | 7-1F  |

**Table 8.14.1.1.2-2: SPDCCH-PRB set parameters**

| Parameter                                  | Unit | Set 1          | Set 2          |
|--|------|----------------|----------------|
| Reference signal                           |      | CRS            | CRS            |
| Transmission type                          |      | Localized      | Localized      |
| Number of OFDM symbols                     |      | 2              | 2              |
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 8              | 8              |
| Rate Matching mode                         |      | Not configured | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | {1, 1}         | Not configured |
| Aggregation level                          | SCCE | 4              | 4              |

Note 1: The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 7} for Set 1, and PRB = {8, 9, ..., 15} for Set 2

**Table 8.14.1.1.2-3: Minimum performance Large Delay CDD (FRC)**

| Test num | Bandwidth and MCS | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value                    |          | UE category |
|----------|-------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|          |                   |                   |              |                       |  | Fraction of maximum Throughput (%) | SNR (dB) |             |
| 1        | 10 MHz QPSK 1/3   | R.sTTI.3 FDD      | OP.1 FDD     | EPA5                  | 2x2 Low                                | 70                                 | 7.1      | ≥2          |
| 2        | 10 MHz QPSK 1/3   | R.sTTI.4 FDD      | OP.1 FDD     | EPA5                  | 2x2 Low                                | 70                                 | 8.4      | ≥2          |

8.14.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.14.1.2-1 are valid for TDD unless otherwise stated.

**Table 8.14.1.2-1: Common Test Parameters**

| Parameter     | Unit | Value  |
|---------------|------|--------|
| Cyclic prefix |      | Normal |
| Cell ID       |      | 0      |

|  |              |                |
|--|--------------|----------------|
| Number of HARQ processes                             | Processes    | 8 (Slot-PDSCH) |
| Maximum number of HARQ transmission                  |              | 4              |
| Redundancy version coding sequence                   |              | {0,1,2,3}      |
| Number of OFDM symbols for PDCCH                     | OFDM symbols | 2              |
| Uplink downlink configuration (Note 1)               |              | 1              |
| Special subframe configuration (Note 2)              |              | 4              |
| ACK/NACK feedback mode                               |              | Multiplexing   |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4] |              |                |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4] |              |                |

8.14.1.2.1 Open-loop spatial multiplexing performance

The requirements are specified in Table 8.14.1.2.1-3, with the addition of the parameters in Table 8.14.1.2.1-1 and Table 8.14.1.2.1-2, and the downlink physical channel setup according to Annex C.3.2.

**Table 8.14.1.2.1-1: Test Parameters for PDSCH**

| Parameter                                |          | Unit      | Test 1                |
|--|----------|-----------|-----------------------|
| Number of PDCCH symbols                  |          | symbols   | 2                     |
| Unused RE-s and PRB-s                    |          |           | OCNG                  |
| Cell ID                                  |          |           | 0                     |
| Downlink power allocation                | $\rho_A$ | dB        | -6                    |
|  | $\rho_B$ | dB        | -6                    |
|  | $\sigma$ | dB        | 0                     |
| $N_{oc}$ at antenna port                 |          | dBm/15kHz | -98                   |
| Subframe configuration                   |          |           | Non-MBSFN             |
| Cell specific reference signal           |          |           | Antenna ports 0,1,2,3 |
| DL TTI length                            |          |           | Slot                  |
| Configured SPDCCH-PRB sets               |          |           | {Set 1, Set 2}        |
| SPDCCH-PRB set used for DCI transmission |          |           | Set 1                 |
| Used/Unused SPDCCH resource indication   |          |           | N/A                   |
| PDSCH transmission mode                  |          |           | TM3                   |
| DCI format                               |          |           | 7-1B                  |

**Table 8.14.1.2.1-2: SPDCCH-PRB set parameters**

| Parameter   | Unit | Set 1          | Set 2          |
|---|------|----------------|----------------|
| Reference signal  |      | CRS            | CRS            |
| Transmission type   |      | Localized      | Localized      |
| Number of OFDM symbols  |      | 1              | 1              |
| Number of PRBs per SPDCCH-PRB set (Note 1)  |      | 16             | 16             |
| Rate Matching mode  |      | Mode 1         | Not configured |
| SPDCCH L1 Reuse Indication  |      | Not configured | {2, 0}         |
| Aggregation level   | SCCE | 2              | 2              |
| Note 1: The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 15} for Set 1, and PRB = {35, 36, ..., 49} for Set 2 |      |                |                |

**Table 8.14.1.2.1-3: Minimum performance Large Delay CDD (FRC)**

|  |  |  |  |        |  |                 |  |
|--|--|--|--|--------|--|-----------------|--|
|  |  |  |  | Propa- |  | Reference value |  |
|--|--|--|--|--------|--|-----------------|--|

| Test num | Bandwidth and MCS   | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Fraction of maximum Throughput (%) | SNR (dB) | UE category |
|----------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
| 1        | 10 MHz<br>16QAM 0.5 | R.sTTI.1<br>FDD   | OP.1 TDD     | EVA30                 | 4x2 Low                                | 70                                 | 13.5     | ≥2          |

#### 8.14.1.2.2 Closed-loop spatial multiplexing performance (User-Specific Reference Signals)

The requirements are specified in Table 8.14.1.2.2-3, with the addition of the parameters in Table 8.14.1.2.2-1 and Table 8.14.1.2.2-2, and the downlink physical channel setup according to Annex C.3.2.

**Table 8.14.1.2.2-1: Test Parameters for PDSCH**

| Parameter                                |          | Unit      | Test 1                  |
|--|----------|-----------|-------------------------|
| Number of PDCCH symbols                  |          | symbols   | 2                       |
| Unused RE-s and PRB-s                    |          |           | OCNG                    |
| Cell ID                                  |          |           | 0                       |
| Downlink power allocation                | $\rho_A$ | dB        | -3                      |
|  | $\rho_B$ | dB        | -3                      |
|  | $\sigma$ | dB        | 0                       |
| $N_{oc}$ at antenna port                 |          | dBm/15kHz | -98                     |
| CSI-RS signals                           |          |           | Antenna ports<br>15, 16 |
| CRS-RS periodicity and subframe offset   |          |           | 5 / 4                   |
| CSI-RS configuration                     |          |           | 0                       |
| Zero-power CRI-RS configuration          |          |           | Not configured          |
| Subframe configuration                   |          |           | Non-MBSFN               |
| Precoder update granularity              |          | SREG      | 2                       |
|  |          | ms        | 1                       |
| Beamforming precoder                     |          |           | Annex B.4.2             |
| Cell specific reference signal           |          |           | 0,1                     |
| DL TTI length                            |          |           | Slot                    |
| Configured SPDCCH-PRB sets               |          |           | {Set 1, Set 2}          |
| SPDCCH-PRB set used for DCI transmission |          |           | Set 1                   |
| Used/Unused SPDCCH resource indication   |          |           | '10'                    |
| PDSCH transmission mode                  |          |           | TM9                     |
| DCI format                               |          |           | 7-1F                    |

**Table 8.14.1.2.2-2: SPDCCH-PRB set parameters**

| Parameter                                  | Unit | Set 1          | Set 2          |
|--|------|----------------|----------------|
| Reference symbol                           |      | CRS            | CRS            |
| Transmission type                          |      | Localized      | Localized      |
| Number of OFDM symbols                     |      | 2              | 2              |
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 8              | 8              |
| Rate Matching mode                         |      | Not configured | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | {1, 1}         | Not configured |
| Aggregation level                          | SCCE | 4              | 4              |

Note 1: The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 7} for Set 1, and PRB = {8, 9, ..., 15} for Set 2

**Table 8.14.1.2.2-3: Minimum performance Large Delay CDD (FRC)**

| Test num | Bandwidth and MCS | Reference channel | OCNG pattern | Propa- | Correlation matrix and | Reference value     |          | UE category |
|----------|-------------------|-------------------|--------------|--------|------------------------|---------------------|----------|-------------|
|          |                   |                   |              |        |                        | Fraction of maximum | SNR (dB) |             |

|   |                    |                 |          | gation<br>condi-<br>tion | antenna<br>config. | Throughput<br>(%) |     |    |
|---|--------------------|-----------------|----------|--------------------------|--------------------|-------------------|-----|----|
| 1 | 10 MHz<br>QPSK 1/3 | R.sTTI.2<br>TDD | OP.1 TDD | EPA5                     | 2x2 Low            | 70                | 6.8 | ≥2 |

## 8.14.2 SPDCCH

The receiver characteristics of the SPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

### 8.14.2.1 FDD

The parameters specified in Table 8.14.2.1-1 and Table 8.14.2.1-2 are valid for all FDD tests unless otherwise stated.

**Table 8.14.2.1-1: Test Parameters for SPDCCH**

| Parameter   |          | Unit      | Test 1<br>Test 3         | Test 2<br>Test 4     |
|---|----------|-----------|--------------------------|----------------------|
| Number of PDCCH symbols   |          | symbols   | 2                        | 2                    |
| Unused RE-s and PRB-s   |          |           | OCNG                     | OCNG                 |
| Cell ID   |          |           | 0                        | 0                    |
| Downlink power<br>allocation  | $\rho_A$ | dB        | -6                       | -3                   |
|   | $\rho_B$ | dB        | -6                       | -3                   |
|   | $\sigma$ | dB        | 0                        | 0                    |
|   | $\delta$ | dB        | N/A                      | 3                    |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                      | -98                  |
| Cyclic prefix   |          |           | Normal                   | Normal               |
| Subframe configuration  |          |           | Non-MBSFN                | Non-MBSFN            |
| Precoder update granularity   |          | SREG      | N/A                      | 2                    |
|   |          | ms        | N/A                      | 1                    |
| Beamforming precoder  |          |           | N/A                      | Annex B.4.4          |
| Cell specific reference signal  |          |           | Antenna ports<br>0,1,2,3 | Antenna ports<br>0,1 |
| Configured SPDCCH-PRB sets  |          |           | {Set 1}                  | {Set 2}              |
| SPDCCH-PRB set used for DCI<br>transmission   |          |           | Set 1                    | Set 2                |
| PDSCH transmission mode   |          |           | TM4                      | TM9                  |
| DCI format  |          |           | 7-1C                     | 7-1F                 |
| Note 1: For slot-based transmission, DCI 7-1C and 7-1F are transmitted only on SPDCCH in slot 1. For subslot-based transmission, DCI 7-1C and 7-1F are transmitted on SPDCCH in all the subslots. |          |           |                          |                      |

**Table 8.14.2.1-2: SPDCCH-PRB set parameters**

| Parameter  | Unit | Set 1     | Set 2       |
|--|------|-----------|-------------|
| Reference symbol   |      | CRS       | DMRS        |
| Transmission type  |      | Localized | Distributed |
| Number of OFDM symbols   |      | 1         | Note 2      |
| Number of PRBs per SPDCCH-<br>PRB set (Note 1)   |      | 16        | 16          |
| Note 1: The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 15} for Set 1 and PRB = {0, 1, 6, 7, 12, 13, 18, 19, 28, 29, 34, 35, 40, 41, 46, 47} for Set 2. |      |           |             |
| Note 2: 2 OFDM symbols for slot-based SPDCCH. 2 OFDM symbols for subslot indices 2, 3, and 4, and 3 OFDM symbols for subslot indices 1 and 5 for subslot-based SPDCCH.     |      |           |             |

## 8.14.2.1.1 Minimum requirement

For the parameters specified in Table 8.14.2.1-1 and Table 8.14.2.1-2 the average probability of a missed downlink scheduling grant (P<sub>m-dsg</sub>) shall be below the specified value in Table 8.14.2.1.1-1. The metric P<sub>m-dsg</sub> is calculated across all the slots for slot-based SPDCCH and across all the subslots for subslot-based SPDCCH. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.14.2.1.1-1: Minimum performance SPDCCH

| Test number | Bandwidth | DL TTI length | Aggregation Level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value        |          |
|-------------|-----------|---------------|-------------------|-------------------|--------------|-----------------------|--|------------------------|----------|
|             |           |               |                   |                   |              |                       |  | P <sub>m-dsg</sub> (%) | SNR (dB) |
| 1           | 10 MHz    | Slot          | 2 SCCE            | R.sTTI.10 FDD     | OP.7 FDD     | EVA30                 | 4 x 2 Low                                    | 1                      | 2.9      |
| 2           | 10 MHz    | Slot          | 8 SCCE            | R.sTTI.11 FDD     | OP.7 FDD     | EPA5                  | 2 x 2 Low                                    | 1                      | 1.3      |
| 3           | 10 MHz    | Subslot       | 2 SCCE            | R.sTTI.10 FDD     | OP.7 FDD     | EVA30                 | 4 x 2 Low                                    | 1                      | 2.3      |
| 4           | 10 MHz    | Subslot       | 8 SCCE            | R.sTTI.11 FDD     | OP.7 FDD     | EPA5                  | 2 x 2 Low                                    | 1                      | 0.9      |

## 8.14.2.2 TDD

The parameters specified in Table 8.14.2.2-1 and Table 8.14.2.2-2 are valid for all TDD tests unless otherwise stated.

Table 8.14.2.2-1: Test Parameters for SPDCCH

| Parameter   |          | Unit      | Test 1                | Test 2            |
|---|----------|-----------|-----------------------|-------------------|
| Number of PDCCH symbols   |          | symbols   | 2                     | 2                 |
| Unused RE-s and PRB-s   |          |           | OCNG                  | OCNG              |
| Cell ID   |          |           | 0                     | 0                 |
| Downlink power allocation   | $\rho_A$ | dB        | -6                    | -3                |
|   | $\rho_B$ | dB        | -6                    | -3                |
|   | $\sigma$ | dB        | 0                     | 0                 |
|   | $\delta$ | dB        | N/A                   | 3                 |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98                   | -98               |
| Cyclic prefix   |          |           | Normal                | Normal            |
| Subframe configuration  |          |           | Non-MBSFN             | Non-MBSFN         |
| Precoder update granularity   | SREG     |           | N/A                   | 2                 |
|   | ms       |           | N/A                   | 1                 |
| Beamforming precoder  |          |           | N/A                   | Annex B.4.4       |
| Cell specific reference signal  |          |           | Antenna ports 0,1,2,3 | Antenna ports 0,1 |
| Configured SPDCCH-PRB sets  |          |           | {Set 1}               | {Set 2}           |
| SPDCCH-PRB set used for DCI transmission  |          |           | Set 1                 | Set 2             |
| PDSCH transmission mode   |          |           | TM4                   | TM9               |
| DCI format  |          |           | 7-1C                  | 7-1F              |
| TDD UL/DL Configuration   |          |           | 0                     | 0                 |
| TDD Special Subframe  |          |           | 1                     | 1                 |
| Note 1: For slot-based transmission, DCI 7-1C and 7-1F are transmitted only on SPDCCH in slot 1. For subslot-based transmission, DCI 7-1C and 7-1F are transmitted on SPDCCH in all the subslots. |          |           |                       |                   |

Table 8.14.2.2-2: SPDCCH-PRB set parameters

| Parameter              | Unit | Set 1     | Set 2       |
|------------------------|------|-----------|-------------|
| Reference symbol       |      | CRS       | DMRS        |
| Transmission type      |      | Localized | Distributed |
| Number of OFDM symbols |      | 1         | Note 2      |

|  |  |    |    |
|--|--|----|----|
| Number of PRBs per SPDCCH-PRB set (Note 1) |  | 16 | 16 |
| Note 1:                                    | The two SPDCCH-PRB sets are non-overlapping with PRB = {0, 1, ..., 15} for Set 1 and PRB = {0, 1, 6, 7, 12, 13, 18, 19, 28, 29, 34, 35, 40, 41, 46, 47} for Set 2. |    |    |
| Note 2:                                    | 2 OFDM symbols for slot-based SPDCCH. 2 OFDM symbols for subslot indices 2, 3, and 4, and 3 OFDM symbols for subslot indices 1 and 5 for subslot-based SPDCCH.     |    |    |

#### 8.14.2.2.1 Minimum requirement

For the parameters specified in Table 8.14.2.2-1 and Table 8.14.2.2-2 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.14.2.2.1-1. The metric Pm-dsg is calculated across all the slots. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.14.2.2.1-1: Minimum performance SPDCCH**

| Test number | Bandwidth | DL TTI length | Aggregation Level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|---------------|-------------------|-------------------|--------------|-----------------------|--|-----------------|----------|
|             |           |               |                   |                   |              |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | Slot          | 2 SCCE            | R.sTTI.10 TDD     | OP.7 TDD     | EVA30                 | 4 x 2 Low                                    | 1               | 2.7      |
| 2           | 10 MHz    | Slot          | 8 SCCE            | R.sTTI.11 TDD     | OP.7 TDD     | EPA5                  | 2 x 2 Low                                    | 1               | 1.2      |

## 8.15 Demodulation (8 receiver antenna ports)

### 8.15.1 PDSCH

#### 8.15.1.1 Void

#### 8.15.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.15.1.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.15.1.2-1: Common Test Parameters (TDD)**

| Parameter                                      | Unit         | Value  |
|--|--------------|--|
| Uplink downlink configuration (Note 1)         |              | 1  |
| Special subframe configuration (Note 2)        |              | 4  |
| Cyclic prefix                                  |              | Normal   |
| Cell ID  |              | 0  |
| Inter-TTI Distance                             |              | 1  |
| Number of HARQ processes per component carrier | Processes    | 7  |
| Maximum number of HARQ transmission            |              | 4  |
| Redundancy version coding sequence             |              | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH               | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |



|                             |   |  |
|-----------------------------|---|--|
| Cross carrier scheduling    |   | Not configured   |
| Precoder update granularity |   | Frequency domain: 1 PRG for Transmission modes 9 and 10 unless stated otherwise<br>Time domain: 1 ms |
| ACK/NACK feedback mode      |   | Multiplexing   |
| Note 1:                     | as specified in Table 4.2-2 in TS 36.211 [4]. |  |
| Note 2:                     | as specified in Table 4.2-1 in TS 36.211 [4]. |  |

### 8.15.1.2.1 Transmit diversity performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.15.1.2.1-2, with the addition of the parameters in Table 8.15.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.15.1.2.1-1: Test Parameters for Transmit diversity Performance (FRC) with 8Rx Antenna Ports**

| Parameter                 | Unit     | Test 1    |
|---------------------------|----------|-----------|
| Downlink power allocation | $\rho_A$ | dB        |
|                           | $\rho_B$ | dB        |
|                           | $\sigma$ | dB        |
| $N_{oc}$ at antenna port  |          | dBm/15kHz |
| PDSCH transmission mode   |          | 2         |
| Note 1: $P_B = 1$         |          |           |

**Table 8.15.1.2.1-2: Minimum performance Transmit Diversity (FRC) with 8Rx Antenna Ports**

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.11 TDD          | OP.1 TDD     | EVA5                  | 2x8 Medium correlation B, ULA                | 70                                 | 1.4      | $\geq 2$    |

### 8.15.1.2.2 Open-loop spatial multiplexing performance with 2Tx Antenna Ports (Cell-Specific Reference Symbols)

The requirements are specified in Table 8.15.1.2.2-2, with the addition of the parameters in Table 8.15.1.2.2-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.15.1.2.2-1: Test Parameters for Large Delay CDD (FRC) with 8Rx Antenna Ports**

| Parameter                 | Unit     | Test 1    |
|---------------------------|----------|-----------|
| Downlink power allocation | $\rho_A$ | dB        |
|                           | $\rho_B$ | dB        |
|                           | $\sigma$ | dB        |
| $N_{oc}$ at antenna port  |          | dBm/15kHz |
| ACK/NACK feedback mode    |          | Bundling  |
| PDSCH transmission mode   |          | 3         |
| Note 1: $P_B = 1$         |          |           |

Table 8.15.1.2.2-2: Minimum performance Large Delay CDD (FRC) with 8Rx Antenna Ports

| Test number | Bandwidth and MCS   | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category |
|-------------|---------------------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |                     |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz<br>16QAM 1/2 | R.11-1<br>TDD     | OP.1<br>TDD  | EVA70                 | 2x8 Low                                      | 70                                 | 4.1      | ≥2          |

## 8.15.1.2.3 8 Layer Spatial Multiplexing (User-Specific Reference Symbols)

The requirements are specified in Table 8.15.1.2.3-2, with the addition of the parameters in Table 8.15.1.2.3-1 and the downlink physical channel setup according to Annex C.3.2.

Table 8.15.1.2.3-1: Minimum performance for 8 Layer Spatial Multiplexing (User-Specific Reference Symbols)

| Parameter   | Unit               | Test 1                                     |            |
|---|--------------------|--|------------|
| Downlink power allocation   | $\rho_A$           | dB   | 0          |
|   | $\rho_B$           | dB   | 0 (Note 1) |
|   | $\sigma$           | dB   | -3         |
| Beamforming model   |                    | 8 layer precoding based on WB PMI feedback |            |
| Cell-specific reference signals   |                    | Antenna ports 0,1                          |            |
| CSI reference signals   |                    | Antenna ports 15,...,22                    |            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  | Subframes          | 5 / 4                                      |            |
| CSI reference signal configuration  |                    | 3  |            |
| Zero-power CSI-RS configuration<br>$l_{\text{CSI-RS}} /$<br>ZeroPowerCSI-RS bitmap  | Subframes / bitmap | 4 /<br>0010000000000000                    |            |
| $N_{oc}$ at antenna port  | dBm/15kHz          | -98  |            |
| Symbols for unused PRBs   |                    | OCNG (Note 3)                              |            |
| Number of allocated resource blocks (Note 2)  | PRB                | 50   |            |
| Simultaneous transmission   |                    | No   |            |
| PDSCH transmission mode   |                    | 9  |            |
| Precoding granularity   |                    | 50   |            |
| PMI delay   |                    | 10 or 11                                   |            |
| Reporting interval  |                    | 1 or 4                                     |            |
| Reporting mode  |                    | PUSCH 3-1                                  |            |
| alternativeCodeBookEnabledFor4TX-r12  |                    | False                                      |            |
| CodeBookSubsetRestriction bitmap  |                    | 0x0000 0000 0000 0010 0000<br>0000 0000    |            |
| Note 1: $P_B = 1$ .<br>Note 2: 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0, 1 and 6.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 4: Number of OFDM symbols for PDCCH: 2 |                    |  |            |

**Table 8.15.1.2.3-2: Minimum performance for for 8 Layer Spatial Multiplexing (User-Specific Reference Symbols)**

| Test number | Bandwidth and MCS | Reference Channel | OCN G Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value                    |          | UE Category | DL UE Category                         |
|-------------|-------------------|-------------------|---------------|-----------------------|--|------------------------------------|----------|-------------|--|
|             |                   |                   |               |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |  |
| 1           | 10 MHz 16QAM      | R.50-4 TDD        | OP.1 TDD      | EPA5                  | 8x8 Low                                      | 70                                 | 18.5     | 8           | 14, 17, 18, 19, 20, 22, 23, 24, 25, 26 |

## 8.15.2 CA

### 8.15.2.1 Void

### 8.15.2.2 TDD

The parameters specified in Table 8.15.2.2-1 are valid for all TDD CA and DC tests unless otherwise stated.

**Table 8.15.2.2-1: Common Test Parameters (TDD)**

| Parameter  | Unit  | Value  |
|--|---|--|
| Uplink downlink configuration (Note 1)                 |   | 1  |
| Special subframe configuration (Note 2)                |   | 4  |
| Cyclic prefix  |   | Normal   |
| Cell ID  |   | 0  |
| Inter-TTI Distance                                     |   | 1  |
| Number of HARQ processes per component carrier         | Processes                                     | 7  |
| Maximum number of HARQ transmission                    |   | 4  |
| Redundancy version coding sequence                     |   | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM   |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols                                  | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cross carrier scheduling                               |   | Not configured   |
| Note 1:  | as specified in Table 4.2-2 in TS 36.211 [4]. |  |
| Note 2:  | as specified in Table 4.2-1 in TS 36.211 [4]. |  |

### 8.15.2.2.1 Eight Layer Spatial Multiplexing (User-Specific Reference Symbols)

#### 8.15.2.2.1.1 Minimum Requirement Eight-Layer Spatial Multiplexing 8 Tx Antenna Port

The purpose of these tests is to verify the closed loop rank-eight performance with frequency selective precoding with 8Tx and 8Rx under CA.

For CA with 2 DL CCs, the requirements are specified in Table 8.15.2.2.1.1-3, based on single carrier requirement specified in Table 8.15.2.2.1.1-2, with the addition of the parameters in Table 8.15.2.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.15.2.2.1.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter  |          | Unit                  | Test 1                                  |
|--|----------|-----------------------|---|
| ownlink power allocation   | $\rho_A$ | dB                    | 0                                       |
|  | $\rho_B$ | dB                    | 0 (Note 1)                              |
|  | $\sigma$ | dB                    | -3                                      |
| Cell-specific reference signals  |          |                       | Antenna ports 0,1                       |
| CSI reference signals  |          |                       | Antenna ports 15,...,22                 |
| Beamforming model  |          |                       | Annex B.4.3(Note 4, 5)                  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   |          | Subframes             | 5 / 2                                   |
| CSI reference signal configuration   |          |                       | 3                                       |
| Zero-power CSI-RS configuration<br>$I_{\text{CSI-RS}} /$<br>$\text{ZeroPowerCSI-RS}$ bitmap  |          | Subframes<br>/ bitmap | 3 /<br>0001000000000000                 |
| $N_{oc}$ at antenna port   |          | dBm/15kHz             | -98                                     |
| Symbols for unused PRBs  |          |                       | OCNG (Note 3)                           |
| Number of allocated resource blocks<br>(Note 2)  |          | PRB                   | 50                                      |
| Simultaneous transmission  |          |                       | No                                      |
| PDSCH transmission mode  |          |                       | 9                                       |
| Precoding granularity  |          |                       | 50                                      |
| PMI delay  |          |                       | 8                                       |
| Reporting interval   |          |                       | 5                                       |
| Reporting mode   |          |                       | PUSCH 3-1                               |
| alternativeCodeBookEnabledFor4TX-r12   |          |                       | False                                   |
| CodeBookSubsetRestriction bitmap   |          |                       | 0x0000 0000 0000 0010 0000 0000<br>0000 |
| <p>Note 1: <math>P_B = 1</math>.</p> <p>Note 2: 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.</p> <p>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.</p> <p>Note 4: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 5: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> |          |                       |   |

**Table 8.15.2.2.1.1-2: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config | Reference value                    |          |
|------------|-------------------|--------------|-----------------------|---------------------------------------|------------------------------------|----------|
|            |                   |              |                       |                                       | Fraction of maximum throughput (%) | SNR (dB) |
| 5MHz       | R.50-3 TDD        | OP.1 TDD     | EPA5                  | 8x8 Low                               | 70                                 | 17.6     |
| 10MHz      | R.50-4 TDD        | OP.1 TDD     | EPA5                  | 8x8 Low                               | 70                                 | 18.5     |
| 15MHz      | R.50-5 TDD        | OP.1 TDD     | EPA5                  | 8x8 Low                               | 70                                 | 18.9     |
| 20MHz      | R.50-6 TDD        | OP.1 TDD     | EPA5                  | 8x8 Low                               | 70                                 | 18.9     |

**Table 8.15.2.2.1.1-3: Minimum performance (FRC) based on single carrier performance for CA with 2 DL CCs**

| Test num.  | CA Bandwidth combination | Requirement                                 | UE category | DL UE category                         |
|--|--------------------------|---|-------------|--|
| 1  | 2x20 MHz                 | As specified in Table 8.15.2.2.1.1-2 per CC | 8           | 14, 17, 18, 19, 20, 22, 23, 24, 25, 26 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.12.3. |                          |   |             |  |

## 9 Reporting of Channel State Information

### 9.1 General

This section includes requirements for the reporting of channel state information (CSI). For all test cases in this section, the definition of SNR and SINR are in accordance with the one given in clause 8.1.1.

For the performance requirements specified in this clause, it is assumed that  $N_{RX}=2$  unless otherwise stated.

Unless otherwise stated, 4-bit CQI Table in Table 7.2.3-1 in TS 36.213 [6], and Modulation and TBS index table in Table 7.1.7.1-1 for PDSCH in TS 36.213 [6] are applied in all the CSI requirements.

#### 9.1.1 Applicability of requirements

##### 9.1.1.1 Applicability of requirements for different channel bandwidths

In Clause 9 the test cases may be defined with different channel bandwidth to verify the same CSI requirement.

Test cases defined for 5MHz channel bandwidth that reference this clause are applicable to UEs that support only Band 31, 72, 73, 87 and/or 88.

##### 9.1.1.2 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA CQI tests in Clause 9 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CCs in Table 9.1.1.2-1 and 3 or more DL CCs in Table 9.1.1.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 9.1.1.2-1: Applicability and test rules for CA UE CQI tests with 2 DL CCs**

| Tests                                | CA capability where the tests apply                                    | CA configuration from the selected CA capability where the tests apply                          | CA Bandwidth combination to be tested in priority order |
|--------------------------------------|--|---|---|
| CA tests with 2CCs in Clause 9.6.1.1 | Any of one of the supported CA capabilities                            | Any one of the supported FDD CA configurations  | 10+10 MHz, 20+20 MHz, 5+5 MHz, 10MHz+5MHz, 15MHz+5MHz   |
| CA tests with 2CCs in Clause 9.6.1.2 | Any of one of the supported CA capabilities with largest aggregated CA | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |

|         |   |  |  |
|---------|---|--|--|
|         | bandwidth combination   |  |  |
| Note 1: | The applicability and test rules are specified in this table, unless otherwise stated.                |  |  |
| Note 2: | Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |  |  |
| Note 3: | A single Uplink CC is configured for all tests  |  |  |

**Table 9.1.1.2-2: Applicability and test rules for CA UE CQI tests with 3 or more DL CCs**

| Tests   | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply                          | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 3 or more CCs in Clause 9.6.1.1 | Any of one of the supported CA capabilities with largest aggregated CA bandwidth combination          | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 3 or more CCs in Clause 9.6.1.2 | Any of one of the supported CA capabilities with largest aggregated CA bandwidth combination          | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| Note 1:                                       | The applicability and test rules are specified in this table, unless otherwise stated.                |   |   |
| Note 2:                                       | Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |   |   |
| Note 3:                                       | A single Uplink CC is configured for all tests  |   |   |

### 9.1.1.2A Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets

The performance requirement for TDD-FDD CA CQI tests in Clause 9 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL TDD-FDD CA in Table 9.1.1.2A-1 and for 3 or more DL TDD-FDD CA in Table 9.1.1.2A-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 9.1.1.2A-1: Applicability and test rules for CA UE CQI tests for TDD-FDD CA with 2 DL CCs**

| Tests                                | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|--------------------------------------|---|--|---|
| CA tests with 2CCs in Clause 9.6.1.3 | Any of one of the supported CA capabilities   | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 2CCs in Clause 9.6.1.4 | Any of one of the supported CA capabilities   | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| Note 1:                              | The applicability and test rules are specified in this table, unless otherwise stated.                |  |   |
| Note 2:                              | Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |  |   |
| Note 3:                              | A single Uplink CC is configured for all tests  |  |   |

**Table 9.1.1.2A-2: Applicability and test rules for CA UE CQI tests for TDD-FDD CA with 3 or more DL CCs**

| Tests                                | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply   | CA Bandwidth combination to be tested in priority order |
|--------------------------------------|---|--|---|
| CA tests with 3CCs in Clause 9.6.1.3 | Any of one of the supported CA capabilities   | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| CA tests with 3CCs in Clause 9.6.1.4 | Any of one of the supported CA capabilities   | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |
| Note 1:                              | The applicability and test rules are specified in this table, unless otherwise stated.                |  |   |
| Note 2:                              | Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1. |  |   |
| Note 3:                              | A single Uplink CC is configured for all tests  |  |   |

### 9.1.1.3 Test coverage for different number of component carriers

For FDD CA tests specified in 9.6.1.1, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 9.6.1.2, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 9.6.1.3 and 9.6.1.4, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

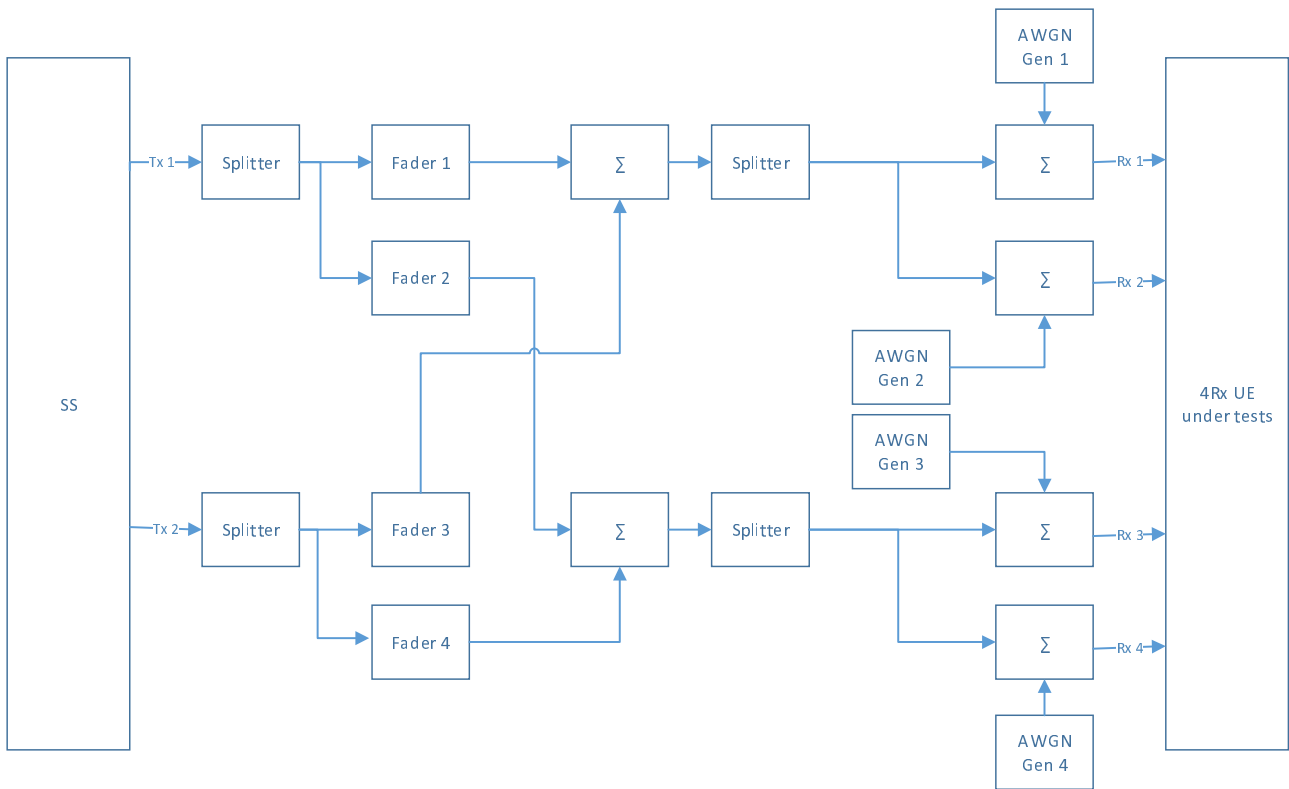
### 9.1.1.4 Applicability of performance requirements for 4Rx capable UEs

#### 9.1.1.4.1 Applicability rule and antenna connection for single carrier tests with 2Rx

For 4Rx capable UEs all single carrier tests specified in 9.2 to 9.5 with 2Rx are tested on any of the 2Rx supported RF bands by connecting 2 out of the 4Rx with data source from system simulator, and the other 2 Rx are connected with zero input, depending on UE's declaration and AP configuration. Same requirements specified with 2Rx should be applied.

For 4Rx capable UEs without any 2Rx supported RF bands, all single carrier tests specified in 9.2 to 9.5 with 2Rx are tested on any of the 4Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent noise for each Rx antenna where applicable. Figure 9.1.1.4.1-1 shows an example of antenna connection for 4Rx UE in any one 4Rx supported RF band to perform a 2Rx performance test with antenna configuration as 2x2 without interference for information. The SNR requirements should be applied with 3 dB less than the number specified with 2Rx, unless there is no SNR requirements specified.

For 4Rx capable UEs without any 2Rx supported RF bands, all single carrier tests specified in 9.3.3 with 2Rx are tested on any of the 4Rx supported RF bands by duplicating the fading channel from each Tx antenna and add independent interference for each Rx antenna.



**Figure 9.1.1.4.1-1 Antenna connection example for 2Rx tests with antenna configuration as 2x2 without interference (informative)**

For 4Rx capable UEs without any 2Rx supported RF bands, for all single carrier tests listed in Table 9.1.1.4.1-1 specified from 9.2 to 9.5 with 2Rx can be skipped.

**Table 9.1.1.4.1-1 Requirement lists for 4Rx capable UEs**

| Requirement lists  |
|--|
| Enhanced performance requirements type B   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS   |
| Requirements with demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured |

For 4Rx capable UEs, if corresponding tests listed from the 4Rx test lists from Table 9.1.1.4.1-2 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed from the 2Rx test lists from Table 9.1.1.4.1-2.

**Table 9.1.1.4.1-2: Applicability rules for single carrier tests with 2Rx**

| 4Rx test lists   | 2Rx test lists   |
|------------------|------------------|
| 9.9.1.1.1 Test 1 | 9.2.1.1 Test 1   |
| 9.9.1.1.1 Test 2 | 9.2.1.1 Test 2   |
| 9.9.1.1.2 Test 1 | 9.2.1.2 Test 1   |
| 9.9.1.1.2 Test 2 | 9.2.1.2 Test 2   |
| 9.9.1.2.1 Test 1 | 9.2.3.1 Test 1   |
| 9.9.1.2.1 Test 2 | 9.2.3.1 Test 2   |
| 9.9.1.2.2 Test 1 | 9.2.3.2 Test 1   |
| 9.9.1.2.2 Test 2 | 9.2.3.2 Test 2   |
| 9.9.2.1.1        | 9.3.5.1.1        |
| 9.9.2.1.2        | 9.3.5.1.2        |
| 9.9.2.2.1        | 9.3.5.2.1        |
| 9.9.2.2.2        | 9.3.5.2.2        |
| 9.9.3.1.1 Test 1 | 9.4.2.3.2 Test 1 |



|                  |                |
|------------------|----------------|
| 9.9.4.1.1 Test 1 | 9.5.1.1 Test 1 |
| 9.9.4.1.1 Test 2 | 9.5.1.1 Test 2 |
| 9.9.4.1.1 Test 3 | 9.5.1.1 Test 3 |
| 9.9.4.1.2 Test 1 | 9.5.1.2 Test 1 |
| 9.9.4.1.2 Test 2 | 9.5.1.2 Test 2 |
| 9.9.4.1.2 Test 3 | 9.5.1.2 Test 3 |
| 9.9.4.2.1 Test 1 | 9.5.2.1 Test 1 |
| 9.9.4.2.1 Test 2 | 9.5.2.1 Test 2 |
| 9.9.4.2.1 Test 3 | 9.5.2.1 Test 3 |
| 9.9.4.2.2 Test 1 | 9.5.2.2 Test 1 |
| 9.9.4.2.2 Test 2 | 9.5.2.2 Test 2 |
| 9.9.4.2.2 Test 3 | 9.5.2.2 Test 3 |

#### 9.1.1.4.2 Applicability rule and antenna connection for CA tests with 2Rx

All tests specified in 9.6 with 2Rx with CA and TDD-FDD CA are tested with 4 Rx capable UEs by connecting all 4Rx with data source from system simulator with the following change on the power level in the test configurations listed in Table 9.1.1.4.2-1 and by scheduling the PDSCH for user data based on the Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 for FDD cells and Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 for TDD cells.

**Table 9.1.1.4.2-1: Power level for 4Rx capable UE to verify CA tests with 2Rx**

| Number of CCs |                        | $\hat{I}_{or}^{(j)}$<br>dB[mW/15kHz] |
|---------------|------------------------|--------------------------------------|
| 2             | PCell                  | -88                                  |
|               | SCell                  | -95                                  |
| 3,4           | PCell                  | -85                                  |
|               | SCell1                 | -92                                  |
|               | SCell2, SCell3         | -99                                  |
| 5             | PCell                  | -85                                  |
|               | SCell1                 | -92                                  |
|               | SCell2, SCell3, SCell4 | -99                                  |

Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, keep the same power level listed in Table 9.1.1.4.2-1. Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, configure the power level 3 dB smaller than the number listed in Table 9.1.1.4.2-1. Same requirements specified with 2Rx should be applied.

Same applicability rules defined in 9.1.1.2, 9.1.1.2A for CA and TDD-FDD CA applied for different CA configurations and bandwidth combination sets should be applied for 4 Rx capable UEs.

#### 9.1.1.4.3 Applicability rule and antenna connection for single carrier tests with 4Rx

For 4Rx capable UEs all single carrier tests specified in 9.9 with 4Rx are tested on any of the 4 Rx supported RF bands by connecting all 4Rx with data source from system simulator.

#### 9.1.1.5 Applicability of requirements for UEs supporting coverage enhancement

For 2Rx capable UEs supporting coverage enhancement mode A (ce-ModeA in UE-EUTRA-Capability [7]), all the tests for CE Mode A specified in 9.8.1 and 9.8.2 are tested on any of the 2Rx supported RF bands by connecting all 2Rx with data source from system simulator. The SNR requirements should be applied with 3dB less than the number specified with UE DL Category M1.

For 4Rx capable UEs supporting coverage enhancement mode A (ce-ModeA in UE-EUTRA-Capability [7]), all the tests for CE Mode A specified in 9.8.1 and 9.8.2 are tested on any of the 4Rx supported RF bands by connecting all 4Rx with data source from system simulator. The SNR requirements should be applied with 6dB less than the number specified with UE DL Category M1.

## 9.2 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 36.213 [6]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

### 9.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbols)

#### 9.2.1.1 FDD

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.1.1-1 and Table 9.2.1.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1 FDD / RC.14 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

The applicability of the requirement with 5MHz bandwidth as specified in Table 9.2.1.1-2 is defined in 9.1.1.1.

**Table 9.2.1.1-1: PUCCH 1-0 static test (FDD)**

| Parameter  |          | Unit         | Test 1         |     | Test 2 |     |
|--|----------|--------------|----------------|-----|--------|-----|
| Bandwidth  |          | MHz          | 10             |     |        |     |
| PDSCH transmission mode  |          |              | 1              |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0              |     |        |     |
|  | $\rho_B$ | dB           | 0              |     |        |     |
|  | $\sigma$ | dB           | 0              |     |        |     |
| Propagation condition and antenna configuration  |          |              | AWGN (1 x 2)   |     |        |     |
| SNR (Note 2)   |          | dB           | 0              | 1   | 6      | 7   |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -98            | -97 | -92    | -91 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98            |     | -98    |     |
| Max number of HARQ transmissions   |          |              | 1              |     |        |     |
| Physical channel for CQI reporting   |          |              | PUCCH Format 2 |     |        |     |
| PUCCH Report Type  |          |              | 4              |     |        |     |
| Reporting periodicity  |          | ms           | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 6              |     |        |     |
| Note 1: Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.4 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2.<br>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |          |              |                |     |        |     |

**Table 9.2.1.1-2: PUCCH 1-0 static test (FDD 5MHz)**

| Parameter                 |          | Unit | Test 1 | Test 2 |
|---------------------------|----------|------|--------|--------|
| Bandwidth                 |          | MHz  | 5      |        |
| PDSCH transmission mode   |          |      | 1      |        |
| Downlink power allocation | $\rho_A$ | dB   | 0      |        |
|                           | $\rho_B$ | dB   | 0      |        |
|                           | $\sigma$ | dB   | 0      |        |

| Propagation condition and antenna configuration |   | AWGN (1 x 2)   |     |     |     |
|---|---|----------------|-----|-----|-----|
| SNR (Note 2)                                    | dB  | 0              | 1   | 6   | 7   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]  | -98            | -97 | -92 | -91 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]  | -98            |     | -98 |     |
| Max number of HARQ transmissions                |   | 1              |     |     |     |
| Physical channel for CQI reporting              |   | PUCCH Format 2 |     |     |     |
| PUCCH Report Type                               |   | 4              |     |     |     |
| Reporting periodicity                           | ms  | $N_{pd} = 5$   |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 6              |     |     |     |
| Note 1:   | Reference measurement channel RC.14 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.15 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2. |                |     |     |     |
| Note 2:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                |     |     |     |

### 9.2.1.2 TDD

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.1.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.2.1.2-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       |              | Unit           | Test 1       |     | Test 2 |  |
|---|--------------|----------------|--------------|-----|--------|--|
| Bandwidth                                       |              | MHz            | 10           |     |        |  |
| PDSCH transmission mode                         |              |                | 1            |     |        |  |
| Uplink downlink configuration                   |              |                | 2            |     |        |  |
| Special subframe configuration                  |              |                | 4            |     |        |  |
| Downlink power allocation                       | $\rho_A$     | dB             | 0            |     |        |  |
|   | $\rho_B$     | dB             | 0            |     |        |  |
|   | $\sigma$     | dB             | 0            |     |        |  |
| Propagation condition and antenna configuration |              |                | AWGN (1 x 2) |     |        |  |
| SNR (Note 2)                                    | dB           | 0              | 1            | 6   | 7      |  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -98            | -97          | -92 | -91    |  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98            |              | -98 |        |  |
| Max number of HARQ transmissions                |              | 1              |              |     |        |  |
| Physical channel for CQI reporting              |              | PUSCH (Note 3) |              |     |        |  |
| PUCCH Report Type                               |              | 4              |              |     |        |  |
| Reporting periodicity                           | ms           | $N_{pd} = 5$   |              |     |        |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |              | 3              |              |     |        |  |
| ACK/NACK feedback mode                          |              | Multiplexing   |              |     |        |  |

|         |  |
|---------|--|
| Note 1: | Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, except for category 1 UE use RC.4 TDD with two sided dynamic OCNG Pattern OP.2 TDD as described in Annex A.5.2.2.                |
| Note 2: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 3: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |

9.2.1.3 FDD (CSI measurements in case two CSI subframe sets are configured)

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.1.3-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C.3.3-1 for Cell 2 and C.3.2-2, the reported CQI value according to RC.2 FDD / RC.6 FDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI - 1) shall be less than or equal to 0.1. The value of the median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  minus the median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  shall be larger than or equal to 2 and less than or equal to 5 in Test 1 and shall be larger than or equal to 0 and less than or equal to 1 in Test 2.

Table 9.2.1.3-1: PUCCH 1-0 static test (FDD)

| Parameter                                       | Unit            | Test 1   |         |  | Test 2                  |  |  |     |
|---|-----------------|--|---------|--|-------------------------|--|--|-----|
|   |                 | Cell 1   | Cell 2  | Cell 1   | Cell 2                  | Cell 1   | Cell 2   |     |
| Bandwidth                                       | MHz             | 10   |         |  | 10                      |  |  |     |
| PDSCH transmission mode                         |                 | 2  | Note 10 | 2  | Note 10                 |  |  |     |
| Downlink power allocation                       | $\rho_A$        | dB   |         |  | -3                      |  |  |     |
|   | $\rho_B$        | dB   |         |  | -3                      |  |  |     |
|   | $\sigma$        | dB   |         |  | 0                       |  |  |     |
| Propagation condition and antenna configuration |                 | Clause B.1 (2x2)   |         |  | Clause B.1 (2x2)        |  |  |     |
| $\widehat{E}_s/N_{oc2}$ (Note 1)                | dB              | 4  | 5       | 6  | 4                       | 5  | -12  |     |
| $N_{oc}^{(j)}$ at antenna port                  | $N_{oc1}^{(j)}$ | dBm/15kHz  |         | -102 (Note 7)  | N/A                     |  | -98(Note 7)  | N/A |
|   | $N_{oc2}^{(j)}$ | dBm/15kHz  |         | -98 (Note 8)   | N/A                     |  | -98(Note 8)  | N/A |
|   | $N_{oc3}^{(j)}$ | dBm/15kHz  |         | -94.8 (Note 9)   | N/A                     |  | -98(Note 9)  | N/A |
| $\widehat{I}_{or}^{(j)}$                        | dB[mW/15kHz]    | -94  | -93     | -92  | -94                     | -93  | -110   |     |
| Subframe Configuration                          |                 | Non-MBSFN  |         | Non-MBSFN  | Non-MBSFN               |  | Non-MBSFN  |     |
| Cell Id   |                 | 0  |         | 1  | 0                       |  | 1  |     |
| Time Offset between Cells                       | $\mu s$         | 2.5 (synchronous cells)                                  |         |  | 2.5 (synchronous cells) |  |  |     |
| ABS pattern (Note 2)                            |                 | N/A  |         | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A                     |  | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |     |
| RLM/RRM Measurement Subframe Pattern (Note 4)   |                 | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |         | N/A  |                         | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |  | N/A |
| CSI Subframe Sets (Note 3)                      | $C_{CSI,0}$     | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |         | N/A  |                         | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |  | N/A |

|  |                    |    |  |     |  |     |
|--|--------------------|----|--|-----|--|-----|
|  | C <sub>CSI,1</sub> |    | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A |
| Number of control OFDM symbols   |                    |    | 3  |     | 3  |     |
| Max number of HARQ transmissions   |                    |    | 1  |     | 1  |     |
| Physical channel for C <sub>CSI,0</sub> CQI reporting  |                    |    | PUCCH Format 2   |     | PUCCH Format 2   |     |
| Physical channel for C <sub>CSI,1</sub> CQI reporting  |                    |    | PUSCH (Note 12)  |     | PUSCH (Note 12)  |     |
| PUCCH Report Type  |                    |    | 4  |     | 4  |     |
| Reporting periodicity  |                    | Ms | N <sub>pd</sub> = 5                                      |     | N <sub>pd</sub> = 5                                      |     |
| <i>cqi-pmi-ConfigurationIndex</i><br>C <sub>CSI,0</sub> (Note 13)  |                    |    | 6  | N/A | 6  | N/A |
| <i>cqi-pmi-ConfigurationIndex2</i><br>C <sub>CSI,1</sub> (Note 14)   |                    |    | 5  | N/A | 5  | N/A |
| <p>Note 1: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 2: ABS pattern as defined in [9].</p> <p>Note 3: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 4: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 6: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.</p> <p>Note 7: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 8: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.</p> <p>Note 9: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.</p> <p>Note 10: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5</p> <p>Note 11: Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 for UE Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, and RC.6 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP. 1/2 FDD as described in Annex A.5.1.1 and A.5.1.2.</p> <p>Note 12: To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> <p>Note 13: <i>cqi-pmi-ConfigurationIndex</i> is applied for C<sub>CSI,0</sub>.</p> <p>Note 14: <i>cqi-pmi-ConfigurationIndex2</i> is applied for C<sub>CSI,1</sub>.</p> |                    |    |  |     |  |     |

9.2.1.4 TDD (CSI measurements in case two CSI subframe sets are configured)

The following requirements apply to UE Category ≥1. For the parameters specified in Table 9.2.1.4-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C3.3-1 for Cell 2 and C.3.2-2, the reported CQI value according to RC.2 TDD / RC.6 TDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets C<sub>CSI,1</sub> is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1. The value of the median CQI obtained by reports in CSI subframe sets C<sub>CSI,0</sub> minus the median CQI obtained by reports in CSI subframe sets C<sub>CSI,1</sub> shall be larger than or equal to 2 and less than or equal to 5 in Test 1 and shall be larger than or equal to 0 and less than or equal to 1 in Test 2.

Table 9.2.1.4-1: PUCCH 1-0 static test (TDD)

| Parameter               | Unit | Test 1 |         | Test 2 |         |
|-------------------------|------|--------|---------|--------|---------|
|                         |      | Cell 1 | Cell 2  | Cell 1 | Cell 2  |
| Bandwidth               | MHz  | 10     |         | 10     |         |
| PDSCH transmission mode |      | 2      | Note 10 | 2      | Note 10 |

|   |                 |              |                          |     |                          |                          |     |                          |
|---|-----------------|--------------|--------------------------|-----|--------------------------|--------------------------|-----|--------------------------|
| Uplink downlink configuration                       |                 |              | 1                        |     |                          | 1                        |     |                          |
| Special subframe configuration                      |                 |              | 4                        |     |                          | 4                        |     |                          |
| Downlink power allocation                           | $\rho_A$        | dB           | -3                       |     |                          | -3                       |     |                          |
|   | $\rho_B$        | dB           | -3                       |     |                          | -3                       |     |                          |
|   | $\sigma$        | dB           | 0                        |     |                          | 0                        |     |                          |
| Propagation condition and antenna configuration     |                 |              | Clause B.1 (2x2)         |     |                          | Clause B.1 (2x2)         |     |                          |
| $\hat{E}_s / N_{oc2}$ (Note 1)                      |                 | dB           | 4                        | 5   | 6                        | 4                        | 5   | -12                      |
| $N_{oc}^{(j)}$ at antenna port                      | $N_{oc1}^{(j)}$ | dBm/15kHz    | -102 (Note 7)            |     | N/A                      | -98 (Note 7)             |     | N/A                      |
|   | $N_{oc2}^{(j)}$ | dBm/15kHz    | -98 (Note 8)             |     | N/A                      | -98 (Note 8)             |     | N/A                      |
|   | $N_{oc3}^{(j)}$ | dBm/15kHz    | -94.8 (Note 9)           |     | N/A                      | -98 (Note 9)             |     | N/A                      |
| $\hat{I}_{or}^{(j)}$                                |                 | dB[mW/15kHz] | -94                      | -93 | -92                      | -94                      | -93 | -110                     |
| Subframe Configuration                              |                 |              | Non-MBSFN                |     | Non-MBSFN                | Non-MBSFN                |     | Non-MBSFN                |
| Cell Id   |                 |              | 0                        |     | 1                        | 0                        |     | 1                        |
| Time Offset between Cells                           |                 | $\mu$ s      | 2.5 (synchronous cells)  |     |                          | 2.5 (synchronous cells)  |     |                          |
| ABS pattern (Note 2)                                |                 |              | N/A                      |     | 0100010001<br>0100010001 | N/A                      |     | 0100010001<br>0100010001 |
| RLM/RRM Measurement Subframe Pattern (Note 4)       |                 |              | 0000000001<br>0000000001 |     | N/A                      | 0000000001<br>0000000001 |     | N/A                      |
| CSI Subframe Sets (Note 3)                          | $C_{CSI,0}$     |              | 0100010001<br>0100010001 |     | N/A                      | 0100010001<br>0100010001 |     | N/A                      |
|   | $C_{CSI,1}$     |              | 1000101000<br>1000101000 |     | N/A                      | 1000101000<br>1000101000 |     | N/A                      |
| Number of control OFDM symbols                      |                 |              | 3                        |     |                          | 3                        |     |                          |
| Max number of HARQ transmissions                    |                 |              | 1                        |     |                          | 1                        |     |                          |
| Physical channel for $C_{CSI,0}$ CQI reporting      |                 |              | PUCCH Format 2           |     |                          | PUCCH Format 2           |     |                          |
| Physical channel for $C_{CSI,1}$ CQI reporting      |                 |              | PUSCH (Note 12)          |     |                          | PUSCH                    |     |                          |
| PUCCH Report Type                                   |                 |              | 4                        |     |                          | 4                        |     |                          |
| Reporting periodicity                               |                 | ms           | $N_{pd} = 5$             |     |                          | $N_{pd} = 5$             |     |                          |
| $cqi-pmi-ConfigurationIndex$ $C_{CSI,0}$ (Note 13)  |                 |              | 3                        | N/A |                          | 3                        | N/A |                          |
| $cqi-pmi-ConfigurationIndex2$ $C_{CSI,1}$ (Note 14) |                 |              | 4                        | N/A |                          | 4                        | N/A |                          |
| ACK/NACK feedback mode                              |                 |              | Multiplexing             |     |                          | Multiplexing             |     |                          |

|          |   |
|----------|---|
| Note 1:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |
| Note 2:  | ABS pattern as defined in [9].  |
| Note 3:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]   |
| Note 4:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].  |
| Note 5:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]   |
| Note 6:  | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.   |
| Note 7:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.  |
| Note 8:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS  |
| Note 9:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.   |
| Note 10: | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5  |
| Note 11: | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 for UE Category ≥2 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, and RC.6 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1 and Annex A.5.2.2. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.   |
| Note 13: | <i>cqi-pmi-ConfigurationIndex</i> is applied for $C_{CSI,0}$ .  |
| Note 14: | <i>cqi-pmi-ConfigurationIndex2</i> is applied for $C_{CSI,1}$ .   |

### 9.2.1.5 FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

The following requirements apply to UE Category ≥2. For the parameters specified in Table 9.2.1.5-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C.3.3-2 for Cell 2 and Cell 3, and C.3.2-2, the reported CQI value according to RC.2 FDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time.

For test 1 and test 2, if the PDSCH BLER in ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  is less than or equal to 0.1, the BLER in ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

For test 2, if the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 2) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.2.1.5-1: PUCCH 1-0 static test (FDD)**

| Parameter                                       | Unit            | Test 1           |              |                          | Test 2           |              |                          |
|---|-----------------|------------------|--------------|--------------------------|------------------|--------------|--------------------------|
|   |                 | Cell 1           | Cell 2 and 3 |                          | Cell 1           | Cell 2 and 3 |                          |
| Bandwidth                                       | MHz             | 10               |              |                          | 10               |              |                          |
| PDSCH transmission mode                         |                 | 2                | Note 10      |                          | 2                | Note 10      |                          |
| Downlink power allocation                       | $\rho_A$        | -3               |              |                          | -3               |              |                          |
|   | $\rho_B$        | -3               |              |                          | -3               |              |                          |
|   | $\sigma$        | 0                |              |                          | 0                |              |                          |
| Propagation condition and antenna configuration |                 | Clause B.1 (2x2) |              |                          | Clause B.1 (2x2) |              |                          |
| $\widehat{E}_s/N_{oc2}$ (Note 1)                | dB              | 4                | 5            | Cell 2: 12<br>Cell 3: 10 | 13               | 14           | Cell 2: 12<br>Cell 3: 10 |
| $N_{oc}^{(j)}$ at antenna port                  | $N_{oc1}^{(j)}$ | -98 (Note 7)     |              | N/A                      | -98 (Note 7)     |              | N/A                      |
|   | $N_{oc2}^{(j)}$ | -98 (Note 8)     |              | N/A                      | -98 (Note 8)     |              | N/A                      |

|   |                 |           |  |  |  |  |
|---|-----------------|-----------|--|--|--|--|
|   | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9)   | N/A  | -93 (Note 9)   | N/A  |
| Subframe Configuration                              |                 |           | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  | Non-MBSFN  |
| Cell Id   |                 |           | 0  | Cell 2: 6<br>Cell 3: 1                                   | 0  | Cell 2: 6<br>Cell 3: 1                                   |
| Time Offset between Cells                           |                 | $\mu$ s   | Cell 2: 3 usec<br>Cell 3: -1usec                         |  | Cell 2: 3 usec<br>Cell 3: -1usec                         |  |
| Frequency Shift between Cells                       |                 | Hz        | Cell 2: 300Hz<br>Cell 3: -100Hz                          |  | Cell 2: 300Hz<br>Cell 3: -100Hz                          |  |
| ABS pattern (Note 2)                                |                 |           | N/A  | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A  | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |
| RLM/RRM Measurement Subframe Pattern (Note 4)       |                 |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A  |
| CSI Subframe Sets (Note 3)                          | $C_{CSI,0}$     |           | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A  | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A  |
|   | $C_{CSI,1}$     |           | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A  | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A  |
| Number of control OFDM symbols                      |                 |           | 3  |  | 3  |  |
| Max number of HARQ transmissions                    |                 |           | 1  |  | 1  |  |
| Physical channel for $C_{CSI,0}$ CQI reporting      |                 |           | PUCCH Format 2   |  | PUCCH Format 2   |  |
| Physical channel for $C_{CSI,1}$ CQI reporting      |                 |           | PUSCH (Note 12)  |  | PUSCH (Note 12)  |  |
| PUCCH Report Type                                   |                 |           | 4  |  | 4  |  |
| Reporting periodicity                               |                 | Ms        | $N_{pd} = 5$   |  | $N_{pd} = 5$   |  |
| $cqi-pmi-ConfigurationIndex_{C_{CSI,0}}$ (Note 13)  |                 |           | 6  | N/A  | 6  | N/A  |
| $cqi-pmi-ConfigurationIndex2_{C_{CSI,1}}$ (Note 14) |                 |           | 5  | N/A  | 5  | N/A  |

- Note 1: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
- Note 2: ABS pattern as defined in [9].
- Note 3: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
- Note 4: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]
- Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
- Note 6: Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 are the same.
- Note 7: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
- Note 8: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
- Note 9: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.
- Note 10: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5
- Note 11: Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
- Note 12: To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.
- Note 13:  $cqi-pmi-ConfigurationIndex$  is applied for  $C_{CSI,0}$ .
- Note 14:  $cqi-pmi-ConfigurationIndex2$  is applied for  $C_{CSI,1}$ .



### 9.2.1.6 TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in Table 9.2.1.6-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C.3.3-2 for Cell 2 and Cell 3, and C.3.2-2, the reported CQI value according to RC.2 TDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of  $\pm 1$  of the reported median more than 90% of the time.

For test 1 and test 2, if the PDSCH BLER in ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  is less than or equal to 0.1, the BLER in ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

For test 2, if the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 2) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.2.1.6-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       | Unit            | Test 1                           |              |                          | Test 2                           |                          |                          |
|---|-----------------|----------------------------------|--------------|--------------------------|----------------------------------|--------------------------|--------------------------|
|   |                 | Cell 1                           | Cell 2 and 3 | Cell 1                   | Cell 2 and 3                     | Cell 1                   | Cell 2 and 3             |
| Bandwidth                                       | MHz             | 10                               |              |                          | 10                               |                          |                          |
| PDSCH transmission mode                         |                 | 2                                | Note 10      | 2                        | Note 10                          | 2                        | Note 10                  |
| Uplink downlink configuration                   |                 | 1                                |              |                          | 1                                |                          |                          |
| Special subframe configuration                  |                 | 4                                |              |                          | 4                                |                          |                          |
| Downlink power allocation                       | $\rho_A$        | dB                               |              |                          | -3                               |                          |                          |
|   | $\rho_B$        | dB                               |              |                          | -3                               |                          |                          |
|   | $\sigma$        | dB                               |              |                          | 0                                |                          |                          |
| Propagation condition and antenna configuration |                 | Clause B.1 (2x2)                 |              |                          | Clause B.1 (2x2)                 |                          |                          |
| $\widehat{E}_s / N_{oc2}$ (Note 1)              | dB              | 4                                | 5            | Cell 2: 12<br>Cell 3: 10 | 13                               | 14                       | Cell 2: 12<br>Cell 3: 10 |
| $N_{oc}^{(j)}$ at antenna port                  | $N_{oc1}^{(j)}$ | dBm/15kHz                        |              | -98 (Note 7)             | N/A                              |                          | -98 (Note 7)             |
|   | $N_{oc2}^{(j)}$ | dBm/15kHz                        |              | -98 (Note 8)             | N/A                              |                          | -98 (Note 8)             |
|   | $N_{oc3}^{(j)}$ | dBm/15kHz                        |              | -93 (Note 9)             | N/A                              |                          | -93 (Note 9)             |
| Subframe Configuration                          |                 | Non-MBSFN                        |              | Non-MBSFN                | Non-MBSFN                        |                          | Non-MBSFN                |
| Cell Id   |                 | 0                                |              | Cell 2: 6<br>Cell 3: 1   | 0                                |                          | Cell 2: 6<br>Cell 3: 1   |
| Time Offset between Cells                       | $\mu$ s         | Cell 2: 3 usec<br>Cell 3: -1usec |              |                          | Cell 2: 3 usec<br>Cell 3: -1usec |                          |                          |
| Frequency shift between Cells                   | Hz              | Cell 2: 300Hz<br>Cell 3: -100Hz  |              |                          | Cell 2: 300Hz<br>Cell 3: -100Hz  |                          |                          |
| ABS pattern (Note 2)                            |                 | N/A                              |              | 0100010001<br>0100010001 | N/A                              |                          | 0100010001<br>0100010001 |
| RLM/RRM Measurement Subframe Pattern (Note 4)   |                 | 0000000001<br>0000000001         |              | N/A                      |                                  | 0000000001<br>0000000001 |                          |
| CSI Subframe Sets (Note 3)                      | $C_{CSI,0}$     | 0100010001<br>0100010001         |              | N/A                      |                                  | 0100010001<br>0100010001 |                          |
|   | $C_{CSI,1}$     | 1000101000<br>1000101000         |              | N/A                      |                                  | 1000101000<br>1000101000 |                          |
| Number of control OFDM symbols                  |                 | 3                                |              |                          | 3                                |                          |                          |
| Max number of HARQ transmissions                |                 | 1                                |              |                          | 1                                |                          |                          |
| Physical channel for $C_{CSI,0}$ CQI reporting  |                 | PUCCH Format 2                   |              |                          | PUCCH Format 2                   |                          |                          |

|  |   |                     |     |                     |     |
|--|---|---------------------|-----|---------------------|-----|
| Physical channel for C <sub>CSI,1</sub> CQI reporting              |   | PUSCH (Note 12)     |     | PUSCH (Note 12)     |     |
| PUCCH Report Type  |   | 4                   |     | 4                   |     |
| Reporting periodicity  | ms  | N <sub>pd</sub> = 5 |     | N <sub>pd</sub> = 5 |     |
| <i>cqi-pmi-ConfigurationIndex</i><br>C <sub>CSI,0</sub> (Note 13)  |   | 3                   | N/A | 3                   | N/A |
| <i>cqi-pmi-ConfigurationIndex2</i><br>C <sub>CSI,1</sub> (Note 14) |   | 4                   | N/A | 4                   | N/A |
| ACK/NACK feedback mode   |   | Multiplexing        |     | Multiplexing        |     |
| Note 1:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                     |     |                     |     |
| Note 2:  | ABS pattern as defined in [9].  |                     |     |                     |     |
| Note 3:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]   |                     |     |                     |     |
| Note 4:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].  |                     |     |                     |     |
| Note 5:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]   |                     |     |                     |     |
| Note 6:  | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 is the same.  |                     |     |                     |     |
| Note 7:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.  |                     |     |                     |     |
| Note 8:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS  |                     |     |                     |     |
| Note 9:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.   |                     |     |                     |     |
| Note 10:   | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5   |                     |     |                     |     |
| Note 11:   | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |                     |     |                     |     |
| Note 12:   | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |                     |     |                     |     |
| Note 13:   | <i>cqi-pmi-ConfigurationIndex</i> is applied for C <sub>CSI,0</sub> .   |                     |     |                     |     |
| Note 14:   | <i>cqi-pmi-ConfigurationIndex2</i> is applied for C <sub>CSI,1</sub> .  |                     |     |                     |     |

9.2.1.7 FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

The following requirements apply to UE Category 11-12 and DL Category ≥11. For the parameters specified in Table 9.2.1.7-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1A FDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1, or the BLER using the transport format indicated by the (median CQI + 1) shall be less than or equal to 0.1 when the highest MCS value of the test case has reached. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

Table 9.2.1.7-1: PUCCH 1-0 static test (FDD)

| Parameter                                       | Unit         | Test 1       |     | Test 2 |     |
|---|--------------|--------------|-----|--------|-----|
| Bandwidth                                       | MHz          | 10           |     |        |     |
| PDSCH transmission mode                         |              | 1            |     |        |     |
| Downlink power allocation                       | $\rho_A$     | dB           |     | 0      |     |
|   | $\rho_B$     | dB           |     | 0      |     |
|   | $\sigma$     | dB           |     | 0      |     |
| Propagation condition and antenna configuration |              | AWGN (1 x 2) |     |        |     |
| SNR (Note 2)                                    | dB           | -1           | 0   | 20     | 21  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -99          | -98 | -78    | -77 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98          |     | -98    |     |
| Max number of HARQ transmissions                |              | 1            |     |        |     |

|                                    |  |                |
|------------------------------------|--|----------------|
| Physical channel for CQI reporting |  | PUCCH Format 2 |
| PUCCH Report Type                  |  | 4              |
| Reporting periodicity              | ms   | $N_{pd} = 5$   |
| <i>cqi-pmi-ConfigurationIndex</i>  |  | 6              |
| Note 1:                            | Reference measurement channel RC.1A FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |                |
| Note 2:                            | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                |

### 9.2.1.8 TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

The following requirements apply to UE Category 11-12 and UE DL Category  $\geq 11$ . For the parameters specified in Table 9.2.1.8-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1A TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1, or the BLER using the transport format indicated by the (median CQI + 1) shall be less than or equal to 0.1 when the highest MCS value of the test case has reached. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.2.1.8-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       |  | Unit         | Test 1         |     | Test 2 |     |
|---|--|--------------|----------------|-----|--------|-----|
| Bandwidth                                       |  | MHz          | 20             |     |        |     |
| PDSCH transmission mode                         |  |              | 1              |     |        |     |
| Uplink downlink configuration                   |  |              | 2              |     |        |     |
| Special subframe configuration                  |  |              | 4              |     |        |     |
| Downlink power allocation                       | $\rho_A$   | dB           | 0              |     |        |     |
|   | $\rho_B$   | dB           | 0              |     |        |     |
|   | $\sigma$   | dB           | 0              |     |        |     |
| Propagation condition and antenna configuration |  |              | AWGN (1 x 2)   |     |        |     |
| SNR (Note 2)                                    |  | dB           | -1             | 0   | 20     | 21  |
| $\hat{I}_{or}^{(j)}$                            |  | dB[mW/15kHz] | -99            | -98 | -78    | -77 |
| $N_{oc}^{(j)}$                                  |  | dB[mW/15kHz] | -98            |     | -98    |     |
| Max number of HARQ transmissions                |  |              | 1              |     |        |     |
| Physical channel for CQI reporting              |  |              | PUSCH (Note 3) |     |        |     |
| PUCCH Report Type                               |  |              | 4              |     |        |     |
| Reporting periodicity                           |  | ms           | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |  |              | 3              |     |        |     |
| ACK/NACK feedback mode                          |  |              | Multiplexing   |     |        |     |
| Note 1:   | Reference measurement channel RC.1A TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |              |                |     |        |     |
| Note 2:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |                |     |        |     |
| Note 3:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |              |                |     |        |     |

### 9.2.1.9 FDD (Modulation and TBS index Table 3 and 4-bit CQI Table 4 are used)

The following requirements apply to UE DL Category 20 and DL Category  $\geq 22$ . For the parameters specified in Table 9.2.1.9-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.X FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 4 in Table 7.2.3-4 in TS 36.213 [6], and Modulation and TBS index table 3 in Table 7.1.7.1-1B for PDSCH in TS 36.213 [6] are applied.

**Table 9.2.1.9-1: PUCCH 1-0 static test (FDD)**

| Parameter                                       | Unit   | Test 1         |     |
|---|--|----------------|-----|
| Bandwidth                                       | MHz  | 10             |     |
| PDSCH transmission mode                         |  | 1              |     |
| Downlink power allocation                       | $\rho_A$   | dB             | 0   |
|   | $\rho_B$   | dB             | 0   |
|   | $\sigma$   | dB             | 0   |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |     |
| SNR (Note 2)                                    | dB   | 28             | 29  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -70            | -69 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            |     |
| Max number of HARQ transmissions                |  | 1              |     |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |     |
| PUCCH Report Type                               |  | 4              |     |
| Reporting periodicity                           | ms   | $N_{pd} = 5$   |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 6              |     |
| Note 1:   | Reference measurement channel RC.30 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |                |     |
| Note 2:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                |     |

### 9.2.1.10 TDD (Modulation and TBS index Table 3 and 4-bit CQI Table 4 are used)

The following requirements apply to UE DL Category 20 and DL Category  $\geq 22$ . For the parameters specified in Table 9.2.1.10-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.X TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 3 in Table 7.2.3-4 in TS 36.213 [6], and Modulation and TBS index table 3 in Table 7.1.7.1-1B for PDSCH in TS 36.213 [6] are applied.

**Table 9.2.1.10-1: PUCCH 1-0 static test (TDD)**

| Parameter                      | Unit     | Test 1 |   |
|--------------------------------|----------|--------|---|
| Bandwidth                      | MHz      | 20     |   |
| PDSCH transmission mode        |          | 1      |   |
| Uplink downlink configuration  |          | 2      |   |
| Special subframe configuration |          | 4      |   |
|                                | $\rho_A$ | dB     | 0 |

|  |          |              |                |     |
|--|----------|--------------|----------------|-----|
| Downlink power allocation  | $\rho_B$ | dB           | 0              |     |
|  | $\sigma$ | dB           | 0              |     |
| Propagation condition and antenna configuration  |          |              | AWGN (1 x 2)   |     |
| SNR (Note 2)   |          | dB           | 28             | 29  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -70            | -69 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98            |     |
| Max number of HARQ transmissions   |          |              | 1              |     |
| Physical channel for CQI reporting   |          |              | PUSCH (Note 3) |     |
| PUCCH Report Type  |          |              | 4              |     |
| Reporting periodicity  |          | ms           | $N_{pd} = 5$   |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 3              |     |
| ACK/NACK feedback mode   |          |              | Multiplexing   |     |
| <p>Note 1: Reference measurement channel RC.30 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> |          |              |                |     |

## 9.2.2 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

### 9.2.2.1 FDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.2.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> - 1, median CQI<sub>1</sub>, median CQI<sub>1</sub> + 1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

**Table 9.2.2.1-1: PUCCH 1-1 static test (FDD)**

| Parameter                                       | Unit     | Test 1             | Test 2 |
|---|----------|--------------------|--------|
| Bandwidth                                       | MHz      | 10                 |        |
| PDSCH transmission mode                         |          | 4                  |        |
| Downlink power allocation                       | $\rho_A$ | dB                 | -3     |
|   | $\rho_B$ | dB                 | -3     |
|   | $\sigma$ | dB                 | 0      |
| Propagation condition and antenna configuration |          | Clause B.1 (2 x 2) |        |

|   |   |                |     |     |     |
|---|---|----------------|-----|-----|-----|
| CodeBookSubsetRestriction<br>bitmap       |   | 010000         |     |     |     |
| SNR (Note 2)                              | dB  | 10             | 11  | 16  | 17  |
| $\hat{I}_{or}^{(j)}$                      | dB[mW/15kHz]  | -88            | -87 | -82 | -81 |
| $N_{oc}^{(j)}$                            | dB[mW/15kHz]  | -98            |     | -98 |     |
| Max number of HARQ<br>transmissions       |   | 1              |     |     |     |
| Physical channel for CQI/PMI<br>reporting |   | PUCCH Format 2 |     |     |     |
| PUCCH Report Type for<br>CQI/PMI          |   | 2              |     |     |     |
| PUCCH Report Type for RI                  |   | 3              |     |     |     |
| Reporting periodicity                     | ms  | $N_{pd} = 5$   |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>         |   | 6              |     |     |     |
| <i>ri-ConfigIndex</i>                     |   | 1 (Note 3)     |     |     |     |
| Note 1:                                   | Reference measurement channel RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |                |     |     |     |
| Note 2:                                   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |                |     |     |     |
| Note 3:                                   | It is intended to have UL collisions between RI reports and HARQ-ACK, since the RI reports shall not be used by the eNB in this test.       |                |     |     |     |

### 9.2.2.2 TDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.2.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set  $\{\text{median CQI}_1 - 1, \text{median CQI}_1, \text{median CQI}_1 + 1\}$  for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.2.2.2-1: PUCCH 1-1 static test (TDD)**

| Parameter  | Unit         | Test 1             |     | Test 2 |     |
|--|--------------|--------------------|-----|--------|-----|
| Bandwidth  | MHz          | 10                 |     |        |     |
| PDSCH transmission mode                            |              | 4                  |     |        |     |
| Uplink downlink configuration                      |              | 2                  |     |        |     |
| Special subframe<br>configuration                  |              | 4                  |     |        |     |
| Downlink power<br>allocation                       | $\rho_A$     | dB                 | -3  |        |     |
|  | $\rho_B$     | dB                 | -3  |        |     |
|  | $\sigma$     | dB                 | 0   |        |     |
| Propagation condition and<br>antenna configuration |              | Clause B.1 (2 x 2) |     |        |     |
| CodeBookSubsetRestriction<br>bitmap                |              | 010000             |     |        |     |
| SNR (Note 2)                                       | dB           | 10                 | 11  | 16     | 17  |
| $\hat{I}_{or}^{(j)}$                               | dB[mW/15kHz] | -88                | -87 | -82    | -81 |
| $N_{oc}^{(j)}$                                     | dB[mW/15kHz] | -98                |     | -98    |     |
| Max number of HARQ<br>transmissions                |              | 1                  |     |        |     |

|  |  |                |
|--|--|----------------|
| Physical channel for CQI/PMI reporting |  | PUSCH (Note 3) |
| PUCCH Report Type                      |  | 2              |
| Reporting periodicity                  | ms   | $N_{pd} = 5$   |
| <i>cqi-pmi-ConfigurationIndex</i>      |  | 3              |
| <i>ri-ConfigIndex</i>                  |  | 805 (Note 4)   |
| ACK/NACK feedback mode                 |  | Multiplexing   |
| Note 1:                                | Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |                |
| Note 2:                                | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                |
| Note 3:                                | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.   |                |
| Note 4:                                | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |                |

### 9.2.3 Minimum requirement PUCCH 1-1 (CSI Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

#### 9.2.3.1 FDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.3.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set  $\{\text{median CQI}_1 - 1, \text{median CQI}_1, \text{median CQI}_1 + 1\}$  for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.2.3.1-1: PUCCH 1-1 static test (FDD)**

| Parameter  | Unit     | Test 1                        | Test 2 |
|--|----------|-------------------------------|--------|
| Bandwidth  | MHz      |                               | 10     |
| PDSCH transmission mode  |          |                               | 9      |
| Downlink power allocation  | $\rho_A$ | dB                            | 0      |
|  | $\rho_B$ | dB                            | 0      |
|  | $P_C$    | dB                            | -3     |
|  | $\sigma$ | dB                            | -3     |
| Cell-specific reference signals  |          | Antenna ports 0, 1            |        |
| CSI reference signals  |          | Antenna ports 15,...,18       |        |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | 5/1                           |        |
| CSI reference signal configuration   |          | 0                             |        |
| Propagation condition and antenna configuration  |          | Clause B.1 (4 x 2)            |        |
| Beamforming Model  |          | As specified in Section B.4.3 |        |

|  |              |                       |     |     |     |
|--|--------------|-----------------------|-----|-----|-----|
| CodeBookSubsetRestriction bitmap   |              | 0x0000 0000 0100 0000 |     |     |     |
| SNR (Note 2)   | dB           | 7                     | 8   | 13  | 14  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -91                   | -90 | -85 | -84 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                   |     | -98 |     |
| Max number of HARQ transmissions   |              | 1                     |     |     |     |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note3)         |     |     |     |
| PUCCH Report Type for CQI/PMI  |              | 2                     |     |     |     |
| Physical channel for RI reporting  |              | PUCCH Format 2        |     |     |     |
| PUCCH Report Type for RI   |              | 3                     |     |     |     |
| Reporting periodicity  | ms           | $N_{pd} = 5$          |     |     |     |
| CQI delay  | ms           | 8                     |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 2                     |     |     |     |
| <i>ri-ConfigIndex</i>  |              | 1                     |     |     |     |
| <p>Note 1: Reference measurement channel RC.7 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.</p> |              |                       |     |     |     |

9.2.3.1A FDD (With *channelMeasRestriction* configured)

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.3.1A-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> - 1, median CQI<sub>1</sub>, median CQI<sub>1</sub> + 1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.2.3.1A-1: PUCCH 1-1 static test (FDD)

| Parameter  | Unit     | Test 1                        | Test 2 |    |    |
|--|----------|-------------------------------|--------|----|----|
| Bandwidth  | MHz      |                               | 10     |    |    |
| PDSCH transmission mode  |          |                               | 9      |    |    |
| Downlink power allocation  | $\rho_A$ | dB                            | 0      |    |    |
|  | $\rho_B$ | dB                            | 0      |    |    |
|  | $P_C$    | dB                            | -3     |    |    |
|  | $\sigma$ | dB                            | -3     |    |    |
| Cell-specific reference signals  |          | Antenna ports 0, 1            |        |    |    |
| e-MIMO Type  |          | Class B                       |        |    |    |
| Number of CSI-RS resource (K)  |          | 1                             |        |    |    |
| <i>channelMeasRestriction</i>  |          | Enable                        |        |    |    |
| CSI reference signals  |          | Antenna ports 15,...,18       |        |    |    |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |          | 5/1                           |        |    |    |
| CSI reference signal configuration                                       |          | 0                             |        |    |    |
| Propagation condition and antenna configuration                          |          | Clause B.1 (4 x 2)            |        |    |    |
| Beamforming Model  |          | As specified in Section B.4.3 |        |    |    |
| CodeBookSubsetRestriction bitmap   |          | 0x0000 0000 0100 0000         |        |    |    |
| SNR (Note 2)   | dB       | 7                             | 8      | 13 | 14 |



|   |              |                |     |     |     |
|---|--------------|----------------|-----|-----|-----|
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -91            | -90 | -85 | -84 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98            |     | -98 |     |
| Max number of HARQ transmissions  |              | 1              |     |     |     |
| Physical channel for CQI/PMI reporting  |              | PUSCH (Note3)  |     |     |     |
| PUCCH Report Type for CQI/PMI   |              | 2              |     |     |     |
| Physical channel for RI reporting   |              | PUCCH Format 2 |     |     |     |
| PUCCH Report Type for RI  |              | 3              |     |     |     |
| Reporting periodicity   | ms           | $N_{pd} = 10$  |     |     |     |
| CQI delay   | ms           | 8              |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 12             |     |     |     |
| <i>ri-ConfigIndex</i>   |              | 1              |     |     |     |
| PDSCH scheduled sub-frames  |              | 1,2,3,4,7,8,9  |     |     |     |
| NOTE 1: Reference measurement channel RC.7 FDD according to Table A.4-1 with one sided dynamic OCNB Pattern OP.1 FDD as described in Annex A.5.1.1.   |              |                |     |     |     |
| NOTE 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |              |                |     |     |     |
| NOTE 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink #5. |              |                |     |     |     |
| NOTE 4: In sub-frame 6, transmission power of CSI-RS REs is 9dB lower than CRS REs, in sub-frame 1, there is no power offset between CSI-RS REs and CRS REs.  |              |                |     |     |     |

### 9.2.3.2 TDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.3.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set  $\{\text{median CQI}_1 - 1, \text{median CQI}_1, \text{median CQI}_1 + 1\}$  for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.2.3.2-1: PUCCH 1-1 submode 1 static test (TDD)**

| Parameter  | Unit     | Test 1                               | Test 2  |
|--|----------|--------------------------------------|---------|
| Bandwidth  | MHz      | 10                                   |         |
| PDSCH transmission mode  |          | 9                                    |         |
| Uplink downlink configuration  |          | 2                                    |         |
| Special subframe configuration   |          | 4                                    |         |
| Downlink power allocation  | $\rho_A$ | dB                                   | 0       |
|  | $\rho_B$ | dB                                   | 0       |
|  | $P_C$    | dB                                   | -6      |
|  | $\sigma$ | dB                                   | -3      |
| CRS reference signals  |          | Antenna ports 0, 1                   |         |
| CSI reference signals  |          | Antenna ports 15, ..., 22            |         |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | 5/3                                  |         |
| CSI reference signal configuration   |          | 0                                    |         |
| Propagation condition and antenna configuration  |          | Clause B.1 (8 x 2)                   |         |
| Beamforming Model  |          | As specified in Section B.4.3        |         |
| CodeBookSubsetRestriction bitmap   |          | 0x0000 0000 0020 0000 0000 0001 0000 |         |
| SNR (Note 2)   | dB       | 4                                    | 5 10 11 |

|  |              |                |     |     |     |
|--|--------------|----------------|-----|-----|-----|
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -94            | -93 | -88 | -87 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98            |     | -98 |     |
| Max number of HARQ transmissions   |              | 1              |     |     |     |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 3) |     |     |     |
| PUCCH Report Type for CQI/second PMI   |              | 2b             |     |     |     |
| Physical channel for RI reporting  |              | PUSCH          |     |     |     |
| PUCCH Report Type for RI/ first PMI  |              | 5              |     |     |     |
| Reporting periodicity  | ms           | $N_{pd} = 5$   |     |     |     |
| CQI delay  | ms           | 10 or 11       |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 3              |     |     |     |
| <i>ri-ConfigIndex</i>  |              | 805 (Note 4)   |     |     |     |
| ACK/NACK feedback mode   |              | Multiplexing   |     |     |     |
| <p>Note 1: Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.</p> <p>Note 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.</p> |              |                |     |     |     |

9.2.3.2A TDD (With *channelMeasRestriction* configured)

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.3.2A-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> -1, median CQI<sub>1</sub>, median CQI<sub>1</sub> +1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.2.3.2A-1: PUCCH 1-1 submode 1 static test (TDD)

| Parameter  | Unit     | Test 1 | Test 2                  |
|--|----------|--------|-------------------------|
| Bandwidth  | MHz      |        | 10                      |
| PDSCH transmission mode  |          |        | 9                       |
| Uplink downlink configuration  |          |        | 2                       |
| Special subframe configuration   |          |        | 4                       |
| Downlink power allocation  | $\rho_A$ | dB     | 0                       |
|  | $\rho_B$ | dB     | 0                       |
|  | $P_C$    | dB     | -6                      |
|  | $\sigma$ | dB     | -3                      |
| CRS reference signals  |          |        | Antenna ports 0, 1      |
| e-MIMO Type  |          |        | Class B                 |
| Number of CSI-RS resource (K)  |          |        | 1                       |
| <i>channelMeasRestriction</i>  |          |        | Enable                  |
| CSI reference signals  |          |        | Antenna ports 15,...,22 |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          |        | 5/ 3                    |

|  |              |                                      |     |     |     |
|--|--------------|--------------------------------------|-----|-----|-----|
| CSI reference signal configuration   |              | 0                                    |     |     |     |
| Propagation condition and antenna configuration  |              | Clause B.1 (8 x 2)                   |     |     |     |
| Beamforming Model  |              | As specified in Section B.4.3        |     |     |     |
| CodeBookSubsetRestriction bitmap   |              | 0x0000 0000 0020 0000 0000 0001 0000 |     |     |     |
| SNR (Note 2)   | dB           | 4                                    | 5   | 10  | 11  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -94                                  | -93 | -88 | -87 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                                  |     | -98 |     |
| Max number of HARQ transmissions   |              | 1                                    |     |     |     |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 3)                       |     |     |     |
| PUCCH Report Type for CQI/second PMI   |              | 2b                                   |     |     |     |
| Physical channel for RI reporting  |              | PUSCH                                |     |     |     |
| PUCCH Report Type for RI/ first PMI  |              | 5                                    |     |     |     |
| Reporting periodicity  | ms           | $N_{pd} = 10$                        |     |     |     |
| CQI delay  | ms           | 10 or 11                             |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 13                                   |     |     |     |
| <i>ri-ConfigIndex</i>  |              | 805 (Note 4)                         |     |     |     |
| ACK/NACK feedback mode   |              | Multiplexing                         |     |     |     |
| PDSCH scheduled sub-frames   |              | 3,4,9                                |     |     |     |
| NOTE 1: Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNB Pattern OP.1 TDD as described in Annex A.5.2.1.  |              |                                      |     |     |     |
| NOTE 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |                                      |     |     |     |
| NOTE 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7.  |              |                                      |     |     |     |
| NOTE 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |              |                                      |     |     |     |
| NOTE 5: In sub-frame 8, transmission power of CSI-RS REs is 9dB lower than CRS REs, in sub-frame 3, there is no power offset between CSI-RS REs and CRS REs.   |              |                                      |     |     |     |

## 9.2.4 Minimum requirement PUCCH 1-1 (With Single CSI Process)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

If UE supporting *interferenceMeasRestriction*, test cases specified in 9.2.4.1A and 9.2.4.2A are applicable for such UE otherwise test cases specified in 9.2.4.1 and 9.2.4.2 are applied.

### 9.2.4.1 FDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.4.1-1, and using the downlink physical channels specified in Tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set {median  $\text{CQI}_1 - 1$ , median  $\text{CQI}_1$ , median  $\text{CQI}_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

Table 9.2.4.1-1: PUCCH 1-1 static test (FDD)

| Parameter   | Unit         | Test 1                       |                              |     | Test 2                       |                              |     |
|---|--------------|------------------------------|------------------------------|-----|------------------------------|------------------------------|-----|
|   |              | TP1                          | TP2                          |     | TP1                          | TP2                          |     |
| Bandwidth   | MHz          | 10                           |                              |     |                              |                              |     |
| PDSCH transmission mode   |              | 10                           |                              |     |                              |                              |     |
| Downlink power allocation (Note 1)  | $\rho_A$     | dB                           | 0                            | 0   | 0                            | 0                            | 0   |
|   | $\rho_B$     | dB                           | 0                            | 0   | 0                            | 0                            | 0   |
|   | $P_c$        | dB                           | -3                           | -3  | -3                           | -3                           | -3  |
|   | $\sigma$     | dB                           | -3                           | N/A | -3                           | N/A                          | N/A |
| Cell ID   |              | 0                            |                              |     | 0                            |                              |     |
| Cell-specific reference signals   |              | Antenna ports<br>0, 1        | (Note 2)                     |     | Antenna ports<br>0, 1        | (Note 2)                     |     |
| CSI reference signals   |              | Antenna ports<br>15, ..., 18 | N/A                          |     | Antenna ports<br>15, ..., 18 | N/A                          |     |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$       |              | 5/1                          | N/A                          |     | 5/1                          | N/A                          |     |
| CSI-RS configuration  |              | 0                            | N/A                          |     | 0                            | N/A                          |     |
| Zero-Power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$<br>bitmap |              | 1 /<br>001000000000<br>0000  | 1 /<br>100000000000<br>00000 |     | 1 /<br>001000000000<br>0000  | 1 /<br>100000000000<br>00000 |     |
| CSI-IM configuration<br>$l_{CSI-IM} / ZeroPowerCSI-RS$<br>bitmap            |              | 1 /<br>001000000000<br>0000  | N/A                          |     | 1 /<br>001000000000<br>0000  | N/A                          |     |
| CSI process configuration<br>Signal/Interference/Reporting<br>mode          |              | CSI-RS/CSI-IM/PUCCH 1-1      |                              |     | CSI-RS/CSI-IM/PUCCH 1-1      |                              |     |
| Propagation condition and antenna configuration                             |              | Clause B.1<br>(4 x 2)        | Clause B.1<br>(2 x 2)        |     | Clause B.1<br>(4 x 2)        | Clause B.1<br>(2 x 2)        |     |
| CodeBookSubsetRestriction<br>bitmap   |              | 0x0000 0000<br>0100 0000     | 100000                       |     | 0x0000 0000<br>0100 0000     | 100000                       |     |
| SNR (Note 3)  | dB           | 20                           | 6                            | 7   | 20                           | 14                           | 15  |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -78                          | -92                          | -91 | -78                          | -84                          | -83 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98                          |                              |     | -98                          |                              |     |
| Modulation / Information bit<br>payload                                     |              | (Note4)                      | QPSK / 4392                  |     | (Note4)                      | QPSK / 4392                  |     |
| Max number of HARQ<br>transmissions   |              | 1                            | N/A                          |     | 1                            | N/A                          |     |
| Physical channel for CQI/PMI<br>reporting                                   |              | PUSCH<br>(Note5)             | N/A                          |     | PUSCH<br>(Note5)             | N/A                          |     |
| PUCCH Report Type for<br>CQI/PMI  |              | 2                            | N/A                          |     | 2                            | N/A                          |     |
| PUCCH Report Type for RI  |              | 3                            | N/A                          |     | 3                            | N/A                          |     |
| Reporting periodicity   | ms           | $N_{pd} = 5$                 | N/A                          |     | $N_{pd} = 5$                 | N/A                          |     |
| CQI Delay   | ms           | 8                            | N/A                          |     | 8                            | N/A                          |     |
| $cqi-pmi-ConfigurationIndex$  |              | 2                            | N/A                          |     | 2                            | N/A                          |     |
| $ri-ConfigIndex$  |              | 1                            | N/A                          |     | 1                            | N/A                          |     |
| PDSCH scheduled sub-frames  |              | 1,2,3,4,6,7,8,9              |                              |     | 1,2,3,4,6,7,8,9              |                              |     |
| Timing offset between TPs   | us           | 0                            |                              |     | 0                            |                              |     |
| Frequency offset between TPs  | Hz           | 0                            |                              |     | 0                            |                              |     |

|         |   |
|---------|---|
| Note 1: | Reference measurement channel RC.10 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |
| Note 2: | REs for antenna ports 0 and 1 CRS have zero transmission power.   |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |
| Note 4: | N/A.  |
| Note 5: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5. |

9.2.4.1A FDD (With *interferenceMeasRestriction* configured)

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.4.1A-1, and using the downlink physical channels specified in Tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> -1, median CQI<sub>1</sub>, median CQI<sub>1</sub> +1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.2.4.1A-1: PUCCH 1-1 static test (FDD)

| Parameter   | Unit     | Test 1                  |                       | Test 2                  |                       |     |
|---|----------|-------------------------|-----------------------|-------------------------|-----------------------|-----|
|   |          | TP1                     | TP2                   | TP1                     | TP2                   |     |
| Bandwidth   | MHz      | 10                      |                       |                         |                       |     |
| PDSCH transmission mode   |          | 10                      |                       |                         |                       |     |
| Downlink power allocation (Note 1)                                    | $\rho_A$ | dB                      | 0                     | 0                       | 0                     | 0   |
|   | $\rho_B$ | dB                      | 0                     | 0                       | 0                     | 0   |
|   | $P_c$    | dB                      | -3                    | -3                      | -3                    | -3  |
|   | $\sigma$ | dB                      | -3                    | N/A                     | -3                    | N/A |
| Cell ID   |          | 0                       |                       | 0                       |                       |     |
| Cell-specific reference signals                                       |          | Antenna ports 0, 1      | (Note 2)              | Antenna ports 0, 1      | (Note 2)              |     |
| e-MIMO Type   |          | Class B                 |                       |                         |                       |     |
| Number of CSI-RS resource (K)   |          | 1                       |                       |                         |                       |     |
| <i>interferenceMeasRestriction</i>                                    |          | Enable                  |                       |                         |                       |     |
| CSI reference signals   |          | Antenna ports 15,...,18 | N/A                   | Antenna ports 15,...,18 | N/A                   |     |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |          | 5/1                     | N/A                   | 5/1                     | N/A                   |     |
| CSI-RS configuration  |          | 0                       | N/A                   | 0                       | N/A                   |     |
| Zero-Power CSI-RS configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |          | 1 / 001000000000 0000   | 1 / 10000000000 00000 | 1 / 001000000000 0000   | 1 / 10000000000 00000 |     |
| CSI-IM configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap            |          | 1 / 001000000000 0000   | N/A                   | 1 / 001000000000 0000   | N/A                   |     |
| CSI process configuration Signal/Interference/Reporting mode          |          | CSI-RS/CSI-IM/PUCCH 1-1 |                       | CSI-RS/CSI-IM/PUCCH 1-1 |                       |     |
| Propagation condition and antenna configuration                       |          | Clause B.1 (4 x 2)      | Clause B.1 (2 x 2)    | Clause B.1 (4 x 2)      | Clause B.1 (2 x 2)    |     |

|   |                  |              |                          |                 |     |                          |                 |     |
|---|------------------|--------------|--------------------------|-----------------|-----|--------------------------|-----------------|-----|
| CodeBookSubsetRestriction bitmap  |                  |              | 0x0000 0000<br>0100 0000 | 100000          |     | 0x0000 0000<br>0100 0000 | 100000          |     |
| SNR (Note 3)  | Sub-frame 6      | dB           | 20                       | 15              | 16  | 20                       | [23             | 24  |
|   | Other sub-frames |              | 20                       | 6               | 7   | 20                       | 14              | 15  |
| $\hat{I}_{or}^{(j)}$  | Sub-frame 6      | dB[mW/15kHz] | -78                      | -83             | -82 | -78                      | -75             | -74 |
|   | Other sub-frames |              | -78                      | -92             | -91 | -78                      | -84             | -83 |
| $N_{oc}^{(j)}$  |                  | dB[mW/15kHz] | -98                      |                 |     | -98                      |                 |     |
| Modulation / Information bit payload  |                  |              | (Note4)                  | QPSK / 4392     |     | (Note4)                  | QPSK / 4392     |     |
| Max number of HARQ transmissions  |                  |              | 1                        | N/A             |     | 1                        | N/A             |     |
| Physical channel for CQI/PMI reporting  |                  |              | PUSCH (Note5)            | N/A             |     | PUSCH (Note5)            | N/A             |     |
| PUCCH Report Type for CQI/PMI   |                  |              | 2                        | N/A             |     | 2                        | N/A             |     |
| PUCCH Report Type for RI  |                  |              | 3                        | N/A             |     | 3                        | N/A             |     |
| Reporting periodicity   |                  | ms           | $N_{pd} = 10$            | N/A             |     | $N_{pd} = 10$            | N/A             |     |
| CQI Delay   |                  | ms           | 8                        | N/A             |     | 8                        | N/A             |     |
| cqi-pmi-ConfigurationIndex  |                  |              | 12                       | N/A             |     | 12                       | N/A             |     |
| ri-ConfigIndex  |                  |              | 1                        | N/A             |     | 1                        | N/A             |     |
| PDSCH scheduled sub-frames  |                  |              | 1,2,3,4,7,8,9            | 1,2,3,4,6,7,8,9 |     | 1,2,3,4,7,8,9            | 1,2,3,4,6,7,8,9 |     |
| Timing offset between TPs   |                  | us           | 0                        |                 |     | 0                        |                 |     |
| Frequency offset between TPs  |                  | Hz           | 0                        |                 |     | 0                        |                 |     |
| NOTE1: Reference measurement channel RC.10 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.   |                  |              |                          |                 |     |                          |                 |     |
| NOTE 2: REs for antenna ports 0 and 1 CRS have zero transmission power.   |                  |              |                          |                 |     |                          |                 |     |
| NOTE 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                  |              |                          |                 |     |                          |                 |     |
| NOTE 4: N/A.  |                  |              |                          |                 |     |                          |                 |     |
| NOTE 5: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink #5. |                  |              |                          |                 |     |                          |                 |     |

9.2.4.2 TDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.2.4.2-1, and using the downlink physical channels specified in Tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> - 1, median CQI<sub>1</sub>, median CQI<sub>1</sub> + 1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.2.4.2-1: PUCCH 1-1 static test (TDD)

| Parameter                          | Unit     | Test 1 |     | Test 2 |     |    |
|------------------------------------|----------|--------|-----|--------|-----|----|
|                                    |          | TP1    | TP2 | TP1    | TP2 |    |
| Bandwidth                          | MHz      | 10     |     |        |     |    |
| PDSCH transmission mode            |          | 10     |     |        |     |    |
| Uplink downlink configuration      |          | 2      |     |        |     |    |
| Special subframe configuration     |          | 4      |     |        |     |    |
| Downlink power allocation (Note 1) | $\rho_A$ | dB     | 0   | 0      | 0   | 0  |
|                                    | $\rho_B$ | dB     | 0   | 0      | 0   | 0  |
|                                    | $\rho_C$ | dB     | -6  | -6     | -6  | -6 |

|   |  |              |   |                             |   |                             |
|---|--|--------------|---|-----------------------------|---|-----------------------------|
|   | $\sigma$   | dB           | -3  | N/A                         | -3  | N/A                         |
| Cell ID   |  |              | 0   |                             | 0   |                             |
| Cell-specific reference signals   |  |              | Antenna ports<br>0, 1                         | (Note 2)                    | Antenna ports<br>0, 1                         | (Note 2)                    |
| CSI reference signals   |  |              | Antenna ports<br>15,...,22                    | N/A                         | Antenna ports<br>15,...,22                    | N/A                         |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$       |  |              | 5/3   | N/A                         | 5/3   | N/A                         |
| CSI-RS configuration  |  |              | 0   | N/A                         | 0   | N/A                         |
| Zero-Power CSI-RS configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$<br>bitmap |  |              | 3 /<br>001000000000<br>0000                   | 3 /<br>10000100000<br>00000 | 3 /<br>001000000000<br>0000                   | 3 /<br>10000100000<br>00000 |
| CSI-IM configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$<br>bitmap            |  |              | 3 /<br>001000000000<br>0000                   | N/A                         | 3 /<br>001000000000<br>0000                   | N/A                         |
| CSI process configuration<br>Signal/Interference/Reporting<br>mode          |  |              | CSI-RS/CSI-IM/PUCCH 1-1                       |                             | CSI-RS/CSI-IM/PUCCH 1-1                       |                             |
| Propagation condition and antenna configuration                             |  |              | Clause B.1<br>(8 x 2)                         | Clause B.1<br>(2 x 2)       | Clause B.1<br>(8 x 2)                         | Clause B.1<br>(2 x 2)       |
| CodeBookSubsetRestriction<br>bitmap   |  |              | 0x0000 0000<br>0020 0000<br>0000 0001<br>0000 | 100000                      | 0x0000 0000<br>0020 0000<br>0000 0001<br>0000 | 100000                      |
| SNR (Note 3)  |  | dB           | 17  | 6   7                       | 17  | 14   15                     |
| $\hat{I}_{or}^{(j)}$  |  | dB[mW/15kHz] | -81   | -92   -91                   | -81   | -84   -83                   |
| $N_{oc}^{(j)}$  |  | dB[mW/15kHz] | -98   |                             | -98   |                             |
| Modulation / Information bit<br>payload                                     |  |              | (Note4)                                       | QPSK / 4392                 | (Note4)                                       | QPSK / 4392                 |
| Max number of HARQ<br>transmissions   |  |              | 1   | N/A                         | 1   | N/A                         |
| Physical channel for CQI/PMI<br>reporting                                   |  |              | PUSCH<br>(Note5)                              | N/A                         | PUSCH<br>(Note5)                              | N/A                         |
| PUCCH Report Type for<br>CQI/second PMI                                     |  |              | 2b  | N/A                         | 2b  | N/A                         |
| Physical channel for RI reporting   |  |              | PUSCH   | N/A                         | PUSCH   | N/A                         |
| PUCCH Report Type for RI/ first<br>PMI                                      |  |              | 5   | N/A                         | 5   | N/A                         |
| Reporting periodicity   |  | ms           | $N_{pd} = 5$                                  | N/A                         | $N_{pd} = 5$                                  | N/A                         |
| CQI Delay   |  | ms           | 10 or 11                                      | N/A                         | 10 or 11                                      | N/A                         |
| $cqi-pmi-ConfigurationIndex$  |  |              | 3   | N/A                         | 3   | N/A                         |
| $ri-ConfigIndex$  |  |              | 805 (Note 6)                                  | N/A                         | 805 (Note 6)                                  | N/A                         |
| ACK/NACK feedback mode  |  |              | Multiplexing                                  | N/A                         | Multiplexing                                  | N/A                         |
| PDSCH scheduled sub-frames  |  |              | 3,4,8,9                                       |                             | 3,4,8,9                                       |                             |
| Timing offset between TPs   |  | us           | 0   |                             | 0   |                             |
| Frequency offset between TPs  |  | Hz           | 0   |                             | 0   |                             |
| Note 1:   | Reference measurement channel RC.10 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |              |   |                             |   |                             |
| Note 2:   | REs for antenna ports 0 and 1 CRS have zero transmission power.  |              |   |                             |   |                             |
| Note 3:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |   |                             |   |                             |
| Note 4:   | N/A.   |              |   |                             |   |                             |
| Note 5:   | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.  |              |   |                             |   |                             |
| Note 6:   | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |              |   |                             |   |                             |

9.2.4.2A TDD (With *interferenceMeasRestriction* configured)

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.4.2A-1, and using the downlink physical channels specified in Tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> -1, median CQI<sub>1</sub>, median CQI<sub>1</sub> +1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.2.4.2A-1: PUCCH 1-1 static test (TDD)

| Parameter  | Unit             | Test 1  |                             |     | Test 2  |                             |     |     |
|--|------------------|---|-----------------------------|-----|---|-----------------------------|-----|-----|
|  |                  | TP1   | TP2                         |     | TP1   | TP2                         |     |     |
| Bandwidth  | MHz              | 10  |                             |     |   |                             |     |     |
| PDSCH transmission mode  |                  | 10  |                             |     |   |                             |     |     |
| Uplink downlink configuration  |                  | 2   |                             |     |   |                             |     |     |
| Special subframe configuration   |                  | 4   |                             |     |   |                             |     |     |
| Downlink power allocation (Note 1)   | $\rho_A$         | dB  | 0                           | 0   | 0   | 0                           | 0   |     |
|  | $\rho_B$         | dB  | 0                           | 0   | 0   | 0                           | 0   |     |
|  | $P_c$            | dB  | -6                          | -6  | -6  | -6                          | -6  |     |
|  | $\sigma$         | dB  | -3                          | N/A | -3  | N/A                         | N/A |     |
| Cell ID  |                  | 0   |                             |     | 0   |                             |     |     |
| Cell-specific reference signals  |                  | Antenna ports<br>0, 1                         | (Note 2)                    |     | Antenna ports<br>0, 1                         | (Note 2)                    |     |     |
| e-MIMO Type  |                  | Class B                                       |                             |     |   |                             |     |     |
| Number of CSI-RS resource (K)  |                  | 1   |                             |     |   |                             |     |     |
| <i>interferenceMeasRestriction</i>   |                  | Enable  |                             |     |   |                             |     |     |
| CSI reference signals  |                  | Antenna ports<br>15,...,22                    | N/A                         |     | Antenna ports<br>15,...,22                    | N/A                         |     |     |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$    |                  | 5/3   | N/A                         |     | 5/3   | N/A                         |     |     |
| CSI-RS configuration   |                  | 0   | N/A                         |     | 0   | N/A                         |     |     |
| Zero-Power CSI-RS configuration<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |                  | 3 /<br>001000000000<br>0000                   | 3 /<br>10000100000<br>00000 |     | 3 /<br>001000000000<br>0000                   | 3 /<br>10000100000<br>00000 |     |     |
| CSI-IM configuration<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap            |                  | 3 /<br>001000000000<br>0000                   | N/A                         |     | 3 /<br>001000000000<br>0000                   | N/A                         |     |     |
| CSI process configuration<br>Signal/Interference/Reporting mode                        |                  | CSI-RS/CSI-IM/PUCCH 1-1                       |                             |     | CSI-RS/CSI-IM/PUCCH 1-1                       |                             |     |     |
| Propagation condition and antenna configuration  |                  | Clause B.1<br>(8 x 2)                         | Clause B.1<br>(2 x 2)       |     | Clause B.1<br>(8 x 2)                         | Clause B.1<br>(2 x 2)       |     |     |
| CodeBookSubsetRestriction<br>bitmap  |                  | 0x0000 0000<br>0020 0000<br>0000 0001<br>0000 | 100000                      |     | 0x0000 0000<br>0020 0000<br>0000 0001<br>0000 | 100000                      |     |     |
| SNR (Note 3)   | Sub-frame 8      | dB  | 17                          | 15  | 16  | 17                          | 23  | 24  |
|  | Other sub-frames |   | 17                          | 6   | 7   | 17                          | 14  | 15  |
| $\hat{I}_{or}^{(j)}$   | Sub-frame 8      | dB[mW/15kHz]                                  | -81                         | -83 | -82   | -81                         | -75 | -74 |
|  | Other sub-frames |   | -81                         | -92 | -91   | -81                         | -84 | -83 |



| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98           |             | -98           |             |
|--|--------------|---------------|-------------|---------------|-------------|
| Modulation / Information bit payload   |              | (Note4)       | QPSK / 4392 | (Note4)       | QPSK / 4392 |
| Max number of HARQ transmissions   |              | 1             | N/A         | 1             | N/A         |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note5) | N/A         | PUSCH (Note5) | N/A         |
| PUCCH Report Type for CQI/second PMI   |              | 2b            | N/A         | 2b            | N/A         |
| Physical channel for RI reporting  |              | PUSCH         | N/A         | PUSCH         | N/A         |
| PUCCH Report Type for RI/ first PMI  |              | 5             | N/A         | 5             | N/A         |
| Reporting periodicity  | ms           | $N_{pd} = 10$ | N/A         | $N_{pd} = 10$ | N/A         |
| CQI Delay  | ms           | 10 or 11      | N/A         | 10 or 11      | N/A         |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 13            | N/A         | 13            | N/A         |
| <i>ri-ConfigIndex</i>  |              | 805 (Note 6)  | N/A         | 805 (Note 6)  | N/A         |
| <i>ACK/NACK feedback mode</i>  |              | Multiplexing  | N/A         | Multiplexing  | N/A         |
| PDSCH scheduled sub-frames   |              | 3,4,9         | 3,4,8,9     | 3,4,9         | 3,4,8,9     |
| Timing offset between TPs  | us           | 0             |             | 0             |             |
| Frequency offset between TPs   | Hz           | 0             |             | 0             |             |
| NOTE 1: Reference measurement channel RC.10 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |              |               |             |               |             |
| NOTE 2: REs for antenna ports 0 and 1 CRS have zero transmission power.  |              |               |             |               |             |
| NOTE 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |               |             |               |             |
| NOTE 4: N/A.   |              |               |             |               |             |
| NOTE 5: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7.  |              |               |             |               |             |
| NOTE 6: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |              |               |             |               |             |

## 9.2.5 Minimum requirement PUCCH 1-1 (when *csi-SubframeSet –r12* and *EIMTA-MainConfigServCell-r12* are configured)

The following requirements apply to UE Category  $\geq 2$  which supports eIMTA TDD UL-DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI and Rel-12 CSI subframe sets. For the parameters specified in table 9.2.5-1, and using the downlink physical channels specified in Tables C.3.2-1 and C.3.2-2, for each CSI subframe set, the reported CQI value shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. For each CSI subframe set, if the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1. The difference of the median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  and the median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  shall be larger than or equal to 3.

**Table 9.2.5-1: PUCCH 1-1 static test (TDD)**

| Parameter   | Unit | Test   |
|---|------|--------|
| Bandwidth   | MHz  | 10     |
| PDSCH transmission mode   |      | 9      |
| Uplink downlink configuration in SIB1   |      | 0      |
| Downlink HARQ reference configuration (eimta-HarqReferenceConfig-r12) (Note 4)      |      | 2      |
| Set of dynamic TDD UL-DL configurations (Notes 4,5)                                 |      | {0, 2} |
| Periodicity of monitoring the L1 reconfiguration DCI (eimta-CommandPeriodicity-r12) | ms   | 10     |

|  |              |  |      |
|--|--------------|--|------|
| Set of subframes to monitor the L1 reconfiguration DCI (eimta-CommandSubframeSet-r12)    |              | SF#5   |      |
| CSI-MeasSubframeSet-r12  |              | 0001100011   |      |
| Special subframe configuration   |              | 4  |      |
| Downlink power allocation  | $\rho_A$     | dB   | 0    |
|  | $\rho_B$     | dB   | 0    |
|  | $P_C$        | dB   | 0    |
|  | $\sigma$     | dB   | -3   |
| CRS reference signals  |              | Antenna ports 0, 1                                     |      |
| CSI reference signals  |              | Antenna ports 15,16                                    |      |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$   |              | 5/4  |      |
| CSI reference signal configuration   |              | 4  |      |
| Zero-Power CSI-RS configuration 0<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |              | 0 /<br>0000010000000000                                |      |
| Zero-Power CSI-RS configuration 1<br>$I_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |              | 4 /<br>0100000000000000                                |      |
| Propagation condition and antenna configuration  |              | Clause B.1 (2 x 2)                                     |      |
| Beamforming Model  |              | As specified in Section B.4.3                          |      |
| CodeBookSubsetRestriction bitmap   |              | '000001'   |      |
| SNR in CSI subframe set 0  | dB           | 0  | 1    |
| SNR in CSI subframe set 1  | dB           | 10   | 11   |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -98  | -97  |
| $N_{oc1}^{(j)}$ for CSI subframe set 0   | dB[mW/15kHz] | -98  | -98  |
| $N_{oc2}^{(j)}$ for CSI subframe set 1   | dB[mW/15kHz] | -108   | -108 |
| PDSCH scheduled subframes for CSI subframe set 0   |              | 0,5  |      |
| PDSCH scheduled subframes for CSI subframe set 1   |              | 3,4,8,9  |      |
| Max number of HARQ transmissions   |              | 1  |      |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 6)   |      |
| PUCCH Report Type for CQI/second PMI   |              | 2b   |      |
| Physical channel for RI reporting  |              | PUSCH  |      |
| PUCCH Report Type for RI/ first PMI  |              | 5  |      |
| Reporting periodicity  | ms           | $N_{pd} = 10$ for each Rel-12 CSI subframe set         |      |
| CQI delay  | ms           | 14 for CSI subframe set 0<br>12 for CSI subframe set 1 |      |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 8 for set 0<br>13 for set 1                            |      |
| <i>ri-ConfigIndex</i>  |              | 805 for both set 0 and set 1 (Note 7)                  |      |
| ACK/NACK feedback mode   |              | Multiplexing   |      |

|         |  |
|---------|--|
| Note 1: | Reference measurement channel RC.19 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD and dynamic OCNG Pattern with multiple non-contiguous blocks OP.7 TDD as described in Annex A.5.2.1/7 for CSI subframe set 0.  |
| Note 2: | Reference measurement channel RC.20 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 for CSI subframe set 1.  |
| Note 3: | In the test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level for each CSI subframe set separately.   |
| Note 4: | As specified in Table 4.2-2 in TS 36.211.  |
| Note 5: | UL/DL configuration in PDCCH with eIMTA-RNTI is cyclically selected from the given set on a per-DCI basis.   |
| Note 6: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2. CQI/PMI reports for CSI subframe set 0 is transmitted in SF#2 and CQI/PMI reports for CSI subframe set 1 is transmitted in SF#7. |
| Note 7: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.                               |

## 9.2.6 Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbols)

### 9.2.6.1 Frame structure type 3 with FDD Pcell

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.6.1-1, Table 9.2.6.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, two sets of CQI reports are obtained for LAA Scell. The first one is obtained by reports whose reference resource is in the downlink subframes with 6 dB transmission power boost, i.e., high power subframes. The second one is obtained by reports whose reference resource is in the downlink subframe with 0 dB transmission power boost, i.e., low power subframe. In the test, PDSCH transport format in high power subframe is determined by first set of CQI reports and PDSCH transport format in low power subframe is determined by second set of CQI reports.

The reported CQI value in the first set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the first set of reports. The reported CQI value in the second set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the second set of reports.

If the PDSCH BLER in the high power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in high power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the high power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in high power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

If the PDSCH BLER in the low power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in low power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the low power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in low power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

The value of the wideband CQI median for first set of CQI reports minus the wideband CQI median for second set of CQI reports shall be larger than or equal to 2 in Test 1 and Test 2.

**Table 9.2.6.1-1: Parameters for PUSCH 3-0 static test on FDD Pcell**

| Parameter                                       | Unit     | Value              |    |
|---|----------|--------------------|----|
| Bandwidth                                       | MHz      | 20                 |    |
| PDSCH transmission mode                         |          | 3                  |    |
| Downlink power allocation                       | $\rho_A$ | dB                 | -3 |
|   | $\rho_B$ | dB                 | -3 |
|   | $\sigma$ | dB                 | 0  |
| Propagation condition and antenna configuration |          | Clause B.1 (2 x 2) |    |

|                                  |   |           |
|----------------------------------|---|-----------|
| SNR                              | dB  | 20        |
| $\hat{I}_{or}^{(j)}$             | dB[mW/15kHz]  | -78       |
| $N_{oc}^{(j)}$                   | dB[mW/15kHz]  | -98       |
| Max number of HARQ transmissions |   | 1         |
| Reporting mode                   |   | PUSCH 3-0 |
| CSI request field                |   | '10'      |
| trigger1 (Note 2)                |   | 01000000  |
| trigger2 (Note 2)                |   | 00000000  |
| Note 1:                          | PCell is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting. One sided dynamic OCN Pattern OP.1 FDD as described in A.5.1.1 is transmitted on PCell on all RBs, but PDSCH for user data is not transmitted on PCell.  |           |
| Note 2:                          | trigger1 and trigger2 are defined as TS 36.331 for aperiodicCSI-Trigger. They Indicate for which serving cell(s) the aperiodic CSI report is triggered when one or more SCells are configured. PDCCH DCI format 0 with a trigger for aperiodic CQI is transmitted periodically in subframe 1 and subframe 6 with 5ms periodicity. |           |

**Table 9.2.6.1-2: PUSCH 3-0 static test on LAA Scell**

| Parameter   |   | Unit         | Test 1   | Test 2 |
|---|---|--------------|--|--------|
| Bandwidth   |   | MHz          | 20   |        |
| PDSCH transmission mode                           |   |              | 3  |        |
| Downlink power allocation                         | $\rho_A$  | dB           | -3   |        |
|   | $\rho_B$  | dB           | -3   |        |
|   | $\sigma$  | dB           | 0  |        |
| Propagation condition and antenna configuration   |   |              | Clause B.1 (2x2)   |        |
| SNR in subframes with 6 dB power boost (Note 2)   |   | dB           | 9  | 10     |
| SNR in subframes with 0 dB power boost (Note 2)   |   | dB           | 3  | 4      |
| $\hat{I}_{or}^{(j)}$ in subframes with 6 dB power |   | dB[mW/15kHz] | -89  | -88    |
| $\hat{I}_{or}^{(j)}$ in subframes with 0 dB power |   | dB[mW/15kHz] | -95  | -94    |
| $N_{oc}^{(j)}$                                    |   | dB[mW/15kHz] | -98  |        |
| MBSFN subframe Configuration                      |   |              | Non-MBSFN  |        |
| Cell Id   |   |              | 0  |        |
| dmtc-Periodicity                                  |   | ms           | 80   |        |
| dmtc-Offset                                       |   |              | 0  |        |
| Number of control OFDM symbols                    |   |              | 3  |        |
| Max number of HARQ transmissions                  |   |              | 1  |        |
| Reporting mode                                    |   |              | PUSCH 3-0  |        |
| PDSCH transmission model                          | Basic model                                     |              | As specified in Section B.8  |        |
|   | subframeStartPosition                           |              | s0   |        |
|   | Number of occupied symbols per subframe         |              | 14   |        |
|   | The number of subframes set ( $S_1$ ) per burst |              | {3,8}  |        |
|   | Random variable $p$ defined in B.8              |              | 0.5  |        |
|   | Power configuration for each burst              |              | $\hat{I}_{or}^{(j)}$ is randomly selected from 6 dB power boosting or 0 dB power boosting with equal probability |        |

|         |   |
|---------|---|
| Note 1: | Reference measurement channel RC.2A FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FS3 as described in Annex A.5.4.1, except for category 1 UE use RC.4A FDD with two sided dynamic OCNG Pattern OP.2 FS3 as described in Annex A.5.4.2. |
| Note 2: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |

### 9.2.6.2 Frame structure type 3 with TDD Pcell

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.6.2-1, Table 9.2.6.2-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, two sets of CQI reports are obtained for LAA Scell. The first one is obtained by reports whose reference resource is in the downlink subframes with 6 dB transmission power boost, i.e., high power subframes. The second one is obtained by reports whose reference resource is in the downlink subframe with 0 dB transmission power boost, i.e., low power subframe. In the test, PDSCH transport format in high power subframe is determined by first set of CQI reports and PDSCH transport format in low power subframe is determined by second set of CQI reports.

The reported CQI value in the first set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the first set of reports. The reported CQI value in the second set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the second set of reports.

If the PDSCH BLER in the high power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in high power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the high power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in high power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

If the PDSCH BLER in the low power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in low power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the low power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in low power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

The value of the wideband CQI median for first set of CQI reports minus the wideband CQI median for second set of CQI reports shall be larger than or equal to 2 in Test 1 and Test 2.

**Table 9.2.6.2-1: Parameters for PUSCH 3-0 static test on TDD Pcell**

| Parameter                                       | Unit         | Value              |    |
|---|--------------|--------------------|----|
| Bandwidth                                       | MHz          | 20                 |    |
| Uplink downlink configuration                   |              | 2                  |    |
| Special subframe configuration                  |              | 4                  |    |
| PDSCH transmission mode                         |              | 3                  |    |
| Downlink power allocation                       | $\rho_A$     | dB                 | -3 |
|   | $\rho_B$     | dB                 | -3 |
|   | $\sigma$     | dB                 | 0  |
| Propagation condition and antenna configuration |              | Clause B.1 (2 x 2) |    |
| SNR   | dB           | 20                 |    |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -78                |    |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98                |    |
| Max number of HARQ transmissions                |              | 1                  |    |
| Reporting mode                                  |              | PUSCH 3-0          |    |
| CSI request field                               |              | '10'               |    |
| trigger1 (Note 2)                               |              | 01000000           |    |
| trigger2 (Note 2)                               |              | 00000000           |    |

Note 1: PCell is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting. One sided dynamic OCNG Pattern OP.1 TDD as described in A.5.2.1 is transmitted on PCell on all RBs, but PDSCH for user data is not transmitted on PCell.

Note 2: trigger1 and trigger2 are defined as TS 36.331 for aperiodicCSI-Trigger. They Indicate for which serving cell(s) the aperiodic CSI report is triggered when one or more SCells are configured. PDCCH DCI format 0 with a trigger for aperiodic CQI is transmitted periodically in subframe 3 and subframe 8 with 5ms periodicity.

**Table 9.2.6.2-2: PUSCH 3-0 static test on LAA Scell**

| Parameter   |   | Unit         | Test 1   | Test 2 |
|---|---|--------------|--|--------|
| Bandwidth   |   | MHz          | 20   |        |
| PDSCH transmission mode   |   |              | 3  |        |
| Downlink power allocation   | $\rho_A$  | dB           | -3   |        |
|   | $\rho_B$  | dB           | -3   |        |
|   | $\sigma$  | dB           | 0  |        |
| Propagation condition and antenna configuration   |   |              | Clause B.1 (2x2)   |        |
| SNR in subframes with 6 dB power boost (Note 2)   |   | dB           | 9  | 10     |
| SNR in subframes with 0 dB power boost (Note 2)   |   | dB           | 3  | 4      |
| $\hat{I}_{or}^{(j)}$ in subframes with 6 dB power   |   | dB[mW/15kHz] | -89  | -88    |
| $\hat{I}_{or}^{(j)}$ in subframes with 0 dB power   |   | dB[mW/15kHz] | -95  | -94    |
| $N_{oc}^{(j)}$  |   | dB[mW/15kHz] | -98  |        |
| MBSFN subframe Configuration  |   |              | Non-MBSFN  |        |
| Cell Id   |   |              | 0  |        |
| dmtc-Periodicity  |   | ms           | 80   |        |
| dmtc-Offset   |   |              | 0  |        |
| Number of control OFDM symbols  |   |              | 3  |        |
| Max number of HARQ transmissions  |   |              | 1  |        |
| Reporting mode  |   |              | PUSCH 3-0  |        |
| PDSCH transmission model  | Basic model                                     |              | As specified in Section B.7  |        |
|   | subframeStartPosition                           |              | s0   |        |
|   | Number of occupied symbols per subframe         |              | 14   |        |
|   | The number of subframes set ( $S_1$ ) per burst |              | {3,8}  |        |
|   | Random variable $p$ defined in B.8              |              | 0.5  |        |
|   | Power configuration for each burst              |              | $\hat{I}_{or}^{(j)}$ is randomly selected from 6 dB power boosting or 0 dB power boosting with equal probability |        |
| Note 1: Reference measurement channel RC.2A FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FS3 as described in Annex A.5.4.1, except for category 1 UE use RC.4A FDD with two sided dynamic OCNG Pattern OP.2 FS3 as described in Annex A.5.4.2. |   |              |  |        |
| Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |   |              |  |        |

## 9.2.7 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

### 9.2.7.1 Frame structure type 3 with FDD Pcell

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.7.1-1, Table 9.2.7.1-2 and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, two sets of CQI reports are obtained for LAA S-cell. The first one is obtained by reports whose reference resource is in the downlink subframes with 6 dB transmission power boost, i.e., high power subframes. The second one is obtained by reports whose reference resource is in the downlink subframe with 0 dB transmission power boost, i.e., low power subframe. In the test, PDSCH transport format in high power subframe is determined by first set of CQI reports and PDSCH transport format in low power subframe is determined by second set of CQI reports.

The reported CQI value in the first set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the first set of reports. The reported CQI value in the second set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the second set of reports.

If the PDSCH BLER in the high power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in high power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in high power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in high power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

If the PDSCH BLER in the low power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in low power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the low power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in low power subframes using transport format indicated by (wideband CQI median – 1) shall be less than or equal to 0.1.

The value of the wideband CQI for the first set of CQI report minus the wideband CQI median for second set of CQI shall be larger than or equal to 2 in Test 1 and Test 2.

**Table 9.2.7.1-1: Parameters for PUSCH 3-1 static test on FDD Pcell**

| Parameter  | Unit         | Value                |   |
|--|--------------|----------------------|---|
| Bandwidth  | MHz          | 20                   |   |
| PDSCH transmission mode  |              | 9                    |   |
| Downlink power allocation  | $\rho_A$     | dB                   | 0 |
|  | $\rho_B$     | dB                   | 0 |
|  | $P_c$        | dB                   | 0 |
|  | $\sigma$     | dB                   | 0 |
| Propagation condition and antenna configuration                          |              | Clause B.1 (2 x 2)   |   |
| SNR  | dB           | 20                   |   |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -78                  |   |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                  |   |
| CRS reference signals  |              | Antenna ports 0      |   |
| CSI reference signals  |              | Antenna ports 15, 16 |   |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              | 5/ 1                 |   |
| CSI-RS reference signal configuration                                    |              | 4                    |   |
| CodeBookSubsetRestriction bitmap   |              | 000001               |   |
| Number of control OFDM symbols   |              | 3                    |   |
| Max number of HARQ transmissions   |              | 1                    |   |
| Reporting mode   |              | PUSCH 3-1            |   |

|                   |   |          |
|-------------------|---|----------|
| CSI request field |   | '10'     |
| trigger1 (Note 2) |   | 01000000 |
| trigger2 (Note 2) |   | 00000000 |
| Note 1:           | PCell is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting. One sided dynamic OCNG Pattern OP.1 FDD as described in A.5.1.1 is transmitted on PCell on all RBs, but PDSCH for user data is not transmitted on PCell.   |          |
| Note 2:           | trigger1 and trigger2 are defined as TS 36.331 for aperiodicCSI-Trigger. They Indicate for which serving cell(s) the aperiodic CSI report is triggered when one or more SCells are configured. PDCCH DCI format 0 with a trigger for aperiodic CQI is transmitted periodically in subframe 1 and subframe 6 with 5ms periodicity. |          |

**Table 9.2.7.1-2: PUSCH 3-1 static test on LAA Scell**

| Parameter  |   | Unit         | Test 1   | Test 2 |
|--|---|--------------|--|--------|
| Bandwidth  |   | MHz          | 20 MHz   |        |
| Transmission mode  |   |              | 9  |        |
| Downlink power allocation  | $\rho_A$  | dB           | 0  |        |
|  | $\rho_B$  | dB           | 0  |        |
|  | $P_c$   | dB           | 0  |        |
|  | $\sigma$  | dB           | 0  |        |
| SNR in subframes with 6 dB power boost (Note 3)                          |   | dB           | 9  | 10     |
| SNR in subframes with 0 dB power boost (Note 3)                          |   |              | 3  | 4      |
| $\hat{I}_{or}^{(j)}$ in subframes with 6 dB power                        |   |              | -89  | -88    |
| $\hat{I}_{or}^{(j)}$ in subframes with 0 dB power                        |   | dB[mW/15kHz] | -95  | -94    |
| $N_{oc}^{(j)}$   |   | dB[mW/15kHz] | -98  | -98    |
| MBSFN subframe Configuration   |   |              | Non-MBSFN  |        |
| Cell Id  |   |              | 0  |        |
| dmtd-Periodicity   |   | ms           | 80   |        |
| dmtd-Offset  |   |              | 0  |        |
| Propagation condition and antenna configuration                          |   |              | Clause B.1 (2x2)   |        |
| Beamforming Model  |   |              | As specified in Section B.4.3  |        |
| CRS reference signals  |   |              | Antenna ports 0  |        |
| CSI reference signals  |   |              | Antenna ports 15, 16   |        |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |   |              | 5/ 1   |        |
| CSI-RS reference signal configuration                                    |   |              | 4  |        |
| CodeBookSubsetRestriction bitmap   |   |              | 000001   |        |
| Number of control OFDM symbols   |   |              | 3  |        |
| Max number of HARQ transmissions   |   |              | 1  |        |
| Reporting mode   |   |              | PUSCH 3-1  |        |
| PDSCH transmission model   | Basic model                                     |              | As specified in Section B.8  |        |
|  | subframeStartPosition                           |              | s0   |        |
|  | Number of occupied symbols per subframe         |              | 14   |        |
|  | The number of subframes set ( $S_1$ ) per burst |              | {3, 8}   |        |
|  | Random variable $p$ defined in B.8              |              | 0.5  |        |
|  | Power configuration for each burst              |              | $\hat{I}_{or}^{(j)}$ is randomly selected from 6 dB power boosting or 0 dB power boosting with equal probability |        |



|         |  |
|---------|--|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |
| Note 2: | Reference measurement channel RC.9A FDD according to Table A.4-1 with one/two sided dynamic OCNB Pattern OP.1/2 FS3 as described in Annex A.5.4.1/2.   |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |

### 9.2.7.2 Frame structure type 3 with TDD Pcell

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.2.7.2-1, Table 9.2.7.2-2 and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, two sets of CQI reports are obtained for LAA Scell. The first one is obtained by reports whose reference resource is in the downlink subframes with 6 dB transmission power boost, i.e., high power subframes. The second one is obtained by reports whose reference resource is in the downlink subframe with 0 dB transmission power boost, i.e., low power subframe. In the test, PDSCH transport format in high power subframe is determined by first set of CQI reports and PDSCH transport format in low power subframe is determined by second set of CQI reports.

The reported CQI value in the first set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the first set of reports. The reported CQI value in the second set of reports shall be in the range of  $\pm 1$  of the reported median more than 90% of the second set of reports.

If the PDSCH BLER in the high power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in high power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in high power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in high power subframes using transport format indicated by (wideband CQI median - 1) shall be less than or equal to 0.1.

If the PDSCH BLER in the low power subframes using the transport format indicated by wideband CQI median is less than or equal to 0.1, the BLER in low power subframes using the transport format indicated by the (wideband CQI median + 1) shall be greater than 0.1. If the PDSCH BLER in the low power subframes using the transport format indicated by the wideband CQI median is greater than 0.1, the BLER in low power subframes using transport format indicated by (wideband CQI median - 1) shall be less than or equal to 0.1.

The value of the wideband CQI for the first set of CQI report minus the wideband CQI median for second set of CQI shall be larger than or equal to 2 in Test 1 and Test 2.

**Table 9.2.7.2-1: Parameters for PUSCH 3-1 static test on TDD Pcell**

| Parameter                                       | Unit         | Value                |   |
|---|--------------|----------------------|---|
| Bandwidth                                       | MHz          | 20                   |   |
| PDSCH transmission mode                         |              | 9                    |   |
| Uplink downlink configuration                   |              | 2                    |   |
| Special subframe configuration                  |              | 4                    |   |
| Downlink power allocation                       | $\rho_A$     | dB                   | 0 |
|   | $\rho_B$     | dB                   | 0 |
|   | $P_C$        | dB                   | 0 |
|   | $\sigma$     | dB                   | 0 |
| Propagation condition and antenna configuration |              | Clause B.1 (2 x 2)   |   |
| SNR   | dB           | 20                   |   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -78                  |   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98                  |   |
| CRS reference signals                           |              | Antenna ports 0      |   |
| CSI reference signals                           |              | Antenna ports 15, 16 |   |

|   |  |           |
|---|--|-----------|
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |  | 5/ 1      |
| CSI-RS reference signal configuration   |  | 4         |
| CodeBookSubsetRestriction bitmap  |  | 000001    |
| Number of control OFDM symbols  |  | 3         |
| Max number of HARQ transmissions  |  | 1         |
| Reporting mode  |  | PUSCH 3-1 |
| CSI request field   |  | '10'      |
| trigger1 (Note 2)   |  | 01000000  |
| trigger2 (Note 2)   |  | 00000000  |
| <p>Note 1: PCell is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting. One sided dynamic OCNG Pattern OP.1 TDD as described in A.5.2.1 is transmitted on PCell on all RBs, but PDSCH for user data is not transmitted on PCell.</p> <p>Note 2: trigger1 and trigger2 are defined as TS 36.331 for aperiodicCSI-Trigger. They Indicate for which serving cell(s) the aperiodic CSI report is triggered when one or more SCells are configured. PDCCH DCI format 0 with a trigger for aperiodic CQI is transmitted periodically in subframe 3 and subframe 8 with 5ms periodicity.</p> |  |           |

**Table 9.2.7.2-2: PUSCH 3-1 static test on LAA Scell**

| Parameter  |   | Unit         | Test 1                        | Test 2 |
|--|---|--------------|-------------------------------|--------|
| Bandwidth  |   | MHz          | 20 MHz                        |        |
| Transmission mode  |   |              | 9                             |        |
| Downlink power allocation  | $\rho_A$                                | dB           | 0                             |        |
|  | $\rho_B$                                | dB           | 0                             |        |
|  | $P_c$                                   | dB           | 0                             |        |
|  | $\sigma$                                | dB           | 0                             |        |
| SNR in subframes with 6 dB power boost (Note 3)  |   | dB           | 9                             | 10     |
| SNR in subframes with 0 dB power boost (Note 3)  |   |              | 3                             | 4      |
| $\hat{I}_{or}^{(j)}$ in subframes with 6 dB power                                      |   |              | -89                           | -88    |
| $\hat{I}_{or}^{(j)}$ in subframes with 0 dB power                                      |   | dB[mW/15kHz] | -95                           | -94    |
| $N_{oc}^{(j)}$   |   | dB[mW/15kHz] | -98                           | -98    |
| MBSFN subframe Configuration   |   |              | Non-MBSFN                     |        |
| Cell Id  |   |              | 0                             |        |
| dmtd-Periodicity   |   | ms           | 80                            |        |
| dmtd-Offset  |   |              | 0                             |        |
| Propagation condition and antenna configuration  |   |              | Clause B.1 (2x2)              |        |
| Beamforming Model  |   |              | As specified in Section B.4.3 |        |
| CRS reference signals  |   |              | Antenna ports 0               |        |
| CSI reference signals  |   |              | Antenna ports 15, 16          |        |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   |              | 5/ 3                          |        |
| CSI-RS reference signal configuration  |   |              | 4                             |        |
| CodeBookSubsetRestriction bitmap   |   |              | 000001                        |        |
| Number of control OFDM symbols   |   |              | 3                             |        |
| Max number of HARQ transmissions   |   |              | 1                             |        |
| Reporting mode   |   |              | PUSCH 3-1                     |        |
| PDSCH transmission model   | Basic model                             |              | As specified in Section B.8   |        |
|  | subframeStartPosition                   |              | s0                            |        |
|  | Number of occupied symbols per subframe |              | 14                            |        |

|         |  |  |  |
|---------|--|--|--|
|         | The number of subframes set ( $S_1$ ) per burst  |  | {3, 8}   |
|         | Random variable $p$ defined in B.8   |  | 0.5  |
|         | Power configuration for each burst   |  | $\hat{I}_{or}^{(j)}$ is randomly selected from 6 dB power boosting or 0 dB power boosting with equal probability |
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |  |  |
| Note 2: | Reference measurement channel RC.9A FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FS3 as described in Annex A.5.4.1/2.   |  |  |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |  |  |

## 9.3 CQI reporting under fading conditions

### 9.3.1 Frequency-selective scheduling mode

The accuracy of sub-band channel quality indicator (CQI) reporting under frequency selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level the corresponding transport format compared to the case for which a fixed format is transmitted on any sub-band in set  $S$  of TS 36.213 [6]. The purpose is to verify that preferred sub-bands can be used for frequently-selective scheduling. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

#### 9.3.1.1 Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbols)

##### 9.3.1.1.1 FDD

For the parameters specified in Table 9.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.1-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

**Table 9.3.1.1.1-1 Sub-band test for single antenna transmission (FDD)**

| Parameter                 |          | Unit | Test 1     |    | Test 2 |    |
|---------------------------|----------|------|------------|----|--------|----|
| Bandwidth                 |          | MHz  | 10 MHz     |    |        |    |
| Transmission mode         |          |      | 1 (port 0) |    |        |    |
| Downlink power allocation | $\rho_A$ | dB   | 0          |    |        |    |
|                           | $\rho_B$ | dB   | 0          |    |        |    |
|                           | $\sigma$ | dB   | 0          |    |        |    |
| SNR (Note 3)              |          | dB   | 9          | 10 | 14     | 15 |

|                                  |  |  |     |     |     |
|----------------------------------|--|--|-----|-----|-----|
| $\hat{I}_{or}^{(j)}$             | dB[mW/15kHz]   | -89  | -88 | -84 | -83 |
| $N_{oc}^{(j)}$                   | dB[mW/15kHz]   | -98  |     | -98 |     |
| Propagation channel              |  | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1, f_D = 5 \text{ Hz}$ |     |     |     |
| Antenna configuration            |  | 1 x 2  |     |     |     |
| Reporting interval               | ms   | 5  |     |     |     |
| CQI delay                        | ms   | 8  |     |     |     |
| Reporting mode                   |  | PUSCH 3-0  |     |     |     |
| Sub-band size                    | RB   | 6 (full size)  |     |     |     |
| Max number of HARQ transmissions |  | 1  |     |     |     |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |  |     |     |     |
| Note 2:                          | Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.  |  |     |     |     |
| Note 3:                          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |  |     |     |     |

**Table 9.3.1.1.1-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 2        | 2        |
| $\beta$ [%]  | 55       | 55       |
| $\gamma$     | 1.1      | 1.1      |
| UE Category  | $\geq 1$ | $\geq 1$ |

9.3.1.1.2 TDD

For the parameters specified in Table 9.3.1.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.2-2 and by the following

- a) a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$ % of the time but less than  $\beta$ % for each sub-band;
- b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- c) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

**Table 9.3.1.1.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter                      |          | Unit | Test 1     | Test 2 |
|--------------------------------|----------|------|------------|--------|
| Bandwidth                      |          | MHz  | 10 MHz     |        |
| Transmission mode              |          |      | 1 (port 0) |        |
| Downlink power allocation      | $\rho_A$ | dB   | 0          |        |
|                                | $\rho_B$ | dB   | 0          |        |
|                                | $\sigma$ | dB   | 0          |        |
| Uplink downlink configuration  |          |      | 2          |        |
| Special subframe configuration |          |      | 4          |        |

|                                  |  |   |     |     |     |
|----------------------------------|--|---|-----|-----|-----|
| SNR (Note 3)                     | dB   | 9   | 10  | 14  | 15  |
| $\hat{I}_{or}^{(j)}$             | dB[mW/15kHz]   | -89   | -88 | -84 | -83 |
| $N_{oc}^{(j)}$                   | dB[mW/15kHz]   | -98   |     | -98 |     |
| Propagation channel              |  | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |     |     |
| Antenna configuration            |  | 1 x 2   |     |     |     |
| Reporting interval               | ms   | 5   |     |     |     |
| CQI delay                        | ms   | 10 or 11  |     |     |     |
| Reporting mode                   |  | PUSCH 3-0   |     |     |     |
| Sub-band size                    | RB   | 6 (full size)   |     |     |     |
| Max number of HARQ transmissions |  | 1   |     |     |     |
| ACK/NACK feedback mode           |  | Multiplexing  |     |     |     |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |   |     |     |     |
| Note 2:                          | Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.  |   |     |     |     |
| Note 3:                          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |   |     |     |     |

**Table 9.3.1.1.2-2 Minimum requirement (TDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 2        | 2        |
| $\beta$ [%]  | 55       | 55       |
| $\gamma$     | 1.1      | 1.1      |
| UE Category  | $\geq 1$ | $\geq 1$ |

### 9.3.1.1.3 FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

For the parameters specified in Table 9.3.1.1.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.3-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput in ABS subframes obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER in ABS subframes for the indicated transport formats shall be greater than or equal to  $\epsilon$ .

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

**Table 9.3.1.1.3-1 Sub-band test for single antenna transmission (FDD)**

| Parameter               | Unit     | Test 1 |              | Test 2 |              |
|-------------------------|----------|--------|--------------|--------|--------------|
|                         |          | Cell 1 | Cell 2 and 3 | Cell 1 | Cell 2 and 3 |
| Bandwidth               | MHz      | 10     |              | 10     |              |
| PDSCH transmission mode |          | 1      | Note 10      | 1      | Note 10      |
|                         | $\rho_A$ | dB     |              | 0      |              |

|   |                 |           |   |   |  |   |  |                          |  |  |
|---|-----------------|-----------|---|---|--|---|--|--------------------------|--|--|
| Downlink power allocation                     | $\rho_B$        | dB        | 0   |   | 0  |   |  |                          |  |  |
|   | $\sigma$        | dB        | 0   |   | 0  |   |  |                          |  |  |
| Propagation condition                         |                 |           | Clause B.2.4 with $T_d = 0.45$ us, $a = 1$ , $f_d = 5$ Hz |   | EVA5 Low antenna correlation                             | Clause B.2.4 with $T_d = 0.45$ us, $a = 1$ , $f_d = 5$ Hz |  |                          |  |  |
| Antenna configuration                         |                 |           | 1x2   |   | 1x2  |   |  |                          |  |  |
| $\widehat{E}_s/N_{oc2}$ (Note 1)              |                 | dB        | 4   | 5 | Cell 2: 12<br>Cell 3: 10                                 | 14  | 15   | Cell 2: 12<br>Cell 3: 10 |  |  |
| $N_{oc}^{(j)}$ at antenna port                | $N_{oc1}^{(j)}$ | dBm/15kHz | -98 (Note 7)  |   | N/A  |   | -98 (Note 7)   |                          | N/A  |  |
|   | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8)  |   | N/A  |   | -98 (Note 8)   |                          | N/A  |  |
|   | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9)  |   | N/A  |   | -93 (Note 9)   |                          | N/A  |  |
| Subframe Configuration                        |                 |           | Non-MBSFN   |   | Non-MBSFN  |   | Non-MBSFN  |                          | Non-MBSFN  |  |
| Cell Id                                       |                 |           | 0   |   | Cell 2: 6<br>Cell 3: 1                                   |   | 0  |                          | Cell 2: 6<br>Cell 3: 1                                   |  |
| Time Offset between Cells                     |                 | $\mu$ s   | Cell 2: 3 usec<br>Cell 3: -1usec                          |   | Cell 2: 3 usec<br>Cell 3: -1usec                         |   |  |                          |  |  |
| Frequency Shift between Cells                 |                 | Hz        | Cell 2: 300Hz<br>Cell 3: -100Hz                           |   | Cell 2: 300Hz<br>Cell 3: -100Hz                          |   |  |                          |  |  |
| ABS pattern (Note 2)                          |                 |           | N/A   |   | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |   | N/A  |                          | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |  |
| RLM/RRM Measurement Subframe Pattern (Note 4) |                 |           | 00000100<br>00000100<br>00000100<br>00000100<br>00000100  |   | N/A  |   | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |                          | N/A  |  |
| CSI Subframe Sets (Note 3)                    | $C_{CSI,0}$     |           | 01010101<br>01010101<br>01010101<br>01010101<br>01010101  |   | N/A  |   | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |                          | N/A  |  |
|   | $C_{CSI,1}$     |           | 10101010<br>10101010<br>10101010<br>10101010<br>10101010  |   | N/A  |   | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 |                          | N/A  |  |
| Number of control OFDM symbols                |                 |           | 3   |   | 3  |   |  |                          |  |  |
| Max number of HARQ transmissions              |                 |           | 1   |   | 1  |   |  |                          |  |  |
| CQI delay                                     |                 | ms        | 8   |   | 8  |   |  |                          |  |  |
| Reporting interval (Note 13)                  |                 | ms        | 10  |   | 10   |   |  |                          |  |  |
| Reporting mode                                |                 |           | PUSCH 3-0   |   | PUSCH 3-0  |   |  |                          |  |  |
| Sub-band size                                 |                 | RB        | 6 (full size)   |   | 6 (full size)  |   |  |                          |  |  |

|          |  |
|----------|--|
| Note 1:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 2:  | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 3:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |
| Note 4:  | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]  |
| Note 5:  | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |
| Note 6:  | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 are the same.  |
| Note 7:  | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.   |
| Note 8:  | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.  |
| Note 9:  | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.  |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNB pattern as defined in Annex A.5.1.5  |
| Note 11: | Reference measurement channel in Cell 1 RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNB Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.  |
| Note 12: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4).  |
| Note 13: | The CSI reporting is such that reference subframes belong to $C_{csi,0}$ .   |

**Table 9.3.1.1.3-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 2        | 2        |
| $\beta$ [%]  | 55       | 55       |
| $\gamma$     | 1.1      | 1.1      |
| $\epsilon$   | 0.01     | 0.01     |
| UE Category  | $\geq 1$ | $\geq 1$ |

#### 9.3.1.1.4 TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

For the parameters specified in Table 9.3.1.1.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.4-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  for each sub-band;
- the ratio of the throughput in ABS subframes obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER in ABS subframes for the indicated transport formats shall be greater than or equal to  $\epsilon$ .

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

**Table 9.3.1.1.4-1: Sub-band test for single antenna transmission (TDD)**

| Parameter                      | Unit | Test 1 |              | Test 2 |              |
|--------------------------------|------|--------|--------------|--------|--------------|
|                                |      | Cell 1 | Cell 2 and 3 | Cell 1 | Cell 2 and 3 |
| Bandwidth                      | MHz  | 10     |              | 10     |              |
| PDSCH transmission mode        |      | 1      | Note 10      | 1      | Note 10      |
| Uplink downlink configuration  |      | 1      |              | 1      |              |
| Special subframe configuration |      | 4      |              | 4      |              |

|  |                 |           |   |                          |                              |   |    |                              |
|--|-----------------|-----------|---|--------------------------|------------------------------|---|----|------------------------------|
| Downlink power allocation  | $\rho_A$        | dB        | 0   |                          |                              | 0   |    |                              |
|  | $\rho_B$        | dB        | 0   |                          |                              | 0   |    |                              |
|  | $\sigma$        | dB        | 0   |                          |                              | 0   |    |                              |
| Propagation condition  |                 |           | Clause B.2.4 with $T_d = 0.45$ us, $a = 1$ , $f_d = 5$ Hz |                          | EVA5 Low antenna correlation | Clause B.2.4 with $T_d = 0.45$ us, $a = 1$ , $f_d = 5$ Hz |    | EVA5 Low antenna correlation |
| Antenna configuration  |                 |           | 1x2   |                          |                              | 1x2   |    |                              |
| $\widehat{E}_s/N_{oc2}$ (Note 1)   |                 | dB        | 4   | 5                        | Cell 2: 12<br>Cell 3: 10     | 14  | 15 | Cell 2: 12<br>Cell 3: 10     |
| $N_{oc}^{(j)}$ at antenna port   | $N_{ocl}^{(j)}$ | dBm/15kHz | -98 (Note 7)  |                          | N/A                          | -98 (Note 7)  |    | N/A                          |
|  | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8)  |                          | N/A                          | -98 (Note 8)  |    | N/A                          |
|  | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9)  |                          | N/A                          | -93 (Note 9)  |    | N/A                          |
| Subframe Configuration   |                 |           | Non-MBSFN   | Non-MBSFN                | Non-MBSFN                    | Non-MBSFN   |    | Non-MBSFN                    |
| Cell Id  |                 |           | 0   | Cell 2: 6<br>Cell 3: 1   | 0                            | Cell 2: 6<br>Cell 3: 1                                    |    | Cell 2: 6<br>Cell 3: 1       |
| Time Offset between Cells  |                 | $\mu$ s   | Cell 2: 3 usec<br>Cell 3: -1usec                          |                          |                              | Cell 2: 3 usec<br>Cell 3: -1usec                          |    |                              |
| Frequency shift between Cells  |                 | Hz        | Cell 2: 300Hz<br>Cell 3: -100Hz                           |                          |                              | Cell 2: 300Hz<br>Cell 3: -100Hz                           |    |                              |
| ABS pattern (Note 2)   |                 |           | N/A   | 0100010001<br>0100010001 | N/A                          | 0100010001<br>0100010001                                  |    |                              |
| RLM/RRM Measurement Subframe Pattern (Note 4)  |                 |           | 0000000001<br>0000000001                                  | N/A                      | 0000000001<br>0000000001     | N/A   |    |                              |
| CSI Subframe Sets (Note 3)   | $C_{csi,0}$     |           | 0100010001<br>0100010001                                  | N/A                      | 0100010001<br>0100010001     | N/A   |    |                              |
|  | $C_{csi,1}$     |           | 1000101000<br>1000101000                                  | N/A                      | 1000101000<br>1000101000     | N/A   |    |                              |
| Number of control OFDM symbols   |                 |           | 3   |                          |                              | 3   |    |                              |
| Max number of HARQ transmissions   |                 |           | 1   |                          |                              | 1   |    |                              |
| CQI delay  |                 | ms        | 10  |                          |                              |   |    |                              |
| Reporting interval (Note 13)   |                 | ms        | 10  |                          |                              |   |    |                              |
| Reporting mode   |                 |           | PUSCH 3-0   |                          |                              |   |    |                              |
| Sub-band size  |                 | RB        | 6 (full size)   |                          |                              |   |    |                              |
| ACK/NACK feedback mode   |                 |           | Multiplexing  |                          |                              | Multiplexing  |    |                              |
| <p>Note 1: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 2: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.</p> <p>Note 3: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 4: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].</p> <p>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]</p> <p>Note 6: Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 is the same.</p> <p>Note 7: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.</p> <p>Note 8: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS</p> <p>Note 9: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.</p> <p>Note 10: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5</p> <p>Note 11: Reference measurement channel in Cell 1 RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 12: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 13: The CSI reporting is such that reference subframes belong to <math>C_{csi,0}</math>.</p> |                 |           |   |                          |                              |   |    |                              |



**Table 9.3.1.1.4-2 Minimum requirement (TDD)**

|               | Test 1   | Test 2   |
|---------------|----------|----------|
| $\alpha$ [%]  | 2        | 2        |
| $\beta$ [%]   | 55       | 55       |
| $\gamma$      | 1.1      | 1.1      |
| $\varepsilon$ | 0.01     | 0.01     |
| UE Category   | $\geq 1$ | $\geq 1$ |

### 9.3.1.1.5 TDD (when *csi-SubframeSet-r12* is configured)

The following requirements apply to UE Category  $\geq 1$  which supports Rel-12 CSI subframe sets. For the parameters specified in Table 9.3.1.1.5-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.5-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band for each CSI subframe set;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$  for each CSI subframe set;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05 and less than 0.60 for each CSI subframe set.
- the difference of the wide-band median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  and the wide-band median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  shall be larger than or equal to 3.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.1.1.5-1: Sub-band test for TDD**

| Parameter  | Unit         | Test  |      |
|--|--------------|---|------|
| Bandwidth  | MHz          | 10  |      |
| Transmission mode  |              | 2   |      |
| Uplink downlink configuration  |              | 2   |      |
| Special subframe configuration   |              | 4   |      |
| CSI-MeasSubframeSet-r12  |              | 0001100000  |      |
| Downlink power allocation  | $\rho_A$     | dB  | -3   |
|  | $\rho_B$     | dB  | -3   |
|  | $\sigma$     | dB  | 0    |
| SNR in CSI subframe set 0  | dB           | 0   | 1    |
| SNR in CSI subframe set 1  | dB           | 10  | 11   |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -98   | -97  |
| $N_{oc1}^{(j)}$ for CSI subframe set 0                                     | dB[mW/15kHz] | -98   | -98  |
| $N_{oc2}^{(j)}$ for CSI subframe set 1                                     | dB[mW/15kHz] | -108  | -108 |
| Propagation channel  |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s$ , $a = 1$ , $f_D = 5$ Hz |      |
| Antenna configuration  |              | 2x2   |      |
| CRS reference signals  |              | Antenna port 0 and 1  |      |
| Zero-Power CSI-RS configuration 0<br>$l_{CSI-RS}$ / ZeroPowerCSI-RS bitmap |              | 3 /<br>0000010000000000   |      |
| Zero-Power CSI-RS configuration 1<br>$l_{CSI-RS}$ / ZeroPowerCSI-RS bitmap |              | 4 /<br>0100000000000000   |      |

|  |   |  |
|--|---|--|
| PDSCH scheduled subframes for CSI subframe set 0 |   | 8,9  |
| PDSCH scheduled subframes for CSI subframe set 1 |   | 3,4  |
| Reporting interval (Note 4)                      | ms  | 10 per subframe set                                    |
| CQI delay  | ms  | 15 for CSI subframe set 0<br>15 for CSI subframe set 1 |
| Reporting mode                                   |   | PUSCH 3-0  |
| Sub-band size                                    | RB  | 6 (full size)  |
| Max number of HARQ transmissions                 |   | 1  |
| ACK/NACK feedback mode                           |   | Multiplexing   |
| Number of EPDCCH Sets Configured                 |   | 2 (Note 5,6)   |
| Number of PRB per EPDCCH Set                     |   | 4  |
| EPDCCH Subframe Monitoring                       |   | NA   |
| EPDCCH Aggregation level                         |   | 8ECCE  |
| EPDCCH beamforming model                         |   | Annex B.4.4  |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)  |  |
| Note 2:  | Reference measurement channel RC.17 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.  |  |
| Note 3:  | In the test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level for each subframe set separately..   |  |
| Note 4:  | For CSI subframe set 0, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF #7. For CSI subframe set 1, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2.  |  |
| Note 5:  | In case UE supports EPDCCH, the PDSCH scheduling grants are transmitted via EPDCCH, otherwise PDCCH is used.  |  |
| Note 6:  | The two sets are distributed EPDCCH sets and non-overlapping with PRB = {0, 3, 6, 9} for the first set and PRB = {40, 43, 46, 49} for the second set. EPDCCH set is selected after scheduling decision for PDSCH to avoid collision between PDSCH and EPDCCH PRBs, respectively. EPDCCH is only transmitted from one set. The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling epdch-StartSymbol-r11 is not configured |  |

Table 9.3.1.1.5-2: Minimum requirement (TDD)

|              | Test     |
|--------------|----------|
| $\alpha$ [%] | 2        |
| $\beta$ [%]  | 55       |
| $\gamma$     | 1.1      |
| UE Category  | $\geq 1$ |

### 9.3.1.2 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

#### 9.3.1.2.1 FDD

For the parameters specified in Table 9.3.1.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.1-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.1.2.1-1 Sub-band test for FDD**

| Parameter  |          | Unit         | Test 1  |     | Test 2 |     |
|--|----------|--------------|---|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode  |          |              | 9   |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |     |        |     |
|  | $\rho_B$ | dB           | 0   |     |        |     |
|  | $P_C$    | dB           | 0   |     |        |     |
|  | $\sigma$ | dB           | 0   |     |        |     |
| SNR (Note 3)   |          | dB           | 4   | 5   | 11     | 12  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -94   | -93 | -87    | -86 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |        |     |
| Antenna configuration  |          |              | 2x2   |     |        |     |
| Beamforming Model  |          |              | As specified in Section B.4.3                                   |     |        |     |
| CRS reference signals  |          |              | Antenna ports 0   |     |        |     |
| CSI reference signals  |          |              | Antenna ports 15, 16  |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              | 5/ 1  |     |        |     |
| CSI-RS reference signal configuration  |          |              | 4   |     |        |     |
| CodeBookSubsetRestriction bitmap   |          |              | 000001  |     |        |     |
| Reporting interval (Note 4)  |          | ms           | 5   |     |        |     |
| CQI delay  |          | ms           | 8   |     |        |     |
| Reporting mode   |          |              | PUSCH 3-1   |     |        |     |
| Sub-band size  |          | RB           | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.8 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.</p> |          |              |   |     |        |     |

**Table 9.3.1.2.1-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 2        | 2        |
| $\beta$ [%]  | 40       | 40       |
| $\gamma$     | 1.1      | 1.1      |
| UE Category  | $\geq 1$ | $\geq 1$ |

### 9.3.1.2.2 TDD

For the parameters specified in Table 9.3.1.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.2-2 and by the following

- a) a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;

- b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- c) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.1.2.2-1 Sub-band test for TDD**

| Parameter  |          | Unit         | Test 1  |     | Test 2 |     |
|--|----------|--------------|---|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode  |          |              | 9   |     |        |     |
| Uplink downlink configuration  |          |              | 2   |     |        |     |
| Special subframe configuration   |          |              | 4   |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |     |        |     |
|  | $\rho_B$ | dB           | 0   |     |        |     |
|  | $P_c$    | dB           | 0   |     |        |     |
|  | $\sigma$ | dB           | 0   |     |        |     |
| SNR (Note 3)   |          | dB           | 4   | 5   | 11     | 12  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -94   | -93 | -87    | -86 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |        |     |
| Antenna configuration  |          |              | 2x2   |     |        |     |
| Beamforming Model  |          |              | As specified in Section B.4.3                                   |     |        |     |
| CRS reference signals  |          |              | Antenna port 0  |     |        |     |
| CSI reference signals  |          |              | Antenna port 15,16  |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              | 5/ 3  |     |        |     |
| CSI-RS reference signal configuration  |          |              | 4   |     |        |     |
| CodeBookSubsetRestriction bitmap   |          |              | 000001  |     |        |     |
| Reporting interval (Note 4)  |          | ms           | 5   |     |        |     |
| CQI delay  |          | ms           | 10  |     |        |     |
| Reporting mode   |          |              | PUSCH 3-1   |     |        |     |
| Sub-band size  |          | RB           | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| ACK/NACK feedback mode   |          |              | Multiplexing  |     |        |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.8 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2 and #7.</p> |          |              |   |     |        |     |

**Table 9.3.1.2.2-2 Minimum requirement (TDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 2        | 2        |
| $\beta$ [%]  | 40       | 40       |
| $\gamma$     | 1.1      | 1.1      |
| UE Category  | $\geq 1$ | $\geq 1$ |

### 9.3.1.2.3 FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

For the parameters specified in Table 9.3.1.2.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.3-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.3.1.2.3-1 Sub-band test for FDD**

| Parameter  | Unit   | Test 1  |     |
|--|--|---|-----|
| Bandwidth  | MHz  | 10 MHz  |     |
| Transmission mode  |  | 9   |     |
| Downlink power allocation  | $\rho_A$   | dB  | 0   |
|  | $\rho_B$   | dB  | 0   |
|  | $P_c$  | dB  | 0   |
|  | $\sigma$   | dB  | 0   |
| SNR (Note 3)   | dB   | 16  | 17  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]   | -82   | -81 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]   | -98   | -98 |
| Propagation channel  |  | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |
| Antenna configuration  |  | 2x2   |     |
| Beamforming Model  |  | As specified in Section B.4.3                                   |     |
| CRS reference signals  |  | Antenna ports 0   |     |
| CSI reference signals  |  | Antenna ports 15, 16  |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |  | 5/ 1  |     |
| CSI-RS reference signal configuration                                    |  | 4   |     |
| CodeBookSubsetRestriction bitmap   |  | 000001  |     |
| Reporting interval (Note 4)  | ms   | 5   |     |
| CQI delay  | ms   | 8   |     |
| Reporting mode   |  | PUSCH 3-1   |     |
| Sub-band size  | RB   | 6 (full size)   |     |
| Max number of HARQ transmissions   |  | 1   |     |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |   |     |
| Note 2:  | Reference measurement channel RC.8A FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.   |   |     |
| Note 3:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |   |     |
| Note 4:  | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.  |   |     |

**Table 9.3.1.2.3-2 Minimum requirement (FDD)**

|                | Test 1    |
|----------------|-----------|
| $\alpha$ [%]   | 2         |
| $\beta$ [%]    | 40        |
| $\gamma$       | 1.1       |
| UE Category    | 11-12     |
| UE DL Category | $\geq 11$ |

#### 9.3.1.2.4 TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

For the parameters specified in Table 9.3.1.2.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.4-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.3.1.2.4-1 Sub-band test for TDD**

| Parameter  | Unit         | Test 1  |     |
|--|--------------|---|-----|
| Bandwidth  | MHz          | 20 MHz  |     |
| Transmission mode  |              | 9   |     |
| Uplink downlink configuration  |              | 2   |     |
| Special subframe configuration   |              | 4   |     |
| Downlink power allocation  | $\rho_A$     | dB  | 0   |
|  | $\rho_B$     | dB  | 0   |
|  | $P_c$        | dB  | 0   |
|  | $\sigma$     | dB  | 0   |
| SNR (Note 3)   | dB           | 16  | 17  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -82   | -81 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98   | -98 |
| Propagation channel  |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |
| Antenna configuration  |              | 2x2   |     |
| Beamforming Model  |              | As specified in Section B.4.3                                   |     |
| CRS reference signals  |              | Antenna port 0  |     |
| CSI reference signals  |              | Antenna port 15,16  |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              | 5/ 3  |     |
| CSI-RS reference signal configuration                                    |              | 4   |     |
| CodeBookSubsetRestriction bitmap   |              | 000001  |     |
| Reporting interval (Note 4)  | ms           | 5   |     |
| CQI delay  | ms           | 10  |     |
| Reporting mode   |              | PUSCH 3-1   |     |
| Sub-band size  | RB           | 8 (full size)   |     |

|                                  |  |              |
|----------------------------------|--|--------------|
| Max number of HARQ transmissions |  | 1            |
| ACK/NACK feedback mode           |  | Multiplexing |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |              |
| Note 2:                          | Reference measurement channel RC.8A TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.   |              |
| Note 3:                          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |
| Note 4:                          | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2 and #7.  |              |

**Table 9.3.1.2.4-2 Minimum requirement (TDD)**

|                | Test 1    |
|----------------|-----------|
| $\alpha$ [%]   | 2         |
| $\beta$ [%]    | 40        |
| $\gamma$       | 1.1       |
| UE Category    | 11-12     |
| UE DL Category | $\geq 11$ |

9.3.1.2.5 Void

**Table 9.3.1.2.5-1: Void****Table 9.3.1.2.5-2: Void**9.3.1.2.6 TDD (when *csi-SubframeSet* *-r12* is configured with one CSI process)

The following requirements apply to UE Category  $\geq 1$  which supports Rel-12 CSI subframe sets and TM10. For the parameters specified in Table 9.3.1.2.6-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.6-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$ % of the time but less than  $\beta$ % for each sub-band for each CSI subframe set;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be  $\geq \gamma$  for each CSI subframe set;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.01 for each CSI subframe set.
- The difference of the wide-band median CQI obtained by reports in CSI subframe sets  $C_{CSI,0}$  and the wide-band median CQI obtained by reports in CSI subframe sets  $C_{CSI,1}$  shall be larger than or equal to 3.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.1.2.6-1: Sub-band test for TDD**

| Parameter                     | Unit | Test |
|-------------------------------|------|------|
| Bandwidth                     | MHz  | 10   |
| Transmission mode             |      | 10   |
| Uplink downlink configuration |      | 2    |

|   |          |  |  |
|---|----------|--|--|
| Special subframe configuration  |          | 4  |  |
| CSI-MeasSubframeSet-r12   |          | 0001100000   |  |
| Downlink power allocation   | $\rho_A$ | dB   | 0  |
|   | $\rho_B$ | dB   | 0  |
|   | $P_c$    | dB   | -3   |
|   | $\sigma$ | dB   | -3   |
| SNR in CSI subframe set 0   |          | dB   | 0      1   |
| SNR in CSI subframe set 1   |          | dB   | 10      11   |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz]   | -98      -97   |
| $N_{oc1}^{(j)}$ for CSI subframe set 0  |          | dB[mW/15kHz]   | -98      -98   |
| $N_{oc2}^{(j)}$ for CSI subframe set 1  |          | dB[mW/15kHz]   | -108      -108   |
| Propagation channel   |          | Clause B.2.4 with $\tau_d = 0.45 \mu s, a = 1, f_D = 5 \text{ Hz}$ |  |
| Antenna configuration   |          | 2x2  |  |
| Beamforming Model   |          | As specified in Section B.4.3                                      |  |
| CRS reference signals   |          | Antenna port 0 and 1   |  |
| CSI reference signals   |          | Antenna port 15,16   |  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          | 5/ 0   |  |
| CSI-RS reference signal configuration   |          | 0  |  |
| Zero-Power CSI-RS configuration 0<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap  |          | 3 /<br>0000010000000000  |  |
| Zero-Power CSI-RS configuration 1<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap  |          | 4 /<br>0100000000000000  |  |
| CSI-IM configuration 0<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap   |          | 3 /<br>0000010000000000  |  |
| CSI-IM configuration 1<br>$l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap   |          | 4 /<br>0100000000000000  |  |
| CSI process configuration<br>Signal/Interference/Reporting mode for<br>CSI subframe set 0   |          | CSI-RS/CSI-IM 0/PUSCH 3-1  |  |
| CSI process configuration<br>Signal/Interference/Reporting mode for<br>CSI subframe set 1   |          | CSI-RS/CSI-IM 1/PUSCH 3-1  |  |
| CodeBookSubsetRestriction bitmap  |          | 000001   |  |
| Reporting interval (Note 4)   |          | ms   | 10 per subframe set                                    |
| CQI delay   |          | ms   | 15 for CSI subframe set 0<br>15 for CSI subframe set 1 |
| Sub-band size   |          | RB   | 6 (full size)  |
| PDSCH scheduled subframes for CSI subframe set 0  |          | 8,9  |  |
| PDSCH scheduled subframes for CSI subframe set 1  |          | 3,4  |  |
| Max number of HARQ transmissions  |          | 1  |  |
| ACK/NACK feedback mode  |          | Multiplexing   |  |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.18 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level for each subframe set separately.</p> <p>Note 4: For CSI subframe set 0, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF #7. For CSI subframe set 1, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2.</p> |          |  |  |



**Table 9.3.1.2.6-2: Minimum requirement (TDD)**

|              | Test     |
|--------------|----------|
| $\alpha$ [%] | 2        |
| $\beta$ [%]  | 55       |
| $\gamma$     | 1.02     |
| UE Category  | $\geq 1$ |

## 9.3.2 Frequency non-selective scheduling mode

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective fading conditions is determined by the reporting variance, and the relative increase of the throughput obtained when the transport format transmitted is that indicated by the reported CQI compared to the case for which a fixed transport format configured according to the reported median CQI is transmitted. In addition, the reporting accuracy is determined by a minimum BLER using the transport formats indicated by the reported CQI. The purpose is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for frequently non-selective scheduling. To account for sensitivity of the input SNR the CQI reporting under frequency non-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

### 9.3.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)

#### 9.3.2.1.1 FDD

For the parameters specified in Table 9.3.2.1.1-1 and Table 9.3.2.1.1-3, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.1.1-2 and Table 9.3.2.1.1-4 and by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$  % of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02

The applicability of the requirement with 5MHz bandwidth as specified in Table 9.3.2.1.1-3 and Table 9.3.2.1.1-4 is defined in 9.1.1.1.

**Table 9.3.2.1.1-1 Fading test for single antenna (FDD)**

| Parameter                             |          | Unit         | Test 1         |     | Test 2 |     |
|---------------------------------------|----------|--------------|----------------|-----|--------|-----|
| Bandwidth                             |          | MHz          | 10 MHz         |     |        |     |
| Transmission mode                     |          |              | 1 (port 0)     |     |        |     |
| Downlink power allocation             | $\rho_A$ | dB           | 0              |     |        |     |
|                                       | $\rho_B$ | dB           | 0              |     |        |     |
|                                       | $\sigma$ | dB           | 0              |     |        |     |
| SNR (Note 3)                          |          | dB           | 6              | 7   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$                  |          | dB[mW/15kHz] | -92            | -91 | -86    | -85 |
| $N_{oc}^{(j)}$                        |          | dB[mW/15kHz] | -98            |     | -98    |     |
| Propagation channel                   |          |              | EPA5           |     |        |     |
| Correlation and antenna configuration |          |              | High (1 x 2)   |     |        |     |
| Reporting mode                        |          |              | PUCCH 1-0      |     |        |     |
| Reporting periodicity                 |          | ms           | $N_{pd} = 2$   |     |        |     |
| CQI delay                             |          | ms           | 8              |     |        |     |
| Physical channel for CQI reporting    |          |              | PUSCH (Note 4) |     |        |     |

|                                   |  |   |
|-----------------------------------|--|---|
| PUCCH Report Type                 |  | 4 |
| <i>cqi-pmi-ConfigurationIndex</i> |  | 1 |
| Max number of HARQ transmissions  |  | 1 |
| Note 1:                           | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)  |   |
| Note 2:                           | Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. |   |
| Note 3:                           | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |   |
| Note 4:                           | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.         |   |

**Table 9.3.2.1.1-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 1$ | $\geq 1$ |

**Table 9.3.2.1.1-3 Fading test for single antenna (FDD)**

| Parameter                             |   | Unit         | Test 1         |     | Test 2 |     |
|---------------------------------------|---|--------------|----------------|-----|--------|-----|
| Bandwidth                             |   | MHz          | 5 MHz          |     |        |     |
| Transmission mode                     |   |              | 1 (port 0)     |     |        |     |
| Downlink power allocation             | $\rho_A$  | dB           | 0              |     |        |     |
|                                       | $\rho_B$  | dB           | 0              |     |        |     |
|                                       | $\sigma$  | dB           | 0              |     |        |     |
| SNR (Note 3)                          |   | dB           | 6              | 7   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$                  |   | dB[mW/15kHz] | -92            | -91 | -86    | -85 |
| $N_{oc}^{(j)}$                        |   | dB[mW/15kHz] | -98            |     | -98    |     |
| Propagation channel                   |   |              | EPA5           |     |        |     |
| Correlation and antenna configuration |   |              | High (1 x 2)   |     |        |     |
| Reporting mode                        |   |              | PUCCH 1-0      |     |        |     |
| Reporting periodicity                 |   | ms           | $N_{pd} = 2$   |     |        |     |
| CQI delay                             |   | ms           | 8              |     |        |     |
| Physical channel for CQI reporting    |   |              | PUSCH (Note 4) |     |        |     |
| PUCCH Report Type                     |   |              | 4              |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>     |   |              | 1              |     |        |     |
| Max number of HARQ transmissions      |   |              | 1              |     |        |     |
| Note 1:                               | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)                         |              |                |     |        |     |
| Note 2:                               | Reference measurement channel RC.14 FDD according to Table A.4-1 for Category $\geq 2$ with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.15 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG |              |                |     |        |     |

Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  
 Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.

**Table 9.3.2.1.1-4 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 1$ | $\geq 1$ |

9.3.2.1.2 TDD

For the parameters specified in Table 9.3.2.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.1.2-2 and by the following

- a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$  % of the time;
- b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

**Table 9.3.2.1.2-1 Fading test for single antenna (TDD)**

| Parameter                             | Unit         | Test 1         |     | Test 2 |     |
|---------------------------------------|--------------|----------------|-----|--------|-----|
| Bandwidth                             | MHz          | 10 MHz         |     |        |     |
| Transmission mode                     |              | 1 (port 0)     |     |        |     |
| Downlink power allocation             | $\rho_A$     | dB             |     |        |     |
|                                       | $\rho_B$     | dB             |     |        |     |
|                                       | $\sigma$     | dB             |     |        |     |
| Uplink downlink configuration         |              | 2              |     |        |     |
| Special subframe configuration        |              | 4              |     |        |     |
| SNR (Note 3)                          | dB           | 6              | 7   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$                  | dB[mW/15kHz] | -92            | -91 | -86    | -85 |
| $N_{oc}^{(j)}$                        | dB[mW/15kHz] | -98            |     | -98    |     |
| Propagation channel                   |              | EPA5           |     |        |     |
| Correlation and antenna configuration |              | High (1 x 2)   |     |        |     |
| Reporting mode                        |              | PUCCH 1-0      |     |        |     |
| Reporting periodicity                 | ms           | $N_{pd} = 5$   |     |        |     |
| CQI delay                             | ms           | 10 or 11       |     |        |     |
| Physical channel for CQI reporting    |              | PUSCH (Note 4) |     |        |     |
| PUCCH Report Type                     |              | 4              |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>     |              | 3              |     |        |     |
| Max number of HARQ transmissions      |              | 1              |     |        |     |
| ACK/NACK feedback mode                |              | Multiplexing   |     |        |     |

|         |  |
|---------|--|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).   |
| Note 2: | Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 4: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.                         |

**Table 9.3.2.1.2-2 Minimum requirement (TDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 1$ | $\geq 1$ |

9.3.2.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

9.3.2.2.1 FDD

For the parameters specified in Table 9.3.2.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.2.1-2 and by the following

- a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha\%$  of the time;
- b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

**Table 9.3.2.2.1-1 Fading test for FDD**

| Parameter                             |          | Unit         | Test 1                        |     | Test 2 |     |
|---------------------------------------|----------|--------------|-------------------------------|-----|--------|-----|
| Bandwidth                             |          | MHz          | 10 MHz                        |     |        |     |
| Transmission mode                     |          |              | 9                             |     |        |     |
| Downlink power allocation             | $\rho_A$ | dB           | 0                             |     |        |     |
|                                       | $\rho_B$ | dB           | 0                             |     |        |     |
|                                       | $P_c$    | dB           | -3                            |     |        |     |
|                                       | $\sigma$ | dB           | -3                            |     |        |     |
| SNR (Note 3)                          |          | dB           | 2                             | 3   | 7      | 8   |
| $\hat{I}_{or}^{(j)}$                  |          | dB[mW/15kHz] | -96                           | -95 | -91    | -90 |
| $N_{oc}^{(j)}$                        |          | dB[mW/15kHz] | -98                           |     | -98    |     |
| Propagation channel                   |          |              | EPA5                          |     |        |     |
| Correlation and antenna configuration |          |              | ULA High (4 x 2)              |     |        |     |
| Beamforming Model                     |          |              | As specified in Section B.4.3 |     |        |     |
| Cell-specific reference signals       |          |              | Antenna ports 0,1             |     |        |     |
| CSI reference signals                 |          |              | Antenna ports 15,...,18       |     |        |     |

|  |  |                       |
|--|--|-----------------------|
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |  | 5/1                   |
| CSI-RS reference signal configuration  |  | 2                     |
| CodeBookSubsetRestriction bitmap   |  | 0x0000 0000 0000 0001 |
| Reporting mode   |  | PUCCH 1-1             |
| Reporting periodicity  | ms   | $N_{\text{pd}} = 5$   |
| CQI delay  | ms   | 8                     |
| Physical channel for CQI/ PMI reporting  |  | PUSCH (Note 4)        |
| PUCCH Report Type for CQI/PMI  |  | 2                     |
| PUCCH channel for RI reporting   |  | PUCCH Format 2        |
| PUCCH report type for RI   |  | 3                     |
| <i>cqi-pmi-ConfigurationIndex</i>  |  | 2                     |
| <i>ri-ConfigIndex</i>  |  | 1                     |
| Max number of HARQ transmissions   |  | 1                     |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)  |                       |
| Note 2:  | Reference measurement channel RC.7 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |                       |
| Note 3:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                       |
| Note 4:  | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5. |                       |

**Table 9.3.2.2.1-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ |

**9.3.2.2.2 TDD**

For the parameters specified in Table 9.3.2.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.2.2-2 and by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha\%$  of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

**Table 9.3.2.2.2-1 Fading test for TDD**

| Parameter                      | Unit     | Test 1 | Test 2 |
|--------------------------------|----------|--------|--------|
| Bandwidth                      | MHz      | 10 MHz |        |
| Transmission mode              |          | 9      |        |
| Uplink downlink configuration  |          | 2      |        |
| Special subframe configuration |          | 4      |        |
| Downlink power allocation      | $\rho_A$ | dB     | 0      |
|                                | $\rho_B$ | dB     | 0      |
|                                | $P_C$    | dB     | -6     |
|                                | $\sigma$ | dB     | -3     |

| SNR (Note 3)   | dB  | 1                                       | 2   | 7   | 8   |
|--|---|---|-----|-----|-----|
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]  | -97                                     | -96 | -91 | -90 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98                                     |     | -98 |     |
| Propagation channel  |   | EPA5                                    |     |     |     |
| Correlation and antenna configuration                                    |   | XP High (8 x 2)                         |     |     |     |
| Beamforming Model  |   | As specified in Section B.4.3           |     |     |     |
| CRS reference signals  |   | Antenna ports 0, 1                      |     |     |     |
| CSI reference signals  |   | Antenna ports 15,...,22                 |     |     |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |   | 5/ 3                                    |     |     |     |
| CSI-RS reference signal configuration                                    |   | 2                                       |     |     |     |
| CodeBookSubsetRestriction bitmap   |   | 0x0000 0000 0000 0020 0000<br>0000 0001 |     |     |     |
| Reporting mode   |   | PUCCH 1-1 (Sub-mode: 2)                 |     |     |     |
| Reporting periodicity  | ms  | $N_{pd} = 5$                            |     |     |     |
| CQI delay  | ms  | 10                                      |     |     |     |
| Physical channel for CQI/ PMI reporting                                  |   | PUSCH (Note 4)                          |     |     |     |
| PUCCH Report Type for CQI/ PMI   |   | 2c                                      |     |     |     |
| Physical channel for RI reporting  |   | PUCCH Format 2                          |     |     |     |
| PUCCH report type for RI   |   | 3                                       |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 3                                       |     |     |     |
| <i>ri-ConfigIndex</i>  |   | 805 (Note 5)                            |     |     |     |
| Max number of HARQ transmissions   |   | 1                                       |     |     |     |
| ACK/NACK feedback mode   |   | Multiplexing                            |     |     |     |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |   |     |     |     |
| Note 2:  | Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |   |     |     |     |
| Note 3:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |   |     |     |     |
| Note 4:  | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#2 and #7.  |   |     |     |     |
| Note 5:  | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |   |     |     |     |

Table 9.3.2.2-2 Minimum requirement (TDD)

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ |

### 9.3.3 Frequency-selective interference

The accuracy of sub-band channel quality indicator (CQI) reporting under frequency selective interference conditions is determined by a percentile of the reported differential CQI offset level +2 for a preferred sub-band, and the relative increase of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level the corresponding transport format compared to the case for which a fixed format is transmitted on any sub-band in set  $S$  of TS 36.213 [6]. The purpose is to verify that preferred sub-bands are used for frequently-selective scheduling under frequency-selective interference conditions.

### 9.3.3.1 Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbol)

#### 9.3.3.1.1 FDD

For the parameters specified in Table 9.3.3.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.3.1.1-2 and by the following

- a sub-band differential CQI offset level of +2 shall be reported at least  $\alpha\%$  for at least one of the sub-bands of full size at the channel edges;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.3.1.1-1 Sub-band test for single antenna transmission (FDD)**

| Parameter                        | Unit   | Test 1  | Test 2     |
|----------------------------------|--|---|------------|
| Bandwidth                        | MHz  | 10 MHz  | 10 MHz     |
| Transmission mode                |  | 1 (port 0)  | 1 (port 0) |
| Downlink power allocation        | $\rho_A$   | dB  | 0          |
|                                  | $\rho_B$   | dB  | 0          |
|                                  | $\sigma$   | dB  | 0          |
| $I_{ot}^{(j)}$ for RB 0...5      | dB[mW/15kHz]   | -102  | -93        |
| $I_{ot}^{(j)}$ for RB 6...41     | dB[mW/15kHz]   | -93   | -93        |
| $I_{ot}^{(j)}$ for RB 42...49    | dB[mW/15kHz]   | -93   | -102       |
| $\hat{I}_{or}^{(j)}$             | dB[mW/15kHz]   | -94   | -94        |
| Max number of HARQ transmissions |  | 1   |            |
| Propagation channel              |  | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |            |
| Reporting interval               | ms   | 5   |            |
| Antenna configuration            |  | 1 x 2   |            |
| CQI delay                        | ms   | 8   |            |
| Reporting mode                   |  | PUSCH 3-0   |            |
| Sub-band size                    | RB   | 6 (full size)   |            |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |   |            |
| Note 2:                          | Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.  |   |            |

**Table 9.3.3.1.1-2 Minimum requirement (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 60       | 60       |
| $\gamma$     | 1.6      | 1.6      |
| UE Category  | $\geq 1$ | $\geq 1$ |

## 9.3.3.1.2 TDD

For the parameters specified in Table 9.3.3.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.3.1.2-2 and by the following

- a) a sub-band differential CQI offset level of +2 shall be reported at least  $\alpha\%$  for at least one of the sub-bands of full size at the channel edges;
- b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.3.1.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter  |          | Unit         | Test 1  | Test 2     |
|--|----------|--------------|---|------------|
| Bandwidth  |          | MHz          | 10 MHz  | 10 MHz     |
| Transmission mode  |          |              | 1 (port 0)  | 1 (port 0) |
| Downlink power allocation  | $\rho_A$ | dB           | 0   | 0          |
|  | $\rho_B$ | dB           | 0   | 0          |
|  | $\sigma$ | dB           | 0   | 0          |
| Uplink downlink configuration  |          |              | 2   |            |
| Special subframe configuration   |          |              | 4   |            |
| $I_{ot}^{(j)}$ for RB 0...5  |          | dB[mW/15kHz] | -102  | -93        |
| $I_{ot}^{(j)}$ for RB 6...41   |          | dB[mW/15kHz] | -93   | -93        |
| $I_{ot}^{(j)}$ for RB 42...49  |          | dB[mW/15kHz] | -93   | -102       |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -94   | -94        |
| Max number of HARQ transmissions   |          |              | 1   |            |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |            |
| Antenna configuration  |          |              | 1 x 2   |            |
| Reporting interval   |          | ms           | 5   |            |
| CQI delay  |          | ms           | 10 or 11  |            |
| Reporting mode   |          |              | PUSCH 3-0   |            |
| Sub-band size  |          | RB           | 6 (full size)   |            |
| ACK/NACK feedback mode   |          |              | Multiplexing  |            |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4).<br>Note 2: Reference measurement channel RC.3 TDD according to table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. |          |              |   |            |

**Table 9.3.3.1.2-2 Minimum requirement (TDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 60       | 60       |
| $\gamma$     | 1.6      | 1.6      |
| UE Category  | $\geq 1$ | $\geq 1$ |



### 9.3.3.2 Void

#### 9.3.3.2.1 Void

#### 9.3.3.2.2 Void

## 9.3.4 UE-selected subband CQI

The accuracy of UE-selected subband channel quality indicator (CQI) reporting under frequency-selective fading conditions is determined by the relative increase of the throughput obtained when transmitting on the UE-selected subbands with the corresponding transport format compared to the case for which a fixed format is transmitted on any subband in set  $S$  of TS 36.213 [6]. The purpose is to verify that correct subbands are accurately reported for frequency-selective scheduling. To account for sensitivity of the input SNR the subband CQI reporting under frequency-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

### 9.3.4.1 Minimum requirement PUSCH 2-0 (Cell-Specific Reference Symbols)

#### 9.3.4.1.1 FDD

For the parameters specified in Table 9.3.4.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.1.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting on a randomly selected subband among the best  $M$  subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each TTI for FDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{\text{PRB}}^{(j)}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.1.1-1 Subband test for single antenna transmission (FDD)**

| Parameter  |          | Unit         | Test 1  |     | Test 2 |     |
|--|----------|--------------|---|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode  |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |     |        |     |
|  | $\rho_B$ | dB           | 0   |     |        |     |
|  | $\sigma$ | dB           | 0   |     |        |     |
| SNR (Note 3)   |          | dB           | 9   | 10  | 14     | 15  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -89   | -88 | -84    | -83 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45 \mu\text{s}$ ,<br>$a = 1$ , $f_D = 5 \text{ Hz}$ |     |        |     |
| Reporting interval   |          | ms           | 5   |     |        |     |
| CQI delay  |          | ms           | 8   |     |        |     |
| Reporting mode   |          |              | PUSCH 2-0   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| Subband size ( $k$ )   |          | RBs          | 3 (full size)   |     |        |     |
| Number of preferred subbands ( $M$ )   |          |              | 5   |     |        |     |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF# $n$ based on CQI estimation at a downlink subframe not later than SF# $(n-4)$ , this reported subband or wideband CQI cannot be applied at the eNB downlink before SF# $(n+4)$ |          |              |   |     |        |     |

|         |   |
|---------|---|
| Note 2: | Reference measurement channel RC.5 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.         |

**Table 9.3.4.1.1-2 Minimum requirement (FDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma$    | 1.2      | 1.2      |
| UE Category | $\geq 1$ | $\geq 1$ |

### 9.3.4.1.2 TDD

For the parameters specified in Table 9.3.4.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.1.2-2 and by the following

a) the ratio of the throughput obtained when transmitting on a randomly selected subband among the best  $M$  subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.1.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter                            | Unit  | Test 1  |     | Test 2 |     |
|--------------------------------------|---|---|-----|--------|-----|
| Bandwidth                            | MHz   | 10 MHz  |     |        |     |
| Transmission mode                    |   | 1 (port 0)  |     |        |     |
| Downlink power allocation            | $\rho_A$  | dB  | 0   |        |     |
|                                      | $\rho_B$  | dB  | 0   |        |     |
|                                      | $\sigma$  | dB  | 0   |        |     |
| Uplink downlink configuration        |   | 2   |     |        |     |
| Special subframe configuration       |   | 4   |     |        |     |
| SNR (Note 3)                         | dB  | 9   | 10  | 14     | 15  |
| $\hat{I}_{or}^{(j)}$                 | dB[mW/15kHz]  | -89   | -88 | -84    | -83 |
| $N_{oc}^{(j)}$                       | dB[mW/15kHz]  | -98   |     | -98    |     |
| Propagation channel                  |   | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5$ Hz |     |        |     |
| Reporting interval                   | ms  | 5   |     |        |     |
| CQI delay                            | ms  | 10 or 11  |     |        |     |
| Reporting mode                       |   | PUSCH 2-0   |     |        |     |
| Max number of HARQ transmissions     |   | 1   |     |        |     |
| Subband size ( $k$ )                 | RBs   | 3 (full size)   |     |        |     |
| Number of preferred subbands ( $M$ ) |   | 5   |     |        |     |
| ACK/NACK feedback mode               |   | Multiplexing  |     |        |     |
| Note 1:                              | If the UE reports in an available uplink reporting instance at subframe SF# $n$ based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |   |     |        |     |

|         |   |
|---------|---|
| Note 2: | Reference measurement channel RC.5 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.         |

**Table 9.3.4.1.2-2 Minimum requirement (TDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma$    | 1.2      | 1.2      |
| UE Category | $\geq 1$ | $\geq 1$ |

## 9.3.4.2 Minimum requirement PUCCH 2-0 (Cell-Specific Reference Symbols)

### 9.3.4.2.1 FDD

For the parameters specified in Table 9.3.4.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.2.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting on subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each TTI for FDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.2.1-1 Subband test for single antenna transmission (FDD)**

| Parameter                          |          | Unit         | Test 1  |     | Test 2 |     |
|------------------------------------|----------|--------------|---|-----|--------|-----|
| Bandwidth                          |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode                  |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation          | $\rho_A$ | dB           | 0   |     |        |     |
|                                    | $\rho_B$ | dB           | 0   |     |        |     |
|                                    | $\sigma$ | dB           | 0   |     |        |     |
| SNR (Note 3)                       |          | dB           | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$               |          | dB[mW/15kHz] | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$                     |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel                |          |              | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5$ Hz |     |        |     |
| Reporting periodicity              |          | ms           | $N_P = 2$   |     |        |     |
| CQI delay                          |          | ms           | 8   |     |        |     |
| Physical channel for CQI reporting |          |              | PUSCH (Note 4)  |     |        |     |
| PUCCH Report Type for wideband CQI |          |              | 4   |     |        |     |
| PUCCH Report Type for subband CQI  |          |              | 1   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| Subband size ( $k$ )               |          | RBs          | 6 (full size)   |     |        |     |
| Number of bandwidth parts ( $J$ )  |          |              | 3   |     |        |     |
| K                                  |          |              | 1   |     |        |     |
| $cqi-pmi-ConfigIndex$              |          |              | 1   |     |        |     |

|         |  |
|---------|--|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |
| Note 2: | Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.  |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 4: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3. |
| Note 5: | CQI reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and data scheduling according to the most recent subband CQI report for bandwidth part with j=1.  |
| Note 6: | In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report.  |

**Table 9.3.4.2.1-2 Minimum requirement (FDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma$    | 1.15     | 1.15     |
| UE Category | $\geq 1$ | $\geq 1$ |

### 9.3.4.2.2 TDD

For the parameters specified in Table 9.3.4.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.2.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting on subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set  $S$  shall be  $\geq \gamma$ ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.2.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter                      |          | Unit         | Test 1  |     | Test 2 |     |
|--------------------------------|----------|--------------|---|-----|--------|-----|
| Bandwidth                      |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode              |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation      | $\rho_A$ | dB           | 0   |     |        |     |
|                                | $\rho_B$ | dB           | 0   |     |        |     |
|                                | $\sigma$ | dB           | 0   |     |        |     |
| Uplink downlink configuration  |          |              | 2   |     |        |     |
| Special subframe configuration |          |              | 4   |     |        |     |
| SNR (Note 3)                   |          | dB           | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$           |          | dB[mW/15kHz] | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$                 |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel            |          |              | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5 \text{ Hz}$ |     |        |     |

|                                    |  |                |
|------------------------------------|--|----------------|
| Reporting periodicity              | ms   | $N_P = 5$      |
| CQI delay                          | ms   | 10 or 11       |
| Physical channel for CQI reporting |  | PUSCH (Note 4) |
| PUCCH Report Type for wideband CQI |  | 4              |
| PUCCH Report Type for subband CQI  |  | 1              |
| Max number of HARQ transmissions   |  | 1              |
| Subband size ( $k$ )               | RBs  | 6 (full size)  |
| Number of bandwidth parts ( $J$ )  |  | 3              |
| $K$                                |  | 1              |
| <i>cqi-pmi-ConfigIndex</i>         |  | 3              |
| ACK/NACK feedback mode             |  | Multiplexing   |
| Note 1:                            | If the UE reports in an available uplink reporting instance at subframe SF# $n$ based on CQI estimation at a downlink subframe not later than SF#( $n-4$ ), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#( $n+4$ ).                 |                |
| Note 2:                            | Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.  |                |
| Note 3:                            | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                |
| Note 4:                            | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |                |
| Note 5:                            | CQI reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and data scheduling according to the most recent subband CQI report for bandwidth part with $j=1$ .   |                |
| Note 6:                            | In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report.  |                |

**Table 9.3.4.2.2-2 Minimum requirement (TDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma$    | 1.15     | 1.15     |
| UE Category | $\geq 1$ | $\geq 1$ |

## 9.3.5 Additional requirements for enhanced receiver Type A

The purpose of the test is to verify that the reporting of the channel quality is based on the receiver of the enhanced Type A. Performance requirements are specified in terms of the relative increase of the throughput obtained when the transport format is that indicated by the reported CQI subject to an interference model compared to the case with a white Gaussian noise model, and a requirement on the minimum BLER of the transmitted transport formats indicated by the reported CQI subject to an interference model.

### 9.3.5.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)

#### 9.3.5.1.1 FDD

For the parameters specified in Table 9.3.5.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.5.1.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.1.1-1 Fading test for single antenna (FDD)**

| Parameter  | Unit         | Cell 1         | Cell 2          |
|--|--------------|----------------|-----------------|
| Bandwidth  | MHz          | 10 MHz         |                 |
| Transmission mode  |              | 1 (port 0)     |                 |
| Cyclic Prefix  |              | Normal         | Normal          |
| Cell ID  |              | 0              | 1               |
| SINR (Note 8)  | dB           | -2             | N/A             |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98            | N/A             |
| Propagation channel  |              | EPA5           | Static (Note 7) |
| Correlation and antenna configuration  |              | Low (1 x 2)    | (1 x 2)         |
| DIP (Note 4)   | dB           | N/A            | -0.41           |
| Reference measurement channel  |              | Note 2         | R.2 FDD         |
| Reporting mode   |              | PUCCH 1-0      | N/A             |
| Reporting periodicity  | ms           | $N_{pd} = 2$   | N/A             |
| CQI delay  | ms           | 8              | N/A             |
| Physical channel for CQI reporting   |              | PUSCH (Note 3) | N/A             |
| PUCCH Report Type  |              | 4              | N/A             |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 1              | N/A             |
| Max number of HARQ transmissions   |              | 1              | N/A             |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNB Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNB Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> <p>Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.</p> <p>Note 8: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> |              |                |                 |

**Table 9.3.5.1.1-2 Minimum requirement (FDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

## 9.3.5.1.2 TDD

For the parameters specified in Table 9.3.5.1.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.5.1.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.1.2-1 Fading test for single antenna (TDD)**

| Parameter   | Unit         | Cell 1         | Cell 2          |
|---|--------------|----------------|-----------------|
| Bandwidth   | MHz          | 10 MHz         |                 |
| Transmission mode   |              | 1 (port 0)     |                 |
| Uplink downlink configuration   |              | 2              |                 |
| Special subframe configuration  |              | 4              |                 |
| Cyclic Prefix   |              | Normal         | Normal          |
| Cell ID   |              | 0              | 1               |
| SINR (Note 8)   | dB           | -2             | N/A             |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98            | -98             |
| Propagation channel   |              | EPA5           | Static (Note 7) |
| Correlation and antenna configuration   |              | Low (1 x 2)    | (1 x 2)         |
| DIP (Note 4)  | dB           | N/A            | -0.41           |
| Reference measurement channel   |              | Note 2         | R.2A TDD        |
| Reporting mode  |              | PUCCH 1-0      | N/A             |
| Reporting periodicity   | ms           | $N_{pd} = 5$   | N/A             |
| CQI delay   | ms           | 10 or 11       | N/A             |
| Physical channel for CQI reporting  |              | PUSCH (Note 3) | N/A             |
| PUCCH Report Type   |              | 4              | N/A             |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 3              | N/A             |
| Max number of HARQ transmissions  |              | 1              | N/A             |
| ACK/NACK feedback mode  |              | Multiplexing   | N/A             |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> |              |                |                 |

|         |  |
|---------|--|
| Note 7: | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present. |
| Note 8: | SINR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                                 |

**Table 9.3.5.1.2-2 Minimum requirement (TDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

### 9.3.5.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

#### 9.3.5.2.1 FDD

For the parameters specified in Table 9.3.5.2.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.5.2.1-2 and by the following

- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.2.1-1 Fading test for two antennas (FDD)**

| Parameter  | Unit                  | Cell 1                                      | Cell 2                     |
|--|-----------------------|---|----------------------------|
| Bandwidth  | MHz                   | 10 MHz                                      |                            |
| Transmission mode  |                       | 9   |                            |
| Cyclic Prefix  |                       | Normal                                      | Normal                     |
| Cell ID  |                       | 0   | 1                          |
| SINR (Note 8)  | dB                    | -2  | N/A                        |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]          | -98   | N/A                        |
| Propagation channel  |                       | EPA5  | Static (Note 7)            |
| Correlation and antenna configuration  |                       | Low (2 x 2)                                 | (1 x 2)                    |
| Beamforming Model  |                       | As specified in Section B.4.3 (Note 10, 11) | N/A                        |
| DIP (Note 4)   | dB                    | N/A   | -0.41                      |
| Cell-specific reference signals  |                       | Antenna ports 0,1                           | Antenna port 0             |
| CSI reference signals  |                       | Antenna ports 15,16                         | N/A                        |
| CSI-RS periodicity and subframe offset   |                       | 5/1   | N/A                        |
| CSI-RS reference signal configuration  |                       | 2   | N/A                        |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS}$ /<br>ZeroPowerCSI-RS<br>bitmap | Subframes /<br>bitmap | N/A   | 1 /<br>001000000000<br>000 |
| CodeBookSubsetRestriction bitmap   |                       | 001111                                      | N/A                        |
| Reference measurement channel  |                       | Note 2                                      | R.2 FDD                    |
| Reporting mode   |                       | PUCCH 1-1                                   | N/A                        |
| Reporting periodicity  | ms                    | $N_{pd} = 5$                                | N/A                        |
| CQI delay  | ms                    | 8   | N/A                        |



|  |  |                |     |
|--|--|----------------|-----|
| Physical channel for CQI/PMI reporting   |  | PUSCH (Note 3) | N/A |
| PUCCH Report Type for CQI/PMI  |  | 2              | N/A |
| PUCCH channel for RI reporting   |  | PUCCH Format 2 | N/A |
| PUCCH Report Type for RI   |  | 3              | N/A |
| <i>cqi-pmi-ConfigurationIndex</i>  |  | 2              | N/A |
| <i>ri-ConfigIndex</i>  |  | 1              | N/A |
| Max number of HARQ transmissions   |  | 1              | N/A |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.11 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> <p>Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.</p> <p>Note 8: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> <p>Note 9: N/A.</p> <p>Note 10: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 11: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> |  |                |     |

**Table 9.3.5.2.1-2 Minimum requirement (FDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 2$ |

9.3.5.2.2 TDD

For the parameters specified in Table 9.3.5.2.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.5.2.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.2.2-1 Fading test for single antenna (TDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|-----------|------|--------|--------|
| Bandwidth | MHz  | 10 MHz |        |

|  |                       |   |                             |
|--|-----------------------|---|-----------------------------|
| Transmission mode  |                       | 9   |                             |
| Uplink downlink configuration  |                       | 2   |                             |
| Special subframe configuration   |                       | 4   |                             |
| Cyclic Prefix  |                       | Normal                                      | Normal                      |
| Cell ID  |                       | 0   | 1                           |
| SINR (Note 8)  | dB                    | -2  | N/A                         |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]          | -98   | -98                         |
| Propagation channel  |                       | EPA5  | Static (Note 7)             |
| Correlation and antenna configuration  |                       | Low (2 x 2)                                 | (1 x 2)                     |
| Beamforming Model  |                       | As specified in Section B.4.3 (Note 11, 12) | N/A                         |
| DIP (Note 4)   | dB                    | N/A   | -0.41                       |
| Cell-specific reference signals  |                       | Antenna ports 0,1                           | Antenna port 0              |
| CSI reference signals  |                       | Antenna ports 15,16                         | N/A                         |
| CSI-RS periodicity and subframe offset   |                       | 5/3   | N/A                         |
| CSI-RS reference signal configuration  |                       | 2   | N/A                         |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS}$ /<br>ZeroPowerCSI-RS<br>bitmap   | Subframes /<br>bitmap | N/A   | 3 /<br>001000000000<br>0000 |
| CodeBookSubsetRestriction bitmap   |                       | 001111                                      | N/A                         |
| Reference measurement channel  |                       | Note 2                                      | R.2A TDD                    |
| Reporting mode   |                       | PUCCH 1-1                                   | N/A                         |
| Reporting periodicity  | ms                    | $N_{pd} = 5$                                | N/A                         |
| CQI delay  | ms                    | 10  | N/A                         |
| Physical channel for CQI/PMI reporting   |                       | PUSCH (Note 3)                              | N/A                         |
| PUCCH Report Type for CQI/PMI  |                       | 2   | N/A                         |
| Physical channel for RI reporting  |                       | PUCCH Format 2                              | N/A                         |
| PUCCH Report Type for RI   |                       | 3   | N/A                         |
| $cqi-pmi-ConfigurationIndex$   |                       | 3   | N/A                         |
| $ri-ConfigIndex$   |                       | 805 (Note 9)                                | N/A                         |
| Max number of HARQ transmissions   |                       | 1   | N/A                         |
| ACK/NACK feedback mode   |                       | Multiplexing                                | N/A                         |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#2 and #7.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> |                       |   |                             |

|          |   |
|----------|---|
| Note 5:  | Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Interfering cell is fully loaded.  |
| Note 6:  | Both cells are time-synchronous.  |
| Note 7:  | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.  |
| Note 8:  | SINR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.  |
| Note 9:  | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 10: | N/A.  |
| Note 11: | The precoder in clause B.4.3 follows UE recommended PMI.  |
| Note 12: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).   |

**Table 9.3.5.2.2-2 Minimum requirement (TDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 2$ |

### 9.3.6 Minimum requirement (With multiple CSI processes)

The purpose of the test is to verify the reporting accuracy of the CQI and the UE processing capability for multiple CSI processes. Each CSI process is associated with a CSI-RS resource and a CSI-IM resource as shown in Table 9.3.6-1. For UE supports one CSI process, CSI process 2 is configured and the corresponding requirements shall be fulfilled. For UE supports three CSI processes, CSI processes 0, 1 and 2 are configured and the corresponding requirements shall be fulfilled. For UE supports four CSI processes, CSI processes 0, 1, 2 and 3 are configured and the corresponding requirements shall be fulfilled.

**Table 9.3.6-1: Configuration of CSI processes**

|                 | CSI process 0     | CSI process 1     | CSI process 2     | CSI process 3     |
|-----------------|-------------------|-------------------|-------------------|-------------------|
| CSI-RS resource | CSI-RS signal 0   | CSI-RS signal 1   | CSI-RS signal 0   | CSI-RS signal 1   |
| CSI-IM resource | CSI-IM resource 0 | CSI-IM resource 0 | CSI-IM resource 1 | CSI-IM resource 2 |

#### 9.3.6.1 FDD

For the parameters specified in Table 9.3.6.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.6.1-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  for each sub-band for CSI process 1, 2, or 3;
- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\delta\%$  of the time for CSI process 0;
- the difference of the median CQIs of the reported wideband CQI for configured CSI processes shall be greater or equal to the values as in Table 9.3.6.1-3;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;

- e) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.6.1-1: Fading test for FDD**

| Parameter   | Unit                             | Test 1                        |     |  |     | Test 2                        |     |  |     |
|---|----------------------------------|-------------------------------|-----|--|-----|-------------------------------|-----|--|-----|
|   |                                  | TP1                           |     | TP2  |     | TP1                           |     | TP2  |     |
| Bandwidth   | MHz                              | 10 MHz                        |     |  |     | 10 MHz                        |     |  |     |
| Transmission mode   |                                  | 10                            |     | 10   |     | 10                            |     | 10   |     |
| Downlink power allocation   | $\rho_A$                         | 0                             |     |  |     | 0                             |     |  |     |
|   | $\rho_B$                         | 0                             |     |  |     | 0                             |     |  |     |
|   | $P_C$                            | -3                            |     | 0  |     | -3                            |     | 0  |     |
|   | $\sigma$                         | -3                            |     |  |     | -3                            |     |  |     |
| SNR (Note 7)  | dB                               | 10                            | 11  | 7  | 8   | 14                            | 15  | 9  | 10  |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz]                     | -88                           | -87 | -91  | -90 | -84                           | -85 | -89  | -88 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz]                     | -98                           |     |  |     | -98                           |     |  |     |
| Propagation channel   |                                  | EPA 5 Low                     |     | Clause B.2.4.1 with $\tau_d = 0.45 \mu s, a = 1, f_D = 5$ Hz |     | EPA 5 Low                     |     | Clause B.2.4.1 with $\tau_d = 0.45 \mu s, a = 1, f_D = 5$ Hz |     |
| Antenna configuration   |                                  | 4x2                           |     | 2x2  |     | 4x2                           |     | 2x2  |     |
| Beamforming Model   |                                  | As specified in Section B.4.3 |     |  |     | As specified in Section B.4.3 |     |  |     |
| Timing offset between TPs   | us                               | 0                             |     |  |     | 0                             |     |  |     |
| Frequency offset between TPs  | Hz                               | 0                             |     |  |     | 0                             |     |  |     |
| Cell-specific reference signals   |                                  | Antenna ports 0,1             |     |  |     | Antenna ports 0,1             |     |  |     |
| CSI-RS signal 0   |                                  | Antenna ports 15,...,18       |     | N/A  |     | Antenna ports 15,...,18       |     | N/A  |     |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                                  | 5/1                           |     | N/A  |     | 5/1                           |     | N/A  |     |
| CSI-RS 0 configuration  |                                  | 0                             |     | N/A  |     | 0                             |     | N/A  |     |
| CSI-RS signal 1   |                                  | N/A                           |     | Antenna ports 15,16  |     | N/A                           |     | Antenna ports 15,16  |     |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                                  | N/A                           |     | 5/1  |     | N/A                           |     | 5/1  |     |
| CSI-RS 1 configuration  |                                  | N/A                           |     | 5  |     | N/A                           |     | 5  |     |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                                  | N/A                           |     | 1 / 111000000000 0000  |     | N/A                           |     | 1 / 111000000000 0000  |     |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                                  | 1 / 00100110000 00000         |     | N/A  |     | 1 / 00100110000 00000         |     | N/A  |     |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-IM} / \Delta_{CSI-IM}$ |                                  | 5/1                           |     | 5/1  |     | 5/1                           |     | 5/1  |     |
| CSI-IM 0 configuration  |                                  | 2                             |     | 2  |     | 2                             |     | 2  |     |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-IM} / \Delta_{CSI-IM}$ |                                  | 5/1                           |     | N/A  |     | 5/1                           |     | N/A  |     |
| CSI-IM 1 configuration  |                                  | 6                             |     | N/A  |     | 6                             |     | N/A  |     |
| CSI-IM 2 periodicity and subframe offset $T_{CSI-IM} / \Delta_{CSI-IM}$ |                                  | N/A                           |     | 5/1  |     | N/A                           |     | 5/1  |     |
| CSI-IM 2 configuration  |                                  | N/A                           |     | 1  |     | N/A                           |     | 1  |     |
| CSI process 0   | CSI-RS                           | CSI-RS 0                      |     |  |     | CSI-RS 0                      |     |  |     |
|   | CSI-IM                           | CSI-IM 0                      |     |  |     | CSI-IM 0                      |     |  |     |
|   | Reporting mode                   | PUCCH 1-1                     |     |  |     | PUCCH 1-1                     |     |  |     |
|   | CodeBookSubsetRestriction bitmap | 0x0000 0000 0000 0001         |     |  |     | 0x0000 0000 0000 0001         |     |  |     |

|   |   |    |                        |                        |                        |                        |
|---|---|----|------------------------|------------------------|------------------------|------------------------|
|   | Reporting periodicity   | ms | $N_{pd} = 5$           |                        | $N_{pd} = 5$           |                        |
|   | CQI delay   | ms | 11                     |                        | 11                     |                        |
|   | Physical channel for CQI/ PMI reporting   |    | PUSCH (Note 6)         |                        | PUSCH (Note 6)         |                        |
|   | PUCCH Report Type for CQI/PMI   |    | 2                      |                        | 2                      |                        |
|   | PUCCH channel for RI reporting  |    | PUCCH Format 2         |                        | PUCCH Format 2         |                        |
|   | PUCCH report type for RI  |    | 3                      |                        | 3                      |                        |
|   | <i>cqi-pmi-ConfigurationIndex</i>   |    | 4                      |                        | 4                      |                        |
|   | <i>ri-ConfigIndex</i>   |    | 2                      |                        | 2                      |                        |
| CSI process 1                                       | CSI-RS  |    | CSI-RS 1               |                        | CSI-RS 1               |                        |
|   | CSI-IM  |    | CSI-IM 0               |                        | CSI-IM 0               |                        |
|   | Reporting mode  |    | PUSCH 3-1              |                        | PUSCH 3-1              |                        |
|   | CodeBookSubsetRestriction bitmap  |    | 000001                 |                        | 000001                 |                        |
|   | Reporting interval (Note 10)  | ms | 5                      |                        | 5                      |                        |
|   | CQI delay   | ms | 11                     |                        | 11                     |                        |
|   | Sub-band size   | RB | 6 (full size)          |                        | 6 (full size)          |                        |
| CSI process 2<br>(For UE configured single process) | CSI-RS  |    | CSI-RS 0               |                        | CSI-RS 0               |                        |
|   | CSI-IM  |    | CSI-IM 1               |                        | CSI-IM 1               |                        |
|   | Reporting mode  |    | PUSCH 3-1              |                        | PUSCH 3-1              |                        |
|   | CodeBookSubsetRestriction bitmap  |    | 0x0000 0000 0000 0001  |                        | 0x0000 0000 0000 0001  |                        |
|   | Reporting interval (Note 8)   | ms | 5                      |                        | 5                      |                        |
|   | CQI delay   | ms | 8                      |                        | 8                      |                        |
|   | Sub-band size   | RB | 6 (full size) (Note 9) |                        | 6 (full size) (Note 9) |                        |
| CSI process 3                                       | CSI-RS  |    | CSI-RS 1               |                        | CSI-RS 1               |                        |
|   | CSI-IM  |    | CSI-IM 2               |                        | CSI-IM 2               |                        |
|   | Reporting mode  |    | PUSCH 3-1              |                        | PUSCH 3-1              |                        |
|   | CodeBookSubsetRestriction bitmap  |    | 000001                 |                        | 000001                 |                        |
|   | Reporting interval (Note 10)  | ms | 5                      |                        | 5                      |                        |
|   | CQI delay   | ms | 11                     |                        | 11                     |                        |
|   | Sub-band size   | RB | 6 (full size)          |                        | 6 (full size)          |                        |
| CSI process for PDSCH scheduling                    |   |    | CSI process 2          |                        | CSI process 2          |                        |
| Cell ID   |   |    | 0                      | 6                      | 0                      | 6                      |
| Quasi-co-located CSI-RS                             |   |    | CSI-RS 0               | CSI-RS 1               | CSI-RS 0               | CSI-RS 1               |
| Quasi-co-located CRS                                |   |    | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 |
| PMI for subframe 2, 3, 4, 7, 8 and 9                |   |    | 0x0000 0000 0000 0001  | 100000                 | 0x0000 0000 0000 0001  | 100000                 |
| PMI for subframe 1 and 6                            |   |    | 0x0000 0000 0001 0000  | 100000                 | 0x0000 0000 0001 0000  | 100000                 |
| Max number of HARQ transmissions                    |   |    | 1                      | N/A                    | 1                      | N/A                    |
| Note 1:   | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |    |                        |                        |                        |                        |
| Note 2:   | 3 symbols allocated to PDCCH  |    |                        |                        |                        |                        |
| Note 3:   | Reference measurement channel RC.12 FDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 2, 3, 4, 7, 8 and 9 from TP1.   |    |                        |                        |                        |                        |
| Note 4:   | TM10 OCNG OP.8 FDD as specified in A.5.1.8 is transmitted on subframe 1 and 6 from TP1.   |    |                        |                        |                        |                        |
| Note 5:   | TM10 OCNG OP.8 FDD as specified in A.5.1.8 is transmitted on subframe 1, 2, 3, 4, 6, 7, 8 and 9 from TP2  |    |                        |                        |                        |                        |
| Note 6:   | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#2 and #7. |    |                        |                        |                        |                        |
| Note 7:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |    |                        |                        |                        |                        |
| Note 8:   | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.   |    |                        |                        |                        |                        |
| Note 9:   | For these sub-bands which are not selected for PDSCH transmission, TM10 OCNG should be transmitted.   |    |                        |                        |                        |                        |

Note 10: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#2 and #7 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#1 and #6.

**Table 9.3.6.1-2: Minimum requirement (FDD)**

|              | CSI process 0 | CSI process 1 | CSI process 2 | CSI process 3 |
|--------------|---------------|---------------|---------------|---------------|
| $\alpha$ [%] | N/A           | 2             | 2             | 2             |
| $\beta$ [%]  | N/A           | 40            | 40            | 40            |
| $\delta$ [%] | 10            | N/A           | N/A           | N/A           |
| $\gamma$     | N/A           | N/A           | 1.02          | N/A           |
| UE Category  | $\geq 1$      |               |               |               |

**Table 9.3.6.1-3: Minimum median CQI difference between configured CSI processes (FDD)**

|               | CSI process 1 | CSI process 2 | CSI process 3 |
|---------------|---------------|---------------|---------------|
| CSI process 0 | N/A           | 1             | 3             |
| UE Category   | $\geq 1$      |               |               |

### 9.3.6.2 TDD

For the parameters specified in Table 9.3.6.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.6.2-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band for CSI process 1, 2, or 3;
- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\delta$  % of the time for CSI process 0;
- the difference of the median CQIs of the reported wideband CQI for configured CSI processes shall be greater or equal to the values as in Table 9.3.6.2-3;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

**Table 9.3.6.2-1: Fading test for TDD**

| Parameter                      | Unit         | Test 1 |     |     |     | Test 2 |     |     |     |
|--------------------------------|--------------|--------|-----|-----|-----|--------|-----|-----|-----|
|                                |              | TP1    |     | TP2 |     | TP1    |     | TP2 |     |
| Bandwidth                      | MHz          | 10 MHz |     |     |     | 10 MHz |     |     |     |
| Transmission mode              |              | 10     |     | 10  |     | 10     |     | 10  |     |
| Uplink downlink configuration  |              | 2      |     | 2   |     | 2      |     | 2   |     |
| Special subframe configuration |              | 4      |     | 4   |     | 4      |     | 4   |     |
| Downlink power allocation      | $\rho_A$     | 0      |     |     |     | 0      |     |     |     |
|                                | $\rho_B$     | 0      |     |     |     | 0      |     |     |     |
|                                | $P_c$        | -3     |     | 0   |     | -3     |     | 0   |     |
|                                | $\sigma$     | -3     |     |     |     | -3     |     |     |     |
| SNR (Note 7)                   | dB           | 10     | 11  | 7   | 8   | 14     | 15  | 9   | 10  |
| $\hat{I}_{or}^{(j)}$           | dB[mW/15kHz] | -88    | -87 | -91 | -90 | -84    | -85 | -89 | -88 |

| $N_{oc}^{(j)}$  | dB[mW/15kHz]                            | -98                           |  | -98                           |  |
|---|---|-------------------------------|--|-------------------------------|--|
| Propagation channel   |   | EPA 5 Low                     | Clause B.2.4.1 with $\tau_d = 0.45 \mu\text{s}$ , $a = 1$ , $f_D = 5 \text{ Hz}$ | EPA 5 Low                     | Clause B.2.4.1 with $\tau_d = 0.45 \mu\text{s}$ , $a = 1$ , $f_D = 5 \text{ Hz}$ |
| Antenna configuration   |   | 4x2                           | 2x2  | 4x2                           | 2x2  |
| Beamforming Model   |   | As specified in Section B.4.3 |  | As specified in Section B.4.3 |  |
| Timing offset between TPs   | us                                      | 0                             |  | 0                             |  |
| Frequency offset between TPs  | Hz                                      | 0                             |  | 0                             |  |
| Cell-specific reference signals   |   | Antenna ports 0,1             |  | Antenna ports 0,1             |  |
| CSI-RS signal 0   |   | Antenna ports 15,..., 18      | N/A  | Antenna ports 15,..., 18      | N/A  |
| CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   | 5/3                           | N/A  | 5/3                           | N/A  |
| CSI-RS 0 configuration  |   | 0                             | N/A  | 0                             | N/A  |
| CSI-RS signal 1   |   | N/A                           | Antenna ports 15, 16   | N/A                           | Antenna ports 15, 16   |
| CSI-RS 1 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   | N/A                           | 5/3  | N/A                           | 5/3  |
| CSI-RS 1 configuration  |   | N/A                           | 5  | N/A                           | 5  |
| Zero-power CSI-RS 0 configuration $l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |   | N/A                           | 3 / 11100000000 00000  | N/A                           | 3 / 11100000000 00000  |
| Zero-power CSI-RS 1 configuration $l_{\text{CSI-RS}} / \text{ZeroPowerCSI-RS}$ bitmap |   | 3 / 00100110000 00000         | N/A  | 3 / 00100110000 00000         | N/A  |
| CSI-IM 0 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   | 5/3                           | 5/3  | 5/3                           | 5/3  |
| CSI-IM 0 configuration  |   | 2                             | 2  | 2                             | 2  |
| CSI-IM 1 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   | 5/3                           | N/A  | 5/3                           | N/A  |
| CSI-IM 1 configuration  |   | 6                             | N/A  | 6                             | N/A  |
| CSI-IM 2 periodicity and subframe offset $T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   | N/A                           | 5/3  | N/A                           | 5/3  |
| CSI-IM 2 configuration  |   | N/A                           | 1  | N/A                           | 1  |
| CSI process 0   | CSI-RS                                  | CSI-RS 0                      |  | CSI-RS 0                      |  |
|   | CSI-IM                                  | CSI-IM 0                      |  | CSI-IM 0                      |  |
|   | Reporting mode                          | PUCCH 1-1                     |  | PUCCH 1-1                     |  |
|   | CodeBookSubsetRestriction bitmap        | 0x0000 0000 0000 0001         |  | 0x0000 0000 0000 0001         |  |
|   | Reporting periodicity                   | ms                            | $N_{\text{pd}} = 5$  | ms                            | $N_{\text{pd}} = 5$  |
|   | CQI delay                               | ms                            | 12   | ms                            | 12   |
|   | Physical channel for CQI/ PMI reporting | PUSCH (Note 6)                |  | PUSCH (Note 6)                |  |
|   | PUCCH Report Type for CQI/PMI           | 2                             |  | 2                             |  |
|   | PUCCH channel for RI reporting          | PUCCH Format 2                |  | PUCCH Format 2                |  |
|   | PUCCH report type for RI                | 3                             |  | 3                             |  |
|   | $cqi-pmi-ConfigurationIndex$            | 3                             |  | 3                             |  |
| $ri-ConfigIndex$  | 805 (Note 10)                           |                               | 805 (Note 10)  |                               |  |
| CSI process 1   | CSI-RS                                  | CSI-RS 1                      |  | CSI-RS 1                      |  |
|   | CSI-IM                                  | CSI-IM 0                      |  | CSI-IM 0                      |  |
|   | Reporting mode                          | PUSCH 3-1                     |  | PUSCH 3-1                     |  |
|   | CodeBookSubsetRestriction bitmap        | 000001                        |  | 000001                        |  |
|   | Reporting interval (Note 9)             | ms                            | 5  | ms                            | 5  |
|   | CQI delay                               | ms                            | 12   | ms                            | 12   |
|   | Sub-band size                           | RB                            | 6 (full size)  |                               | 6 (full size)  |

|                                  |   |                          |                        |                          |                        |  |
|----------------------------------|---|--------------------------|------------------------|--------------------------|------------------------|--|
| CSI process 2                    | CSI-RS  |                          | CSI-RS 0               |                          | CSI-RS 0               |  |
|                                  | CSI-IM  |                          | CSI-IM 1               |                          | CSI-IM 1               |  |
|                                  | Reporting mode  |                          | PUSCH 3-1              |                          | PUSCH 3-1              |  |
|                                  | CodeBookSubsetRestriction bitmap  |                          | 0x0000 0000 0000 0001  |                          | 0x0000 0000 0000 0001  |  |
|                                  | Reporting interval (Note 9)   | ms                       | 5                      |                          | 5                      |  |
|                                  | CQI delay   | ms                       | 12                     |                          | 12                     |  |
|                                  | Sub-band size   | RB                       | 6 (full size) (Note 8) |                          | 6 (full size) (Note 8) |  |
| CSI process 3                    | CSI-RS  |                          | CSI-RS 1               |                          | CSI-RS 1               |  |
|                                  | CSI-IM  |                          | CSI-IM 2               |                          | CSI-IM 2               |  |
|                                  | Reporting mode  |                          | PUSCH 3-1              |                          | PUSCH 3-1              |  |
|                                  | CodeBookSubsetRestriction bitmap  |                          | 000001                 |                          | 000001                 |  |
|                                  | Reporting interval (Note 9)   | ms                       | 5                      |                          | 5                      |  |
|                                  | CQI delay   | ms                       | 12                     |                          | 12                     |  |
|                                  | Sub-band size   | RB                       | 6 (full size)          |                          | 6 (full size)          |  |
| CSI process for PDSCH scheduling |   |                          | CSI process 2          |                          | CSI process 2          |  |
| Cell ID                          |   | 0                        | 6                      | 0                        | 6                      |  |
| Quasi-co-located CSI-RS          |   | CSI-RS 0                 | CSI-RS 1               | CSI-RS 0                 | CSI-RS 1               |  |
| Quasi-co-located CRS             |   | Same Cell ID as Cell 1   | Same Cell ID as Cell 2 | Same Cell ID as Cell 1   | Same Cell ID as Cell 2 |  |
| PMI for subframe 4 and 9         |   | 0x0000 0000<br>0000 0001 | 100000                 | 0x0000 0000<br>0000 0001 | 100000                 |  |
| PMI for subframe 3 and 8         |   | 0x0000 0000<br>0001 0000 | 100000                 | 0x0000 0000<br>0001 0000 | 100000                 |  |
| Max number of HARQ transmissions |   | 1                        | N/A                    | 1                        | N/A                    |  |
| ACK/NACK feedback mode           |   | Multiplexing             | N/A                    | Multiplexing             | N/A                    |  |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |                          |                        |                          |                        |  |
| Note 2:                          | 3 symbols allocated to PDCCH  |                          |                        |                          |                        |  |
| Note 3:                          | Reference measurement channel RC.12 TDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 4 and 9 from TP1.   |                          |                        |                          |                        |  |
| Note 4:                          | TM10 OCNG OP.8 TDD is transmitted as specified in A.5.2.8 on subframe 3 and 8 from TP1.   |                          |                        |                          |                        |  |
| Note 5:                          | TM10 OCNG OP.8 TDD is transmitted as specified in A.5.2.8 on subframe 3, 4, 8 and 9 from TP2  |                          |                        |                          |                        |  |
| Note 6:                          | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.   |                          |                        |                          |                        |  |
| Note 7:                          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                          |                        |                          |                        |  |
| Note 8:                          | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#7 and #2.   |                          |                        |                          |                        |  |
| Note 9:                          | For these sub-bands which are not selected for PDSCH transmission, TM10 OCNG should be transmitted.   |                          |                        |                          |                        |  |
| Note 10:                         | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |                          |                        |                          |                        |  |

Table 9.3.6.2-2: Minimum requirement (TDD)

|              | CSI process 0 | CSI process 1 | CSI process 2 | CSI process 3 |
|--------------|---------------|---------------|---------------|---------------|
| $\alpha$ [%] | N/A           | 2             | 2             | 2             |
| $\beta$ [%]  | N/A           | 40            | 40            | 40            |
| $\delta$ [%] | 10            | N/A           | N/A           | N/A           |
| $\gamma$     | N/A           | N/A           | 1.02          | N/A           |
| UE Category  | ≥1            |               |               |               |

Table 9.3.6.2-3: Minimum median CQI difference between configured CSI processes (TDD)

|               | CSI process 1 | CSI process 2 | CSI process 3 |
|---------------|---------------|---------------|---------------|
| CSI process 0 | N/A           | 1             | 3             |
| UE Category   | ≥1            |               |               |



## 9.3.7 Minimum requirement PUSCH 3-2

### 9.3.7.1 FDD

For the parameters specified in Table 9.3.7.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.7.1-2 and by the following.

- the ratio of the throughput obtained when transmitting based on UE PUSCH 3-2 reported wideband CQI and subband PMI and that obtained when transmitting based on PUSCH 3-1 reported wideband CQI and wideband PMI shall be  $\geq \alpha$ ;
- The ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS based on UE PUSCH3-2 reported subband CQI and subband PMI and that obtained when transmitting on a randomly selected sub-band in set  $S$  based on PUSCH 1-2 reported wideband CQI and subband PMI shall be  $\geq \beta$ ;

The transport block sizes TBS for wideband CQI and subband CQI are selected according to RC.17 FDD for test 1 and according to RC.18 FDD for test 2.

**Table 9.3.7.1-1 Sub-band test for FDD**

| Parameter   |          | Unit         | Test 1                   |     | Test 2                             |     |
|---|----------|--------------|--------------------------|-----|------------------------------------|-----|
| Bandwidth   |          | MHz          | 10MHz                    |     |                                    |     |
| PDSCH resource allocation   |          | RB           | 50PRB                    |     | a subband, 6PRB                    |     |
| Transmission mode   |          |              | TM6                      |     | TM9                                |     |
| Downlink power allocation   | $\rho_A$ | dB           | -6                       |     | 0                                  |     |
|   | $\rho_B$ | dB           | -6                       |     | 0                                  |     |
|   | $P_c$    | dB           | -                        |     | -3                                 |     |
|   | $\sigma$ | dB           | 3                        |     | -3                                 |     |
| SNR (Note 3)  |          | dB           | 0                        | 1   | 5                                  | 6   |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -98                      | -97 | -93                                | -92 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98                      | -98 | -98                                | -98 |
| Propagation channel   |          |              | EVA5                     |     | EVA5                               |     |
| Antenna configuration   |          |              | 4x2 ULA low              |     | 4x2 XP high (Note 4)               |     |
| Beamforming Model   |          |              | -                        |     | B.4.3                              |     |
| CRS reference signals   |          |              | Antenna ports 0, 1, 2, 3 |     | Antenna ports 0, 1                 |     |
| Time offset between TX antenna (Note 5)   |          | ns           | 65                       |     | -                                  |     |
| CSI reference signals   |          |              |                          |     | Antenna ports 15, 16, 17, 18       |     |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |              | -                        |     | 5/ 1                               |     |
| CSI-RS reference signal configuration alternativeCodebookEnabledFor4TX  |          |              | -                        |     | 4                                  |     |
|   |          |              | No                       |     | Yes                                |     |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0000 0000 0000 FFFF    |     | 0x0000 0000 0000 FFFF<br>0000 FFFF |     |
| Reporting interval (Note 6)   |          | ms           | 5                        |     | 5                                  |     |
| CQI delay   |          | ms           | 8                        |     | 8                                  |     |
| Reporting mode  |          |              | PUSCH 3-2, PUSCH 3-1     |     | PUSCH 3-2, PUSCH 1-2               |     |
| Sub-band size   |          | RB           | 6 (full size)            |     | 6 (full size)                      |     |
| Max number of HARQ transmissions  |          |              | 1                        |     | 1                                  |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.17 FDD / RC.18 FDD for Test 1 / 2 according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |          |              |                          |     |                                    |     |

Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3A.4.  
 Note 5: The values of time offset are [0ns 65ns 0ns 65ns] for antenna port [0, 1, 2, 3] respectively.  
 Note 6: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.

**Table 9.3.7.1-2 Minimum requirement (FDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\alpha$    | 1.05     | -        |
| $\beta$     | -        | 1.15     |
| UE Category | $\geq 2$ | $\geq 2$ |

### 9.3.7.2 TDD

For the parameters specified in Table 9.3.7.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.7.2-2 and by the following.

- the ratio of the throughput obtained when transmitting based on UE PUSCH 3-2 reported wideband CQI and subband PMI and that obtained when transmitting based on PUSCH 3-1 reported wideband CQI and wideband PMI shall be  $\geq \alpha$ ;
- The ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS based on UE PUSCH3-2 reported subband CQI and subband PMI and that obtained when transmitting on a randomly selected sub-band in set S based on PUSCH 1-2 reported wideband CQI and subband PMI shall be  $\geq \beta$ ;

The transport block sizes TBS for wideband CQI and subband CQI are selected according to RC.17 TDD for test 1 and RC.18 TDD for test 2.

**Table 9.3.7.2-1 Sub-band test for TDD**

| Parameter   | Unit         | Test 1                   |     | Test 2                             |     |
|---|--------------|--------------------------|-----|------------------------------------|-----|
| Bandwidth   | MHz          | 10MHz                    |     |                                    |     |
| PDSCH resource allocation   | RB           | 50PRB                    |     | a subband, 6PRB                    |     |
| Transmission mode   |              | TM6                      |     | TM9                                |     |
| Uplink downlink configuration   |              | 1                        |     | 1                                  |     |
| Special subframe configuration  |              | 4                        |     | 4                                  |     |
| Downlink power allocation   | $\rho_A$     | dB                       |     | -6                                 |     |
|   | $\rho_B$     | dB                       |     | -6                                 |     |
|   | $P_c$        | dB                       |     | -                                  |     |
|   | $\sigma$     | dB                       |     | 3                                  |     |
| SNR (Note 3)  | dB           | 0                        | 1   | 5                                  | 6   |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -98                      | -97 | -93                                | -92 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98                      | -98 | -98                                | -98 |
| Propagation channel   |              | EVA5                     |     | EVA5                               |     |
| Antenna configuration   |              | 4x2 ULA low              |     | 4x2 XP high (Note 4)               |     |
| Beamforming Model   |              | -                        |     | B.4.3                              |     |
| CRS reference signals   |              | Antenna ports 0, 1, 2, 3 |     | Antenna ports 0, 1                 |     |
| Time offset between TX antenna (Note 5)                                   | ns           | 65                       |     | -                                  |     |
| CSI reference signals   |              |                          |     | Antenna ports 15, 16, 17, 18       |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  |              | -                        |     | 5/ 4                               |     |
| CSI-RS reference signal configuration<br>alternativeCodebookEnabledFor4TX |              | -                        |     | 4                                  |     |
|   |              | No                       |     | Yes                                |     |
| CodeBookSubsetRestriction bitmap  |              | 0x0000 0000 0000 FFFF    |     | 0x0000 0000 0000 FFFF<br>0000 FFFF |     |
| Reporting interval (Note 6)   | ms           | 5                        |     | 5                                  |     |

|                                  |  |                      |                      |
|----------------------------------|--|----------------------|----------------------|
| CQI delay                        | ms   | 8                    | 8                    |
| Reporting mode                   |  | PUSCH 3-2, PUSCH 3-1 | PUSCH 3-2, PUSCH 1-2 |
| Sub-band size                    | RB   | 6 (full size)        | 6 (full size)        |
| Max number of HARQ transmissions |  | 1                    | 1                    |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |                      |                      |
| Note 2:                          | Reference measurement channel RC.17 TDD / RC.18 TDD for Test 1 / 2 according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.  |                      |                      |
| Note 3:                          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                      |                      |
| Note 4:                          | Randomization of the principle beam direction shall be used as specified in B.2.3A.4.  |                      |                      |
| Note 5:                          | The values of time offset are [0ns 65ns 0ns 65ns] for antenna port [0, 1, 2, 3] respectively.  |                      |                      |
| Note 6:                          | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#3 and #8.  |                      |                      |

Table 9.3.7.2-2 Minimum requirement (TDD)

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\alpha$    | 1.05     | -        |
| $\beta$     | -        | 1.15     |
| UE Category | $\geq 2$ | $\geq 2$ |

### 9.3.8 Additional requirements for enhanced receiver Type B

The purpose of the test is to verify that the reporting of the channel quality based on the receiver of the enhanced Type B meets a minimum performance. Performance requirements are specified in terms of the relative throughput obtained when the transport format is that indicated by the reported CQI with NeighCellsInfo-r12 configured compared to the case without NeighCellsInfo-r12 configured. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the interference cells.

#### 9.3.8.1 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols)

##### 9.3.8.1.1 FDD

For the parameters specified in Table 9.3.8.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.1.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be  $\geq \gamma$ ;

Table 9.3.8.1.1-1 Fading test for FDD

| Parameter                 |          | Unit             | Cell 1 | Cell 2 | Cell 3 |
|---------------------------|----------|------------------|--------|--------|--------|
| Bandwidth                 |          | MHz              |        | 10     |        |
| Transmission mode         |          |                  |        | 4      |        |
| Downlink power allocation | $\rho_A$ | dB               |        | -3     |        |
|                           | $\rho_B$ | dB               |        | -3     |        |
|                           | $\sigma$ | dB               |        | 0      |        |
| Cyclic Prefix             |          |                  | Normal | Normal | Normal |
| Cell ID                   |          |                  | 0      | 1      | 6      |
| SNR                       |          | dB               | 8.34   | N/A    | N/A    |
| $\hat{E}_s/N_{oc}$        |          |                  | N/A    | 3.28   | 0.74   |
| $\hat{I}_{or}^{(j)}$      |          | dB<br>[mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$                  |          | dB<br>[mW/15kHz] |        | -98    |        |
| Propagation channel       |          |                  | EPA5   | EPA5   | EPA5   |

|   |                          |    |                      |                                 |                                 |
|---|--------------------------|----|----------------------|---------------------------------|---------------------------------|
| Correlation and antenna configuration   |                          |    | Low 2 x 2            | Low 2 x 2                       | Low 2 x 2                       |
| Cell-specific reference signals   |                          |    | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| Interference model  |                          |    | N/A                  | As specified in<br>clause B.6.3 | As specified in<br>clause B.6.3 |
| Reporting periodicity   |                          | ms | $N_{pd} = 5$         | N/A                             | N/A                             |
| Physical channel for CQI/PMI reporting  |                          |    | PUCCH<br>Format 2    | N/A                             | N/A                             |
| PUCCH Report Type for CQI/PMI   |                          |    | 2                    | N/A                             | N/A                             |
| PUCCH Report Type for RI  |                          |    | 3                    | N/A                             | N/A                             |
| <i>cqi-pmi-ConfigurationIndex</i>   |                          |    | 6                    | N/A                             | N/A                             |
| <i>ri-ConfigurationIndex</i>  |                          |    | 1                    | N/A                             | N/A                             |
| <i>CodeBookSubsetRestriction bitmap</i>   |                          |    | 000001               | N/A                             | N/A                             |
| Max number of HARQ transmissions  |                          |    | 1                    | N/A                             | N/A                             |
| NeighCellsInfo-r12 (Note 4)   | p-aList-r12              |    | N/A                  | {dB-6, dB-3,<br>dB0}            | {dB-6, dB-3,<br>dB0}            |
|   | transmissionModeList-r12 |    | N/A                  | {2,3,4,8,9}                     | {2,3,4,8,9}                     |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |                          |    |                      |                                 |                                 |
| Note 2: Reference measurement channel RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.   |                          |    |                      |                                 |                                 |
| Note 3: All cells are time-synchronous.   |                          |    |                      |                                 |                                 |
| Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].  |                          |    |                      |                                 |                                 |

**Table 9.3.8.1.1-2 Minimum requirement (FDD)**

|             |               |
|-------------|---------------|
|             | <b>Test 1</b> |
| $\gamma$    | 0.925         |
| UE Category | $\geq 2$      |

**9.3.8.1.2 TDD**

For the parameters specified in Table 9.3.8.1.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.8.1.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be  $\geq \gamma$ ;

**Table 9.3.8.1.2-1 Fading test for TDD**

| Parameter                             | Unit             | Cell 1    | Cell 2    | Cell 3    |
|---------------------------------------|------------------|-----------|-----------|-----------|
| Bandwidth                             | MHz              | 10        |           |           |
| Transmission mode                     |                  | 4         |           |           |
| Uplink downlink configuration         |                  | 2         |           |           |
| Special subframe configuration        |                  | 4         |           |           |
| Downlink power allocation             | $\rho_A$         | dB        | -3        |           |
|                                       | $\rho_B$         | dB        | -3        |           |
|                                       | $\sigma$         | dB        | 0         |           |
| Cyclic Prefix                         |                  | Normal    | Normal    | Normal    |
| Cell ID                               |                  | 0         | 1         | 6         |
| SNR                                   | dB               | 8.34      | N/A       | N/A       |
| $\hat{E}_s/N_{oc}$                    |                  | N/A       | 3.28      | 0.74      |
| $\hat{I}_{or}^{(j)}$                  | dB<br>[mW/15kHz] | -89.66    | -94.72    | -97.26    |
| $N_{oc}$                              | dB<br>[mW/15kHz] | -98       |           |           |
| Propagation channel                   |                  | EPA5      | EPA5      | EPA5      |
| Correlation and antenna configuration |                  | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |

|  |                                 |                      |                                 |                                 |
|--|---------------------------------|----------------------|---------------------------------|---------------------------------|
| Cell-specific reference signals  |                                 | Antenna ports<br>0,1 | Antenna ports<br>0,1            | Antenna ports<br>0,1            |
| Interference model   |                                 | N/A                  | As specified in<br>clause B.6.3 | As specified in<br>clause B.6.3 |
| Reporting periodicity  |                                 | ms                   | $N_{pd} = 5$                    | N/A                             |
| Physical channel for CQI/PMI reporting   |                                 | PUSCH<br>(Note 3)    | N/A                             | N/A                             |
| PUCCH Report Type  |                                 | 2                    | N/A                             | N/A                             |
| <i>cqi-pmi-ConfigurationIndex</i>  |                                 | 3                    | N/A                             | N/A                             |
| <i>ri-ConfigIndex</i>  |                                 | 805 (Note 5)         | N/A                             | N/A                             |
| <i>CodeBookSubsetRestriction bitmap</i>  |                                 | 000001               | N/A                             | N/A                             |
| Max number of HARQ transmissions   |                                 | 1                    | N/A                             | N/A                             |
| ACK/NACK feedback mode   |                                 | Multiplexing         | N/A                             | N/A                             |
| NeighCellsInfo-r12 (Note 6)  | <i>p-aList-r12</i>              | N/A                  | {dB-6, dB-3, dB0}               | {dB-6, dB-3, dB0}               |
|  | <i>transmissionModeList-r12</i> | N/A                  | {2,3,4,8,9}                     | {2,3,4,8,9}                     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> <p>Note 4: All cells are time-synchronous.</p> <p>Note 5: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.</p> <p>Note 6: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].</p> |                                 |                      |                                 |                                 |

**Table 9.3.8.1.2-2 Minimum requirement (TDD)**

|             |               |
|-------------|---------------|
|             | <b>Test 1</b> |
| $\gamma$    | 0.925         |
| UE Category | $\geq 2$      |

9.3.8.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbols)

9.3.8.2.1 FDD

For the parameters specified in Table 9.3.8.2.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.2.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be  $\geq \gamma$ ;

**Table 9.3.8.2.1-1 Fading test for FDD**

| Parameter                 |          | Unit | Cell 1 | Cell 2 | Cell 3 |
|---------------------------|----------|------|--------|--------|--------|
| Bandwidth                 |          | MHz  |        | 10     |        |
| Transmission mode         |          |      |        | 9      |        |
| Downlink power allocation | $\rho_A$ | dB   |        | 0      |        |
|                           | $\rho_B$ | dB   |        | 0      |        |
|                           | $P_c$    | dB   |        | 0      |        |
|                           | $\sigma$ | dB   |        | 0      |        |
| Cyclic Prefix             |          |      | Normal | Normal | Normal |
| Cell ID                   |          |      | 0      | 1      | 6      |

|  |                             |                               |                                 |                                 |
|--|-----------------------------|-------------------------------|---------------------------------|---------------------------------|
| SNR  | dB                          | 8.34                          | N/A                             | N/A                             |
| $\hat{E}_s/N_{oc}$   |                             | N/A                           | 3.28                            | 0.74                            |
| $\hat{I}_{or}^{(j)}$   | dB<br>[mW/15kHz]            | -89.66                        | -94.72                          | -97.26                          |
| $N_{oc}$   | dB<br>[mW/15kHz]            | -98                           |                                 |                                 |
| Propagation channel  |                             | EPA5                          | EPA5                            | EPA5                            |
| Correlation and antenna configuration  |                             | Low 2 x 2                     | Low 2 x 2                       | Low 2 x 2                       |
| Cell-specific reference signals  |                             | Antenna ports 0,1             | Antenna ports 0,1               | Antenna ports 0,1               |
| Beamforming Model  |                             | As specified in Section B.4.3 |                                 |                                 |
| CSI reference signals  |                             | Antenna ports<br>15,16        | N/A                             | N/A                             |
| CSI-RS periodicity and subframe offset   |                             | 5/1                           | N/A                             | N/A                             |
| CSI-RS reference signal configuration  |                             | 2                             | N/A                             | N/A                             |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$<br>bitmap  | Subframes /<br>bitmap       | N/A                           | 1 /<br>00010000000000<br>00     | 1 /<br>00010000000000<br>00     |
| CodeBookSubsetRestriction<br>bitmap  |                             | 000001                        | N/A                             | N/A                             |
| Interference model   |                             | N/A                           | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| Reporting periodicity  | ms                          | $N_{pd} = 5$                  | N/A                             | N/A                             |
| Physical channel for CQI/PMI<br>reporting  |                             | PUSCH (Note 3)                | N/A                             | N/A                             |
| PUCCH Report Type for<br>CQI/PMI   |                             | 2                             | N/A                             | N/A                             |
| PUCCH channel for RI<br>reporting  |                             | PUCCH Format 2                | N/A                             | N/A                             |
| PUCCH Report Type for RI   |                             | 3                             | N/A                             | N/A                             |
| $cqi-pmi-ConfigurationIndex$   |                             | 2                             | N/A                             | N/A                             |
| $ri-ConfigIndex$   |                             | 1                             | N/A                             | N/A                             |
| Max number of HARQ<br>transmissions  |                             | 1                             | N/A                             | N/A                             |
| NeighCellsInfo-<br>r12 (Note 5)  | p-aList-r12<br>transmission | N/A                           | {dB-6, dB-3, dB0}               | {dB-6, dB-3, dB0}               |
|  | ModeList-r12                | N/A                           | {2,3,4,8,9}                     | {2,3,4,8,9}                     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.11 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.</p> <p>Note 4: All cells are time-synchronous.</p> <p>Note 5: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].</p> |                             |                               |                                 |                                 |

**Table 9.3.8.2.1-2 Minimum requirement (FDD)**

|             |               |
|-------------|---------------|
|             | <b>Test 1</b> |
| $\gamma$    | 0.925         |
| UE Category | $\geq 2$      |

9.3.8.2.2 TDD

For the parameters specified in Table 9.3.8.2.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.8.2.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when

transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be  $\geq \gamma$ ;

**Table 9.3.8.2.2-1 Fading test for TDD**

| Parameter   |                           | Unit               | Cell 1                        | Cell 2                       | Cell 3                       |
|---|---------------------------|--------------------|-------------------------------|------------------------------|------------------------------|
| Bandwidth   |                           | MHz                |                               | 10                           |                              |
| Transmission mode   |                           |                    |                               | 9                            |                              |
| Downlink power allocation   | $\rho_A$                  | dB                 |                               | 0                            |                              |
|   | $\rho_B$                  | dB                 |                               | 0                            |                              |
|   | Pc                        | dB                 |                               | 0                            |                              |
|   | $\sigma$                  | dB                 |                               | 0                            |                              |
| Uplink downlink configuration   |                           |                    |                               | 2                            |                              |
| Special subframe configuration  |                           |                    |                               | 4                            |                              |
| Cyclic Prefix   |                           |                    | Normal                        | Normal                       | Normal                       |
| Cell ID   |                           |                    | 0                             | 1                            | 6                            |
| SNR   |                           | dB                 | 8.34                          | N/A                          | N/A                          |
| $\hat{E}_s/N_{oc}$  |                           |                    | N/A                           | 3.28                         | 0.74                         |
| $\hat{I}_{or}^{(j)}$  |                           | dB [mW/15kHz]      | -89.66                        | -94.72                       | -97.26                       |
| $N_{oc}$  |                           | dB [mW/15kHz]      |                               | -98                          |                              |
| Propagation channel   |                           |                    | EPA5                          | EPA5                         | EPA5                         |
| Correlation and antenna configuration   |                           |                    | Low 2 x 2                     | Low 2 x 2                    | Low 2 x 2                    |
| Cell-specific reference signals   |                           |                    | Antenna ports 0,1             | Antenna ports 0,1            | Antenna ports 0,1            |
| Beamforming Model   |                           |                    | As specified in Section B.4.3 |                              |                              |
| CSI reference signals   |                           |                    | Antenna ports 15,16           | N/A                          | N/A                          |
| CSI-RS periodicity and subframe offset  |                           |                    | 5/3                           | N/A                          | N/A                          |
| CSI-RS reference signal configuration   |                           |                    | 2                             | N/A                          | N/A                          |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS} / ZeroPowerCSI-RS$ bitmap  |                           | Subframes / bitmap | N/A                           | 3 / 000100000000000          | 3 / 000100000000000          |
| CodeBookSubsetRestriction bitmap  |                           |                    | 000001                        | N/A                          | N/A                          |
| Interference model  |                           |                    | N/A                           | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Reporting periodicity   |                           | ms                 | $N_{pd} = 5$                  | N/A                          | N/A                          |
| Physical channel for CQI/PMI reporting  |                           |                    | PUSCH (Note 3)                | N/A                          | N/A                          |
| PUCCH Report Type for CQI/PMI   |                           |                    | 2                             | N/A                          | N/A                          |
| Physical channel for RI reporting   |                           |                    | PUCCH Format 2                | N/A                          | N/A                          |
| PUCCH Report Type for RI  |                           |                    | 3                             | N/A                          | N/A                          |
| $cqi-pmi-ConfigurationIndex$  |                           |                    | 3                             | N/A                          | N/A                          |
| $ri-ConfigIndex$  |                           |                    | 805 (Note 5)                  | N/A                          | N/A                          |
| Max number of HARQ transmissions  |                           |                    | 1                             | N/A                          | N/A                          |
| ACK/NACK feedback mode  |                           |                    | Multiplexing                  | N/A                          | N/A                          |
| NeighCellsInfo-r12 (Note 6)   | p-aList-r12               |                    | N/A                           | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|   | transmission ModeList-r12 |                    | N/A                           | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |                           |                    |                               |                              |                              |
| Note 2: Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNB Pattern OP.1 TDD as described in Annex A.5.2.1.  |                           |                    |                               |                              |                              |

Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#2 and #7.

Note 4: All cells are time-synchronous.

Note 5: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available.

Note 6: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 9.3.8.2.2-2 Minimum requirement (TDD)**

|             |               |
|-------------|---------------|
|             | <b>Test 1</b> |
| $\gamma$    | 0.925         |
| UE Category | $\geq 2$      |

**9.3.8.3 Minimum requirement with CSI process**

**9.3.8.3.1 FDD**

For the parameters specified in Table 9.3.8.3.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.3.1-2 and by the following

- a) the ratio of the throughput obtained for the Type B receiver with NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with specified  $\hat{E}_s/N_{oc}$  and that obtained for the Type B receiver without NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with the same specified  $\hat{E}_s/N_{oc}$  shall be  $\geq \gamma$ ;

**Table 9.3.8.3.1-1 Fading test for single antenna (FDD)**

| Parameter  | Unit                  | Cell 1                        | Cell 2                     | Cell 3                     |
|--|-----------------------|-------------------------------|----------------------------|----------------------------|
| Bandwidth  | MHz                   | 10                            |                            |                            |
| Transmission mode  |                       | 10                            | 9                          | 9                          |
| Downlink power allocation  | $\rho_A$              | dB                            |                            |                            |
|  | $\rho_B$              | dB                            |                            |                            |
|  | $P_C$                 | dB                            |                            |                            |
|  | $\sigma$              | dB                            |                            |                            |
| Cyclic Prefix  |                       | Normal                        | Normal                     | Normal                     |
| Cell ID  |                       | 0                             | 1                          | 6                          |
| SNR  | dB                    | 8.34                          | N/A                        | N/A                        |
| $\hat{E}_s/N_{oc}$   | dB                    | N/A                           | 3.28                       | 0.74                       |
| $\hat{I}_{or}^{(j)}$   | dB<br>[mW/15kHz]      | -89.66                        | -94.72                     | -97.26                     |
| $N_{oc}$   | dB[mW/15kHz]          | -98                           |                            |                            |
| Propagation channel  |                       | EPA5                          | EPA5                       | EPA5                       |
| Correlation and antenna configuration                                      |                       | Low 2 x 2                     | Low 2 x 2                  | Low 2 x 2                  |
| Cell-specific reference signals  |                       | Antenna ports<br>0,1          | Antenna port 0,<br>1       | Antenna port<br>0, 1       |
| Beamforming Model  |                       | As specified in Section B.4.3 |                            |                            |
| CSI reference signals  |                       | Antenna ports<br>15,16        | N/A                        | N/A                        |
| CSI-RS periodicity and subframe offset                                     |                       | 5/1                           | N/A                        | N/A                        |
| CSI-RS reference signal configuration                                      |                       | 2                             | N/A                        | N/A                        |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS}$ / $ZeroPowerCSI-RS$ bitmap | Subframes /<br>bitmap | N/A                           | 1 /<br>000100000000<br>000 | 1 /<br>0001000000<br>00000 |



|   |   |    |                        |                              |                              |
|---|---|----|------------------------|------------------------------|------------------------------|
| Interference model  |   |    | N/A                    | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI process   | CSI-RS                                  |    | CSI-RS                 | N/A                          | N/A                          |
|   | CSI-IM                                  |    | CSI-IM                 | N/A                          | N/A                          |
|   | Reporting mode                          |    | PUCCH 1-1              | N/A                          | N/A                          |
|   | CodeBookSubsetRestriction bitmap        |    | 000001                 | N/A                          | N/A                          |
|   | Reporting periodicity                   | ms | $N_{pd} = 5$           | N/A                          | N/A                          |
|   | CQI delay                               | ms | 8                      | N/A                          | N/A                          |
|   | Physical channel for CQI/ PMI reporting |    | PUSCH (Note 3)         | N/A                          | N/A                          |
|   | PUCCH Report Type for CQI/PMI           |    | 2                      | N/A                          | N/A                          |
|   | PUCCH channel for RI reporting          |    | PUCCH Format 2         | N/A                          | N/A                          |
|   | PUCCH report type for RI                |    | 3                      | N/A                          | N/A                          |
|   | <i>cqi-pmi-ConfigurationIndex</i>       |    | 2                      | N/A                          | N/A                          |
| <i>ri-ConfigIndex</i>   |   | 1  | N/A                    | N/A                          |                              |
| CSI-IM periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   |   |    | 5/1                    | N/A                          | N/A                          |
| CSI-IM configuration  |   |    | 6                      | N/A                          | N/A                          |
| CSI process for PDSCH scheduling  |   |    | CSI process            | N/A                          | N/A                          |
| Quasi-co-located CSI-RS   |   |    | CSI-RS                 | N/A                          | N/A                          |
| Quasi-co-located CRS  |   |    | Same Cell ID as Cell 1 | N/A                          | N/A                          |
| Reference measurement channel   |   |    | Note 2                 | N/A                          | N/A                          |
| Max number of HARQ transmissions  |   |    | 1                      | N/A                          | N/A                          |
| NeighCellsInfo-r12 (Note 5)   | p-aList-r12                             |    | N/A                    | {dB-6, dB-3, dB0}            | {dB-6, dB-3, dB0}            |
|   | transmissionModeList-r12                |    | N/A                    | {2,3,4,8,9}                  | {2,3,4,8,9}                  |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.11 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.</p> <p>Note 4: All cells are time-synchronous.</p> <p>Note 5: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].</p> |   |    |                        |                              |                              |

**Table 9.3.8.3.1-2 Minimum requirement (FDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 0.925    |
| UE Category | $\geq 2$ |

9.3.8.3.2 TDD

For the parameters specified in Table 9.3.8.3.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.3.2-2 and by the following

- a) the ratio of the throughput obtained for the Type B receiver with NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with specified  $\hat{E}_s/N_{oc}$  and that obtained for the Type B receiver without NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with the same specified  $\hat{E}_s/N_{oc}$  shall be  $\geq \gamma$ ;

Table 9.3.8.3.2-1 Fading test for single antenna (TDD)

| Parameter  |  | Unit                  | Cell 1                        | Cell 2                          | Cell 3                          |
|--|--|-----------------------|-------------------------------|---------------------------------|---------------------------------|
| Bandwidth  |  | MHz                   | 10                            |                                 |                                 |
| Transmission mode  |  |                       | 10                            | 9                               | 9                               |
| Downlink power allocation  | $\rho_A$                               | dB                    | 0                             |                                 |                                 |
|  | $\rho_B$                               | dB                    | 0                             |                                 |                                 |
|  | Pc                                     | dB                    | 0                             |                                 |                                 |
|  | $\sigma$                               | dB                    | 0                             |                                 |                                 |
| Uplink downlink configuration  |  |                       | 2                             |                                 |                                 |
| Special subframe configuration   |  |                       | 4                             |                                 |                                 |
| Cyclic Prefix  |  |                       | Normal                        | Normal                          | Normal                          |
| Cell ID  |  |                       | 0                             | 1                               | 6                               |
| SNR  |  | dB                    | 8.34                          | N/A                             | N/A                             |
| $\hat{E}_s/N_{oc}$   |  | dB                    | N/A                           | 3.28                            | 0.74                            |
| $\hat{I}_{or}^{(j)}$   |  | dB<br>[mW/15kHz]      | -89.66                        | -94.72                          | -97.26                          |
| $N_{oc}$   |  | dB[mW/15k<br>Hz]      | -98                           |                                 |                                 |
| Propagation channel  |  |                       | EPA5                          | EPA5                            | EPA5                            |
| Correlation and antenna configuration                                      |  |                       | Low 2 x 2                     | Low 2 x 2                       | Low 2 x 2                       |
| Cell-specific reference signals  |  |                       | Antenna ports<br>0,1          | Antenna port<br>0,1             | Antenna port<br>0,1             |
| Beamforming Model  |  |                       | As specified in Section B.4.3 |                                 |                                 |
| CSI reference signals  |  |                       | Antenna ports<br>15,16        | N/A                             | N/A                             |
| CSI-RS periodicity and subframe offset                                     |  |                       | 5/3                           | N/A                             | N/A                             |
| CSI-RS reference signal configuration                                      |  |                       | 2                             | N/A                             | N/A                             |
| Zero-power CSI-RS configuration<br>$l_{CSI-RS}$ / $ZeroPowerCSI-RS$ bitmap |  | Subframes /<br>bitmap | N/A                           | 3 /<br>000100000000<br>0000     | 3 /<br>000100000000<br>00000    |
| Interference model   |  |                       | N/A                           | As specified in<br>clause B.6.4 | As specified in<br>clause B.6.4 |
| CSI process  | CSI-RS                                 |                       | CSI-RS                        | N/A                             | N/A                             |
|  | CSI-IM                                 |                       | CSI-IM                        | N/A                             | N/A                             |
|  | Reporting mode                         |                       | PUCCH 1-1                     | N/A                             | N/A                             |
|  | CodeBookSubsetRestriction bitmap       |                       | 000001                        | N/A                             | N/A                             |
|  | Reporting periodicity                  | ms                    | $N_{pd} = 5$                  | N/A                             | N/A                             |
|  | CQI delay                              | ms                    | 8                             | N/A                             | N/A                             |
|  | Physical channel for CQI/PMI reporting |                       | PUSCH<br>(Note 3)             | N/A                             | N/A                             |
|  | PUCCH Report Type for CQI/PMI          |                       | 2                             | N/A                             | N/A                             |
|  | PUCCH channel for RI reporting         |                       | PUCCH<br>Format 2             | N/A                             | N/A                             |
|  | PUCCH report type for RI               |                       | 3                             | N/A                             | N/A                             |
|  | $cqi-pmi-ConfigurationIndex$           |                       | 3                             | N/A                             | N/A                             |
|  | $ri-ConfigIndex$                       |                       | 805 (Note 5)                  | N/A                             | N/A                             |
| CSI-IM periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$      |  |                       | 5/1                           | N/A                             | N/A                             |
| CSI-IM configuration   |  |                       | 6                             | N/A                             | N/A                             |
| CSI process for PDSCH scheduling   |  |                       | CSI process                   | N/A                             | N/A                             |
| Quasi-co-located CSI-RS  |  |                       | CSI-RS                        | N/A                             | N/A                             |
| Quasi-co-located CRS   |  |                       | Same Cell ID<br>as Cell 1     | N/A                             | N/A                             |
| Reference measurement channel  |  |                       | Note 2                        | N/A                             | N/A                             |
| Max number of HARQ transmissions   |  |                       | 1                             | N/A                             | N/A                             |
| ACK/NACK feedback mode   |  |                       | Multiplexing                  | N/A                             | N/A                             |
| NeighCellsInfo-r12 (Note 6)  | p-aList-r12                            |                       | N/A                           | {dB-6, dB-3,<br>dB0}            | {dB-6, dB-3,<br>dB0}            |
|  | transmissionModeList-r12               |                       | N/A                           | {2,3,4,8,9}                     | {2,3,4,8,9}                     |

|         |   |
|---------|---|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |
| Note 2: | Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |
| Note 3: | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.  |
| Note 4: | All cells are time-synchronous.   |
| Note 5: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 6: | NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].  |

Table 9.3.8.3.2-2 Minimum requirement (TDD)

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 0.925    |
| UE Category | $\geq 2$ |

## 9.4 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 6, transmission mode 9 with 4 TX and transmission mode 9 with 8 TX *alternativeCodebookEnabledCLASSB\_K1=TRUE* configured are specified in terms of the ratio

$$\gamma = \frac{t_{ue}}{t_{rnd}}$$

In the definition of  $\gamma$ , for PUSCH 3-1 single PMI and PUSCH 1-2 multiple PMI requirements,  $t_{rnd}$  is 60% of the maximum throughput obtained at  $SNR_{rnd}$  using random precoding, and  $t_{ue}$  the throughput measured at  $SNR_{rnd}$  with precoders configured according to the UE reports;

For the PUCCH 2-1 single PMI requirement,  $t_{rnd}$  is 60% of the maximum throughput obtained at  $SNR_{rnd}$  using random precoding on a randomly selected full-size subband in set S subbands, and  $t_{ue}$  the throughput measured at  $SNR_{rnd}$  with both the precoder and the preferred full-size subband applied according to the UE reports;

For PUSCH 2-2 multiple PMI requirements,  $t_{rnd}$  is 60% of the maximum throughput obtained at  $SNR_{rnd}$  using random precoding on a randomly selected full-size subband in set S subbands, and  $t_{ue}$  the throughput measured at  $SNR_{rnd}$  with both the subband precoder and a randomly selected full-size subband (within the preferred subbands) applied according to the UE reports.

For PUCCH 1-1 single PMI requirement under transmission mode 9 with 4Tx and 8 TX when *alternativeCodebookEnabledCLASSB\_K1=TRUE* configured,  $t_{ue}$  is 70% of the maximum throughput obtained at  $SNR_{follow}$  using the precoders configured according to the UE reports, and  $t_{rnd}$  is the throughput measured at  $SNR_{follow}$  with random precoding.

The requirements for transmission mode 9 with 8 TX and transmission mode 9 with 4TX enhanced codebook are specified in terms of the ratio

$$\gamma = \frac{t_{ue, follow 1, follow 2}}{t_{rnd 1, rnd 2}}$$

In the definition of  $\gamma$ , for PUSCH 3-1 single PMI, PUCCH 1-1 single PMI and PUSCH 1-2 multiple PMI requirements,  $t_{follow 1, follow 2}$  is 70% of the maximum throughput obtained at  $SNR_{follow 1, follow 2}$  using the precoders configured according to the UE reports, and  $t_{rnd 1, rnd 2}$  is the throughput measured at  $SNR_{follow 1, follow 2}$  with random precoding.

The requirements for transmission mode 9 with 12 TX, 16 TX, 24TX and 32 TX Class A codebook are specified in terms of the ratio

$$\gamma = \frac{t_{ue, follow 1, 1, follow 1, 2, follow 2}}{t_{rnd 1, 1, rnd 1, 2, rnd 2}}$$

In the definition of  $\gamma$ , for PUSCH 3-1 single PMI and PUSCH 1-2 multiple PMI requirements,  $t_{ue, follow 1, 1, follow 1, 2, follow 2}$  is 90% of the maximum throughput obtained at  $SNR_{follow 1, 1, follow 1, 2, follow 2}$  using the precoders configured according to the UE reports, and  $t_{rnd 1, 1, rnd 1, 2, rnd 2}$  is the throughput measured at  $SNR_{follow 1, 1, follow 1, 2, follow 2}$  with random precoding.

The requirements for transmission mode 9 with 16 TX Class A *advancedCodebookEnabled=TRUE* configured are specified in terms of the ratio

$$\gamma = \frac{t_{ue, follow 1, 1, follow 1, 2, follow 1, 3, follow 2, follow\_RPI}}{t_{follow 1, 1, follow 1, 2, follow 1, 3, follow 2, fixed\_RPI}}$$

In the definition of  $\gamma$ ,  $t_{ue, follow 1, 1, follow 1, 2, follow 1, 3, follow 2, follow\_RPI}$  is [70%] of the maximum throughput obtained at  $SNR_{follow 1, 1, follow 1, 2, follow 1, 3, follow 2, follow\_RPI}$  using the precoders configured according to both the PMI and relative power indicator (RPI) reported by the UE, and  $t_{follow 1, 1, follow 1, 2, follow 1, 3, follow 2, fixed\_RPI}$  is the throughput measured at  $SNR_{follow 1, 1, follow 1, 2, follow 1, 3, follow 2, follow\_RPI}$  using the precoders configured according to the UE reports PMI and fixed RPI equal to 0.

## 9.4.1 Single PMI

### 9.4.1.1 Minimum requirement PUSCH 3-1 (Cell-Specific Reference Symbols)

#### 9.4.1.1.1 FDD

For the parameters specified in Table 9.4.1.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.1.1-2.

**Table 9.4.1.1.1-1: PMI test for single-layer (FDD)**

| Parameter                             | Unit     | Test 1    |    |
|---------------------------------------|----------|-----------|----|
| Bandwidth                             | MHz      | 10        |    |
| Transmission mode                     |          | 6         |    |
| Propagation channel                   |          | EVA5      |    |
| Precoding granularity                 | PRB      | 50        |    |
| Correlation and antenna configuration |          | Low 2 x 2 |    |
| Downlink power allocation             | $\rho_A$ | dB        | -3 |
|                                       | $\rho_B$ | dB        | -3 |

|   |                |              |           |
|---|----------------|--------------|-----------|
|   | $\sigma$       | dB           | 0         |
|   | $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98       |
| Reporting mode  |                |              | PUSCH 3-1 |
| Reporting interval  |                | ms           | 1         |
| PMI delay (Note 2)  |                | ms           | 8         |
| Measurement channel   |                |              | R. 10 FDD |
| OCNG Pattern  |                |              | OP.1 FDD  |
| Max number of HARQ transmissions  |                |              | 4         |
| Redundancy version coding sequence  |                |              | {0,1,2,3} |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |                |              |           |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |                |              |           |

**Table 9.4.1.1.1-2 Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.1      |
| UE Category | $\geq 1$ |

#### 9.4.1.1.2 TDD

For the parameters specified in Table 9.4.1.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.1.1.2-2.

**Table 9.4.1.1.2-1: PMI test for single-layer (TDD)**

| Parameter                             | Unit           | Test 1       |           |
|---------------------------------------|----------------|--------------|-----------|
| Bandwidth                             | MHz            | 10           |           |
| Transmission mode                     |                | 6            |           |
| Uplink downlink configuration         |                | 1            |           |
| Special subframe configuration        |                | 4            |           |
| Propagation channel                   |                | EVA5         |           |
| Precoding granularity                 | PRB            | 50           |           |
| Correlation and antenna configuration |                | Low 2 x 2    |           |
| Downlink power allocation             | $\rho_A$       | dB           | -3        |
|                                       | $\rho_B$       | dB           | -3        |
|                                       | $\sigma$       | dB           | 0         |
|                                       | $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98       |
| Reporting mode                        |                |              | PUSCH 3-1 |
| Reporting interval                    |                | ms           | 1         |
| PMI delay (Note 2)                    |                | ms           | 10 or 11  |
| Measurement channel                   |                |              | R.10 TDD  |
| OCNG Pattern                          |                |              | OP.1 TDD  |
| Max number of HARQ transmissions      |                |              | 4         |
| Redundancy version coding sequence    |                |              | {0,1,2,3} |

|                        |   |              |
|------------------------|---|--------------|
| ACK/NACK feedback mode |   | Multiplexing |
| Note 1:                | For random precoder selection, the precoder shall be updated in each available downlink transmission instance.  |              |
| Note 2:                | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |

**Table 9.4.1.1.2-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.1      |
| UE Category | $\geq 1$ |

## 9.4.1.2 Minimum requirement PUCCH 2-1 (Cell-Specific Reference Symbols)

### 9.4.1.2.1 FDD

For the parameters specified in Table 9.4.1.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.2.1-2.

**Table 9.4.1.2.1-1: PMI test for single-layer (FDD)**

| Parameter                              | Unit  | Test 1             |    |
|--|---|--------------------|----|
| Bandwidth                              | MHz   | 10                 |    |
| Transmission mode                      |   | 6                  |    |
| Propagation channel                    |   | EVA5               |    |
| Correlation and antenna configuration  |   | Low 4 x 2          |    |
| Downlink power allocation              | $\rho_A$  | dB                 | -6 |
|  | $\rho_B$  | dB                 | -6 |
|  | $\sigma$  | dB                 | 3  |
| $N_{oc}^{(j)}$                         | dB[mW/15kHz]  | -98                |    |
| PMI delay                              | ms  | 8 or 9             |    |
| Reporting mode                         |   | PUCCH 2-1 (Note 6) |    |
| Reporting periodicity                  | ms  | $N_{pd} = 2$       |    |
| Physical channel for CQI reporting     |   | PUSCH (Note 3)     |    |
| PUCCH Report Type for wideband CQI/PMI |   | 2                  |    |
| PUCCH Report Type for subband CQI      |   | 1                  |    |
| Measurement channel                    |   | R.14-1 FDD         |    |
| OCNG Pattern                           |   | OP.1/2 FDD         |    |
| Precoding granularity                  | PRB   | 6 (full size)      |    |
| Number of bandwidth parts ( $J$ )      |   | 3                  |    |
| $K$                                    |   | 1                  |    |
| <i>cqi-pmi-ConfigIndex</i>             |   | 1                  |    |
| Max number of HARQ transmissions       |   | 4                  |    |
| Redundancy version coding sequence     |   | {0,1,2,3}          |    |
| Note 1:                                | For random precoder selection, the precoder shall be updated every two TTI (2 ms granularity).                                  |                    |    |
| Note 2:                                | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later |                    |    |

|         |   |
|---------|---|
|         | than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).   |
| Note 3: | To avoid collisions between HARQ-ACK and wideband CQI/PMI or subband CQI, it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3. |
| Note 4: | Reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and instead data is to be transmitted on the most recently used subband for bandwidth part with j=1.   |
| Note 5: | In the case where wideband PMI is reported, data is to be transmitted on the most recently used subband.  |
| Note 6: | The bit field for PMI confirmation in DCI format 1B shall be mapped to "0" and TPMI information shall indicate the codebook index used in Table 6.3.4.2.3-2 of TS36.211 [4] according to the latest PMI report on PUCCH.  |

**Table 9.4.1.2.1-2: Minimum requirement (FDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

#### 9.4.1.2.2 TDD

For the parameters specified in Table 9.4.1.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.2.2-2.

**Table 9.4.1.2.2-1: PMI test for single-layer (TDD)**

| Parameter                              | Unit         | Test 1             |    |
|--|--------------|--------------------|----|
| Bandwidth                              | MHz          | 10                 |    |
| Transmission mode                      |              | 6                  |    |
| Uplink downlink configuration          |              | 1                  |    |
| Special subframe configuration         |              | 4                  |    |
| Propagation channel                    |              | EVA5               |    |
| Correlation and antenna configuration  |              | Low 4 x 2          |    |
| Downlink power allocation              | $\rho_A$     | dB                 | -6 |
|  | $\rho_B$     | dB                 | -6 |
|  | $\sigma$     | dB                 | 3  |
| $N_{oc}^{(j)}$                         | dB[mW/15kHz] | -98                |    |
| PMI delay                              | ms           | 10                 |    |
| Reporting mode                         |              | PUCCH 2-1 (Note 6) |    |
| Reporting periodicity                  | ms           | $N_p = 5$          |    |
| Physical channel for CQI reporting     |              | PUSCH (Note 3)     |    |
| PUCCH Report Type for wideband CQI/PMI |              | 2                  |    |
| PUCCH Report Type for subband CQI      |              | 1                  |    |
| Measurement channel                    |              | R.14-1 TDD         |    |
| OCNG Pattern                           |              | OP.1/2 TDD         |    |
| Precoding granularity                  | PRB          | 6 (full size)      |    |
| Number of bandwidth parts (J)          |              | 3                  |    |
| K                                      |              | 1                  |    |
| <i>cqi-pmi-ConfigIndex</i>             |              | 4                  |    |
| Max number of HARQ transmissions       |              | 4                  |    |

|                                    |  |              |
|------------------------------------|--|--------------|
| Redundancy version coding sequence |  | {0,1,2,3}    |
| ACK/NACK feedback mode             |  | Multiplexing |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each available downlink transmission instance.   |              |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).  |              |
| Note 3:                            | To avoid collisions between HARQ-ACK and wideband CQI/PMI or subband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |              |
| Note 4:                            | Reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and instead data is to be transmitted on the most recently used subband for bandwidth part with j=1.  |              |
| Note 5:                            | In the case where wideband PMI is reported, data is to be transmitted on the most recently used subband.   |              |
| Note 6:                            | The bit field for PMI confirmation in DCI format 1B shall be mapped to "0" and TPMI information shall indicate the codebook index used in Table 6.3.4.2.3-2 of TS36.211 [4] according to the latest PMI report on PUCCH.   |              |

**Table 9.4.1.2.2-2: Minimum requirement (TDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

### 9.4.1.3 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

#### 9.4.1.3.1 FDD

For the parameters specified in Table 9.4.1.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.1-2.

**Table 9.4.1.3.1-1: PMI test for single-layer (FDD)**

| Parameter                                | Unit | Test 1                     | Test 2                     | Test 3                     |
|--|------|----------------------------|----------------------------|----------------------------|
| Bandwidth                                | MHz  | 10                         | 10                         | 10                         |
| Transmission mode                        |      | 9                          | 9                          | 9                          |
| Propagation channel                      |      | EPA5                       | EPA5                       | EPA5                       |
| Precoding granularity                    | PRB  | 50                         | 50                         | 50                         |
| Correlation and antenna configuration    |      | Low<br>ULA 4 x 2           | Low<br>ULA 4 x 2           | Low<br>ULA 4 x 2           |
| Cell-specific reference signals          |      | Antenna ports<br>0,1       | Antenna ports<br>0,1       | Antenna ports<br>0,1       |
| CSI reference signals                    |      | Antenna ports<br>15,...,18 | Antenna ports<br>15,...,18 | Antenna ports<br>15,...,18 |
| Beamforming model                        |      | Annex B.4.3                | Annex<br>B.4.3             | Annex<br>B.4.3             |
| FrequencyDensityBeamformed               |      | N/A                        | 1                          | 1                          |
| NZP-TransmissionCombBeamformed           |      | N/A                        | N/A                        | N/A                        |
| csi-RS-NZP-mode                          |      | N/A                        | aperiodic                  | multiShot                  |
| NumberActivatedAperiodicCSI-RS-Resources |      | N/A                        | 1                          | NA                         |



|   |          |              |                       |                       |                       |
|---|----------|--------------|-----------------------|-----------------------|-----------------------|
| CSI-RS-ConfigNZP Aperiodic  |          |              | N/A                   | 6,7 (Note 4)          | NA                    |
| NumberActivatedCSI-RS-Resources   |          |              | N/A                   | NA                    | 1                     |
| eMIMO-Type  |          |              | N/A                   | ClassB                | ClassB                |
| alternativeCodebookEnabledCLASSB_K1   |          |              | N/A                   | FALSE                 | FALSE                 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              | 5/ 1                  | N/A                   | 5/ 1                  |
| CSI-RS reference signal configuration   |          |              | 6                     | N/A                   | 6,7 (Note 5,6)        |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0000 0000 0000 FFFF | 0x0000 0000 0000 FFFF | 0x0000 0000 0000 FFFF |
| Downlink power allocation   | $\rho_A$ | dB           | 0                     | 0                     |                       |
|   | $\rho_B$ | dB           | 0                     | 0                     |                       |
|   | $P_c$    | dB           | -3                    | -3                    |                       |
|   | $\sigma$ | dB           | -3                    | -3                    |                       |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98                   | -98                   | -98                   |
| Reporting mode  |          |              | PUSCH 3-1             | PUSCH 3-1             | PUSCH 3-1             |
| Reporting interval  |          | ms           | 5                     | 5                     | 5                     |
| PMI delay (Note 2)  |          | ms           | 8                     | 8                     | 8                     |
| Measurement channel   |          |              | R.44 FDD              | R.44 FDD              | R.44 FDD              |
| OCNG Pattern  |          |              | OP.1 FDD              | OP.1 FDD              | OP.1 FDD              |
| Max number of HARQ transmissions  |          |              | 4                     | 4                     | 4                     |
| Redundancy version coding sequence  |          |              | {0,1,2,3}             | {0,1,2,3}             | {0,1,2,3}             |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 4: Only one of these two aperiodic NZP CSI-RS resources will be randomly selected and activated during test. The selected aperiodic NZP CSI-RS is transmitted in every subframe #1 and #6.</p> <p>Note 5: Through MAC CE, one of these two periodic NZP CSI-RS resources will be activated and the other one will be deactivated in an alternative way. The activation and deactivation command will be transmitted in sub-frame #0 per [10000] ms.</p> <p>Note 6: When activation and/or deactivation command through MAC CE is transmitted at subframe n, the scheduled PDSCH transmission will be skipped for the subsequent 25 subframes.</p> |          |              |                       |                       |                       |

**Table 9.4.1.3.1-2: Minimum requirement (FDD)**

| Parameter   | Test 1   | Test 2   | Test 3   |
|---|----------|----------|----------|
| $\gamma$  | 1.2      | 1.2      | 1.2      |
| UE Category   | $\geq 1$ | $\geq 2$ | $\geq 2$ |
| <p>Note 1: For UE that indicates support of csi-RS-NZP-mode 'aperiodic' and/or 'multiShot', test 2 and/or test 3 will be run and test 1 will be skipped. Otherwise, test 1 will be run and test 2 and test 3 will be skipped.</p> |          |          |          |

9.4.1.3.2 TDD

For the parameters specified in Table 9.4.1.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.2-2.

Table 9.4.1.3.2-1: PMI test for single-layer (TDD)

| Parameter  | Unit         | Test 1  | Test 2  | Test 3  |
|--|--------------|---|---|---|
| Bandwidth  | MHz          | 10  | 10  | 10  |
| Transmission mode  |              | 9   | 9   | 9   |
| Uplink downlink configuration  |              | 1   | 1   | 1   |
| Special subframe configuration   |              | 4   | 4   | 4   |
| Propagation channel  |              | EVA5  | EVA5  | EVA5  |
| Precoding granularity  | PRB          | 50  | 50  | 50  |
| Antenna configuration  |              | 8 x 2   | 8 x 2   | 8 x 2   |
| Correlation modeling   |              | High, Cross polarized   | High, Cross polarized                         | High, Cross polarized                         |
| Cell-specific reference signals  |              | Antenna ports 0,1   | Antenna ports 0,1                             | Antenna ports 0,1                             |
| CSI reference signals  |              | Antenna ports 15,...,22   | Antenna ports 15,...,22                       | Antenna ports 15,...,22                       |
| Beamforming model  |              | Annex B.4.3   | Annex B.4.3                                   | Annex B.4.3                                   |
| FrequencyDensityBeamformed   |              | N/A   | 1   | 1   |
| NZP-TransmissionCombBeamformed   |              | N/A   | N/A   | N/A   |
| csi-RS-NZP-mode  |              | N/A   | aperiodic                                     | multiShot                                     |
| NumberActivatedAperiodicCSI-RS-Resources   |              | N/A   | 1   | N/A   |
| CSI-RS-ConfigNZPAperiodic  |              | N/A   | 0,1 (Note 5)                                  | N/A   |
| NumberActivatedCSI-RS-Resources  |              | N/A   | N/A   | 1   |
| eMIMO-Type   |              | N/A   | ClassB  | ClassB  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |              | 5/ 4  | N/A   | 5/ 4  |
| CSI-RS reference signal configuration  |              | 0   | N/A   | 0,1 (Note 6,7)                                |
| CodeBookSubsetRestriction bitmap   |              | 0x0000 0000<br>001F FFE0<br>0000 0000<br>FFFF                     | 0x0000 0000<br>001F FFE0<br>0000 0000<br>FFFF | 0x0000 0000<br>001F FFE0<br>0000 0000<br>FFFF |
| Downlink power allocation  | $\rho_A$     | dB  | 0   | 0   |
|  | $\rho_B$     | dB  | 0   | 0   |
|  | $P_c$        | dB  | -6  | -6  |
|  | $\sigma$     | dB  | -3  | -3  |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98   | -98   | -98   |
| Reporting mode   |              | PUSCH 3-1   | PUSCH 3-1                                     | PUSCH 3-1                                     |
| Reporting interval   | ms           | 5   | 5   | 5   |
| PMI delay (Note 2)   | ms           | 10  | 10  | 10  |
| Measurement channel  |              | R.45-1 TDD for UE Category 1, R.45 TDD for UE Category $\geq 2$   | R.45 TDD                                      | R.45 TDD                                      |
| OCNG Pattern   |              | OP.7 TDD for UE Category 1, and OP.1 TDD for UE Category $\geq 2$ | OP.1 TDD                                      | OP.1 TDD                                      |
| Max number of HARQ transmissions   |              | 4   | 4   | 4   |

|                                    |   |              |              |              |
|------------------------------------|---|--------------|--------------|--------------|
| Redundancy version coding sequence |   | {0,1,2,3}    | {0,1,2,3}    | {0,1,2,3}    |
| ACK/NACK feedback mode             |   | Multiplexing | Multiplexing | Multiplexing |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |              |              |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).                   |              |              |              |
| Note 3:                            | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |              |              |              |
| Note 4:                            | Randomization of the principle beam direction shall be used as specified in B.2.3A.4  |              |              |              |
| Note 5:                            | Only one of these two aperiodic NZP CSI-RS resources will be randomly selected and activated during test. The selected aperiodic NZP CSI-RS is transmitted in every subframe #4 and #9.   |              |              |              |
| Note 6:                            | Through MAC CE, one of these two periodic NZP CSI-RS resources will be activated and the other one will be deactivated in an alternative way. The activation and deactivation command will be transmitted in sub-frame #0 per [10000] ms. |              |              |              |
| Note 7:                            | When activation and/or deactivation command through MAC CE is transmitted at subframe n, the scheduled PDSCH transmission will be skipped for the subsequent 25 subframes.  |              |              |              |

**Table 9.4.1.3.2-2: Minimum requirement (TDD)**

| Parameter   | Test 1   | Test 2   | Test 3   |
|-------------|--|----------|----------|
| $\gamma$    | 3  | 3        | 3        |
| UE Category | $\geq 1$   | $\geq 2$ | $\geq 2$ |
| Note 1:     | For UE that indicates support of csi-RS-NZP-mode 'aperiodic' and/or 'multiShot', test 2 and/or test 3 will be run and test 1 will be skipped. Otherwise, test 1 will be run and test 2 and test 3 will be skipped. |          |          |

### 9.4.1.3.3 FDD (with Class A 12Tx codebook)

For the parameters specified in Table 9.4.1.3.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.3-2.

**Table 9.4.1.3.3-1: PMI test for single-layer (FDD)**

| Parameter  | Unit | Test 1                      |
|--|------|-----------------------------|
| Bandwidth  | MHz  | 10                          |
| Transmission mode  |      | 9                           |
| Propagation channel  |      | EPA5                        |
| Precoding granularity  | PRB  | 50                          |
| Correlation and antenna configuration  |      | High 2D XP<br>12(2,3,2) x 2 |
| Cell-specific reference signals  |      | Antenna ports 0,1           |
| CSI reference signals  |      | Antenna ports<br>15,...,26  |
| Beamforming model  |      | Annex B.4.3                 |
| CDM Type   |      | CDM2                        |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |      | 5/ 1                        |
| NZP-CSI-RS-Configuration-List  |      | {0,1,2}                     |
| eMIMO-Type   |      | Class A                     |
| codebookConfig-N1  |      | 2                           |
| codebookConfig-N2  |      | 3                           |
| codebook-Over-Sampling-RateConfig-O1   |      | 8                           |
| codebook-Over-Sampling-RateConfig-O2   |      | 4                           |
| Codebook-Config  |      | Note 5                      |
| codebookSubsetRestriction-1  |      | 0x01                        |

|                                    |   |              |  |
|------------------------------------|---|--------------|--|
|                                    |   |              | FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF                        |
| codebookSubsetRestriction-2        |   |              | Codebook-Config 1:<br>0000 0000 1111<br>Codebook-Config 2,3,4:<br>0x 00 000000 0000 FFFF |
| Downlink power allocation          | $\rho_A$  | dB           | 0  |
|                                    | $\rho_B$  | dB           | 0  |
|                                    | $P_c$   | dB           | -8   |
|                                    | $\sigma$  | dB           | -3   |
| $N_{oc}^{(j)}$                     |   | dB[mW/15kHz] | -98  |
| Reporting mode                     |   |              | PUSCH 3-1  |
| Reporting interval                 |   | ms           | 5  |
| PMI delay (Note 2)                 |   | ms           | 8  |
| Measurement channel                |   |              | R.77 FDD   |
| Rank Number of PDSCH               |   |              | 1  |
| OCNG Pattern                       |   |              | OP.1 FDD   |
| Max number of HARQ transmissions   |   |              | 4  |
| Redundancy version coding sequence |   |              | {0,1,2,3}  |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |  |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |  |
| Note 3:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |              |  |
| Note 4:                            | Randomization of the principle beam direction shall be used as specified in B.2.3B.4.   |              |  |
| Note 5:                            | Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |              |  |

**Table 9.4.1.3.3-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 2.5      |
| UE Category | $\geq 2$ |

9.4.1.3.4 TDD (with Class A 12Tx codebook)

For the parameters specified in Table 9.4.1.3.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.4-2.

**Table 9.4.1.3.4-1: PMI test for single-layer (TDD)**

| Parameter                             | Unit | Test 1                      |
|---------------------------------------|------|-----------------------------|
| Bandwidth                             | MHz  | 10                          |
| Transmission mode                     |      | 9                           |
| Uplink downlink configuration         |      | 1                           |
| Special subframe configuration        |      | 4                           |
| Propagation channel                   |      | EPA5                        |
| Precoding granularity                 | PRB  | 50                          |
| Correlation and antenna configuration |      | High 2D XP<br>12(2,3,2) x 2 |
| Cell-specific reference signals       |      | Antenna ports 0,1           |
| CSI reference signals                 |      | Antenna ports<br>15,...,26  |
| Beamforming model                     |      | Annex B.4.3                 |

|   |          |              |  |
|---|----------|--------------|--|
| CDM Type  |          |              | CDM2   |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |              | 5/ 4   |
| NZP-CSI-RS-Configuration-List   |          |              | {0,1,2}  |
| eMIMO-Type  |          |              | Class A  |
| codebookConfig-N1   |          |              | 2  |
| codebookConfig-N2   |          |              | 3  |
| codebook-Over-Sampling-RateConfig-O1  |          |              | 8  |
| codebook-Over-Sampling-RateConfig-O2  |          |              | 4  |
| Codebook-Config   |          |              | Note 5   |
| codebookSubsetRestriction-1   |          |              | 0x01<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF                |
| codebookSubsetRestriction-2   |          |              | Codebook-Config 1:<br>0000 0000 1111<br>Codebook-Config 2,3,4:<br>0x 00 000000 0000 FFFF |
| Downlink power allocation   | $\rho_A$ | dB           | 0  |
|   | $\rho_B$ | dB           | 0  |
|   | $P_c$    | dB           | -8   |
|   | $\sigma$ | dB           | -3   |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98  |
| Reporting mode  |          |              | PUSCH 3-1  |
| Reporting interval  |          | ms           | 5  |
| PMI delay (Note 2)  |          | ms           | 10   |
| Measurement channel   |          |              | R.77 TDD   |
| Rank Number of PDSCH  |          |              | 1  |
| OCNG Pattern  |          |              | OP.1 TDD   |
| Max number of HARQ transmissions  |          |              | 4  |
| Redundancy version coding sequence  |          |              | {0,1,2,3}  |
| ACK/NACK feedback mode  |          |              | Multiplexing   |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.</p> <p>Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3B.4.</p> <p>Note 5: Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.</p> |          |              |  |

**Table 9.4.1.3.4-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 2.5      |
| UE Category | $\geq 2$ |

9.4.1.3.5 FDD (with Class A 24Tx codebook)

For the parameters specified in Table 9.4.1.3.5-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.5-2.

**Table 9.4.1.3.5-1: PMI test for dual-layer (FDD)**

| Parameter   |          | Unit             | Test 1a  | Test 1b  |
|---|----------|------------------|--|--|
| Bandwidth   |          | MHz              | 10   | 10   |
| Transmission mode   |          |                  | 9  | 9  |
| Propagation channel   |          |                  | EPA5   | EPA5   |
| Precoding granularity   |          | PRB              | 50   | 50   |
| Correlation and antenna configuration   |          |                  | High 2D XP<br>24(3,4,2) x 2  | High 2D XP<br>24(3,4,2) x 2  |
| Cell-specific reference signals   |          |                  | Antenna ports 0,1  | Antenna ports 0,1  |
| CSI reference signals   |          |                  | Antenna ports<br>15,...,38   | Antenna ports<br>15,...,38   |
| Beamforming model   |          |                  | Annex B.4.3  | Annex B.4.3  |
| CDM Type  |          |                  | CDM4   | CDM4   |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |                  | 5/ 1   | 5/ 1   |
| FrequencyDensityNonPrecoded   |          |                  | 1  | 1/3  |
| NWP-TransmissionCombListNonprecoded   |          |                  | N/A  | {0,1,2}  |
| NWP-CSI-RS-Configuration-List   |          |                  | {0,1,2}  | {0,1,2}  |
| eMIMO-Type  |          |                  | Class A  | Class A  |
| codebookConfig-N1   |          |                  | 3  | 3  |
| codebookConfig-N2   |          |                  | 4  | 4  |
| codebook-Over-Sampling-RateConfig-O1  |          |                  | 8  | 8  |
| codebook-Over-Sampling-RateConfig-O2  |          |                  | 4  | 4  |
| Codebook-Config   |          |                  | Note 5   | Note 5   |
| codebookSubsetRestriction-1   |          |                  | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2   |          |                  | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   |
| Downlink power allocation   | $\rho_A$ | dB               | 0  | 0  |
|   | $\rho_B$ | dB               | 0  | 0  |
|   | $P_c$    | dB               | -8   | -8   |
|   | $\sigma$ | dB               | -3   | -3   |
| $N_{oc}^{(j)}$  |          | dB[mW/<br>15kHz] | -98  | -98  |
| Reporting mode  |          |                  | PUSCH 3-1  | PUSCH 3-1  |
| Reporting interval  |          | ms               | 5  | 5  |
| PMI delay (Note 2)  |          | ms               | 8  | 8  |
| Measurement channel   |          |                  | R.88 FDD   | R.88A FDD  |
| Rank Number of PDSCH  |          |                  | 2  | 2  |
| OCNG Pattern  |          |                  | OP.1 FDD   | OP.1 FDD   |
| Max number of HARQ transmissions  |          |                  | 4  | 4  |
| Redundancy version coding sequence  |          |                  | {0,1,2,3}  | {0,1,2,3}  |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).<br>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |                  |  |  |

Note 3: PDSCH\_RA= 0 dB, PDSCH\_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.  
 Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3B.4.  
 Note 5: Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.

**Table 9.4.1.3.5-2: Minimum requirement (FDD)**

| Parameter   | Test 1a  | Test 1b  |
|---|----------|----------|
| $\gamma$  | 3.5      | 3.5      |
| UE Category   | $\geq 2$ | $\geq 2$ |
| Note1: For UE that indicates support of density reduction for Class A, test 1b will be run and test 1a will be skipped. Otherwise, test 1a will be run and test 1b will be skipped. |          |          |

9.4.1.3.6 TDD (with Class A 24Tx codebook)

For the parameters specified in Table 9.4.1.3.6-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.6-2.

**Table 9.4.1.3.6-1: PMI test for dual-layer (TDD)**

| Parameter  | Unit | Test 1a  | Test 1b  |
|--|------|--|--|
| Bandwidth  | MHz  | 10   | 10   |
| Transmission mode  |      | 9  | 9  |
| Uplink downlink configuration  |      | 1  | 1  |
| Special subframe configuration   |      | 4  | 4  |
| Propagation channel  |      | EPA5   | EPA5   |
| Precoding granularity  | PRB  | 50   | 50   |
| Correlation and antenna configuration                                    |      | High 2D XP<br>24(3,4,2) x 2  | High 2D XP<br>24(3,4,2) x 2  |
| Cell-specific reference signals  |      | Antenna ports 0,1  | Antenna ports 0,1  |
| CSI reference signals  |      | Antenna ports<br>15,...,38   | Antenna ports<br>15,...,38   |
| Beamforming model  |      | Annex B.4.3  | Annex B.4.3  |
| CDM Type   |      | CDM4   | CDM4   |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |      | 5/ 4   | 5/ 4   |
| FrequencyDensityNonPrecoded  |      | 1  | 1/3  |
| NZP-TransmissionCombListNonprecoded                                      |      | NA   | {0,1,2}  |
| NZP-CSI-RS-Configuration-List  |      | {0,1,2}  | {0,1,2}  |
| eMIMO-Type   |      | Class A  | Class A  |
| codebookConfig-N1  |      | 3  | 3  |
| codebookConfig-N2  |      | 4  | 4  |
| codebook-Over-Sampling-RateConfig-O1                                     |      | 8  | 8  |
| codebook-Over-Sampling-RateConfig-O2                                     |      | 4  | 4  |
| Codebook-Config  |      | Note 5   | Note 5   |
| codebookSubsetRestriction-1  |      | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2  |      | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   |

|   |          |                  |              |              |
|---|----------|------------------|--------------|--------------|
| Downlink power allocation   | $\rho_A$ | dB               | 0            | 0            |
|   | $\rho_B$ | dB               | 0            | 0            |
|   | Pc       | dB               | -8           | -8           |
|   | $\sigma$ | dB               | -3           | -3           |
| $N_{oc}^{(j)}$  |          | dB[mW/1<br>5kHz] | -98          | -98          |
| Reporting mode  |          |                  | PUSCH 3-1    | PUSCH 3-1    |
| Reporting interval  |          | ms               | 5            | 5            |
| PMI delay (Note 2)  |          | ms               | 10           | 10           |
| Measurement channel   |          |                  | R.88 TDD     | R.88A TDD    |
| Rank Number of PDSCH  |          |                  | 2            | 2            |
| OCNG Pattern  |          |                  | OP.1 TDD     | OP.1 TDD     |
| Max number of HARQ transmissions  |          |                  | 4            | 4            |
| Redundancy version coding sequence  |          |                  | {0,1,2,3}    | {0,1,2,3}    |
| ACK/NACK feedback mode  |          |                  | Multiplexing | Multiplexing |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |          |                  |              |              |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |          |                  |              |              |
| Note 3: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |          |                  |              |              |
| Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3B.4.   |          |                  |              |              |
| Note 5: Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |          |                  |              |              |

**Table 9.4.1.3.6-2: Minimum requirement (TDD)**

| Parameter   | Test 1a  | Test 1b  |
|---|----------|----------|
| $\gamma$  | 3.0      | 3.0      |
| UE Category   | $\geq 2$ | $\geq 2$ |
| Note1: For UE that indicates support of density reduction for Class A, test 1b will be run and test 1a will be skipped. Otherwise, test 1a will be run and test 1b will be skipped. |          |          |

#### 9.4.1.4 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

##### 9.4.1.4.1 FDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.1.4.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.1-2.

**Table 9.4.1.4.1-1 PMI test for single-layer (FDD)**

| Parameter  | Unit | Test 1                  |
|--|------|-------------------------|
| Bandwidth  | MHz  | 10                      |
| Transmission mode  |      | 9                       |
| Propagation channel  |      | EPA5                    |
| Precoding granularity  | PRB  | 50                      |
| Correlation and antenna configuration  |      | High XP 4 x 2           |
| Beamforming model  |      | Annex B.4.3             |
| Cell-specific reference signals  |      | Antenna ports 0,1       |
| CSI reference signals  |      | Antenna ports 15,...,18 |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |      | 5/ 1                    |



|  |          |              |                                    |
|--|----------|--------------|------------------------------------|
| $T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              |                                    |
| CSI-RS reference signal configuration  |          |              | 6                                  |
| CodeBookSubsetRestriction bitmap   |          |              | 0x0000 0000 0000<br>FFFF 0000 00FF |
| Downlink power allocation  | $\rho_A$ | dB           | 0                                  |
|  | $\rho_B$ | dB           | 0                                  |
|  | $P_c$    | dB           | -3                                 |
|  | $\sigma$ | dB           | -3                                 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98                                |
| Reporting mode   |          |              | PUCCH 1-1 submode1                 |
| Reporting interval   |          | ms           | 5                                  |
| PMI delay (Note 2)   |          | ms           | 10                                 |
| Physical channel for CQI/PMI reporting   |          |              | PUSCH (Note 3)                     |
| PUCCH Report Type for CQI/second PMI   |          |              | 2b                                 |
| Physical channel for RI reporting  |          |              | PUSCH                              |
| PUCCH Report Type for RI/first PMI   |          |              | 5                                  |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 4                                  |
| <i>ri-ConfigIndex</i>  |          |              | 1                                  |
| Measurement channel  |          |              | R.60 FDD                           |
| OCNG Pattern   |          |              | OP.1 FDD                           |
| Max number of HARQ transmissions   |          |              | 4                                  |
| Redundancy version coding sequence   |          |              | {0,1,2,3}                          |
| alternativeCodeBookEnable dFor4TX-r12  |          |              | True                               |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.</p> <p>Note 4: PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4</p> |          |              |                                    |

**Table 9.4.1.4.1-2 Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

9.4.1.4.2 TDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.1.4.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.2-2.

**Table 9.4.1.4.2-1 PMI test for single-layer (TDD)**

| Parameter | Unit | Test 1 |
|-----------|------|--------|
| Bandwidth | MHz  | 10     |

|   |              |                                    |    |
|---|--------------|------------------------------------|----|
| Transmission mode   |              | 9                                  |    |
| Uplink downlink configuration   |              | 1                                  |    |
| Special subframe configuration  |              | 4                                  |    |
| Propagation channel   |              | EPA5                               |    |
| Precoding granularity   | PRB          | 50                                 |    |
| Correlation and antenna configuration   |              | High XP 4 x 2                      |    |
| Beamforming model   |              | Annex B.4.3                        |    |
| Cell-specific reference signals   |              | Antenna ports 0,1                  |    |
| CSI reference signals   |              | Antenna ports 15,...,18            |    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |              | 5/ 4                               |    |
| CSI-RS reference signal configuration   |              | 6                                  |    |
| CodeBookSubsetRestriction bitmap  |              | 0x0000 0000 0000<br>FFFF 0000 00FF |    |
| Downlink power allocation   | $\rho_A$     | dB                                 | 0  |
|   | $\rho_B$     | dB                                 | 0  |
|   | $P_c$        | dB                                 | -3 |
|   | $\sigma$     | dB                                 | -3 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98                                |    |
| Reporting mode  |              | PUCCH 1-1 submode1                 |    |
| Reporting interval  | ms           | 5                                  |    |
| PMI delay (Note 2)  | ms           | 15                                 |    |
| Physical channel for CQI/PMI reporting  |              | PUSCH (Note 3)                     |    |
| PUCCH Report Type for CQI/second PMI  |              | 2b                                 |    |
| Physical channel for RI reporting   |              | PUSCH                              |    |
| PUCCH Report Type for RI/ first PMI   |              | 5                                  |    |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 4                                  |    |
| <i>ri-ConfigIndex</i>   |              | 1                                  |    |
| Measurement channel   |              | R.60 TDD                           |    |
| OCNG Pattern  |              | OP.1 TDD                           |    |
| Max number of HARQ transmissions  |              | 4                                  |    |
| Redundancy version coding sequence  |              | {0,1,2,3}                          |    |
| ACK/NACK feedback mode  |              | Multiplexing                       |    |
| alternativeCodeBookEnable<br>dFor4TX-r12  |              | True                               |    |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.</p> <p>Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.</p> <p>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4.</p> |              |                                    |    |

**Table 9.4.1.4.2-2 Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

**9.4.1.4.3 FDD (with Class B alternative codebook for one CSI-RS resource configured)**

For the parameters specified in Table 9.4.1.4.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.3-2.

**Table 9.4.1.4.3-1 PMI test for single-layer (FDD)**

| Parameter  | Unit         | Test 1                         | Test 1a                        |    |
|--|--------------|--------------------------------|--------------------------------|----|
| Bandwidth  | MHz          | 10                             | 10                             |    |
| Transmission mode  |              | 9                              | 9                              |    |
| Propagation channel  |              | EPA5                           | EPA5                           |    |
| Precoding granularity  | PRB          | 50                             | 50                             |    |
| Correlation and antenna configuration  |              | ULA Low 4 x 2                  | ULA Low 4 x 2                  |    |
| Beamforming model  |              | Annex B.4.3                    | Annex B.4.3                    |    |
| Cell-specific reference signals  |              | Antenna ports 0,1              | Antenna ports 0,1              |    |
| CSI reference signals  |              | Antenna ports 15,...,18        | Antenna ports 15,...,18        |    |
| FrequencyDensityBeamformed   |              | 1                              | 1/2                            |    |
| NZP-TransmissionCombBeamformed   |              | N/A                            | 0                              |    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |              | 5/ 1                           | 5/ 1                           |    |
| CSI-RS reference signal configuration  |              | 6                              | 6                              |    |
| eMIMO-Type   |              | Class B                        | Class B                        |    |
| alternativeCodebookEnabled<br>CLASSB_K1  |              | TRUE                           | TRUE                           |    |
| codebookSubsetRestriction-3  |              | 00 0000 0000 0000 1111<br>1111 | 00 0000 0000 0000 1111<br>1111 |    |
| Downlink power allocation  | $\rho_A$     | dB                             | 0                              | 0  |
|  | $\rho_B$     | dB                             | 0                              | 0  |
|  | $\rho_C$     | dB                             | -6                             | -6 |
|  | $\sigma$     | dB                             | -3                             | -3 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                            | -98                            |    |
| Reporting mode   |              | PUCCH 1-1                      | PUCCH 1-1                      |    |
| Reporting interval   | ms           | 5                              | 5                              |    |
| PMI delay (Note 2)   | ms           | 10                             | 10                             |    |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 3)                 | PUSCH (Note 3)                 |    |
| PUCCH Report Type for CQI/PMI  |              | 2                              | 2                              |    |
| Physical channel for RI reporting  |              | PUSCH                          | PUSCH                          |    |
| PUCCH Report Type for RI   |              | 3                              | 3                              |    |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 2                              | 2                              |    |
| <i>ri-ConfigIndex</i>  |              | 1                              | 1                              |    |
| Measurement channel  |              | R.45 FDD                       | R.45A-2 FDD                    |    |
| Rank number of PDSCH   |              | 1                              | 1                              |    |
| OCNG Pattern   |              | OP.1 FDD                       | OP.1 FDD                       |    |

|                                    |   |           |           |
|------------------------------------|---|-----------|-----------|
| Max number of HARQ transmissions   |   | 4         | 4         |
| Redundancy version coding sequence |   | {0,1,2,3} | {0,1,2,3} |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |           |           |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |           |
| Note 3:                            | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.  |           |           |
| Note 4:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |           |           |

**Table 9.4.1.4.3-2 Minimum requirement (FDD)**

| Parameter   | Test 1   | Test 1a  |
|-------------|--|----------|
| $\gamma$    | 1.1  | 1.1      |
| UE Category | $\geq 2$   | $\geq 2$ |
| Note1:      | For UE that indicates support of density reduction for Class B, test 1a will be run and test 1 will be skipped. Otherwise, test 1 will be run and test 1a will be skipped. |          |

**9.4.1.4.4 TDD (with Class B alternative codebook for one CSI-RS resource configured)**

For the parameters specified in Table 9.4.1.4.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.4-2.

**Table 9.4.1.4.4-1 PMI test for single-layer (TDD)**

| Parameter  | Unit     | Test 1                  | Test 1a                 |    |
|--|----------|-------------------------|-------------------------|----|
| Bandwidth  | MHz      | 10                      | 10                      |    |
| Transmission mode  |          | 9                       | 9                       |    |
| Uplink downlink configuration  |          | 1                       | 1                       |    |
| Special subframe configuration   |          | 4                       | 4                       |    |
| Propagation channel  |          | EPA5                    | EPA5                    |    |
| Precoding granularity  | PRB      | 50                      | 50                      |    |
| Correlation and antenna configuration  |          | ULA Low 8 x 2           | ULA Low 8 x 2           |    |
| Beamforming model  |          | Annex B.4.3             | Annex B.4.3             |    |
| Cell-specific reference signals  |          | Antenna ports 0,1       | Antenna ports 0,1       |    |
| CSI reference signals  |          | Antenna ports 15,...,22 | Antenna ports 15,...,22 |    |
| FrequencyDensityBeamformed   |          | 1                       | 1/2                     |    |
| NZP-TransmissionCombBeamformed   |          | N/A                     | 0                       |    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          | 5/ 4                    | 5/ 4                    |    |
| CSI-RS reference signal configuration  |          | 0                       | 0                       |    |
| eMIMO-Type   |          | Class B                 | Class B                 |    |
| alternativeCodebookEnabled<br>CLASSB_K1  |          | TRUE                    | TRUE                    |    |
| codebookSubsetRestriction-3  |          | 0x 000 0000 0000 FFFF   | 0x 000 0000 0000 FFFF   |    |
| Downlink power allocation  | $\rho_A$ | dB                      | 0                       | 0  |
|  | $\rho_B$ | dB                      | 0                       | 0  |
|  | $P_c$    | dB                      | -3                      | -3 |

|  |   |              |                |                |
|--|---|--------------|----------------|----------------|
|  | $\sigma$  | dB           | -3             | -3             |
|  | $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98            | -98            |
| Reporting mode                         |   |              | PUCCH 1-1      | PUCCH 1-1      |
| Reporting interval                     | ms  |              | 5              | 5              |
| PMI delay (Note 2)                     | ms  |              | 10             | 10             |
| Physical channel for CQI/PMI reporting |   |              | PUSCH (Note 3) | PUSCH (Note 3) |
| PUCCH Report Type for CQI/PMI          |   |              | 2              | 2              |
| Physical channel for RI reporting      |   |              | PUSCH          | PUSCH          |
| PUCCH Report Type for RI               |   |              | 3              | 3              |
| <i>cqi-pmi-ConfigurationIndex</i>      |   |              | 4              | 4              |
| <i>ri-ConfigIndex</i>                  |   |              | 805            | 805            |
| Measurement channel                    |   |              | R.45 TDD       | R.45A TDD      |
| Rank number of PDSCH                   |   |              | 1              | 1              |
| OCNG Pattern                           |   |              | OP.1 TDD       | OP.1 TDD       |
| Max number of HARQ transmissions       |   |              | 4              | 4              |
| Redundancy version coding sequence     |   |              | {0,1,2,3}      | {0,1,2,3}      |
| ACK/NACK feedback mode                 |   |              | Multiplexing   | Multiplexing   |
| Note 1:                                | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |                |                |
| Note 2:                                | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |                |                |
| Note 3:                                | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.  |              |                |                |
| Note 4:                                | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |              |                |                |

**Table 9.4.1.4.4-2 Minimum requirement (TDD)**

| Parameter   | Test 1   | Test 1a  |
|-------------|--|----------|
| $\gamma$    | 1.2  | 1.2      |
| UE Category | $\geq 2$   | $\geq 2$ |
| Note1:      | For UE that indicates support of density reduction for Class B, test 1a will be run and test 1 will be skipped. Otherwise, test 1 will be run and test 1a will be skipped. |          |

## 9.4.1a Void

### 9.4.1a.1 Void

#### 9.4.1a.1.1 Void

#### 9.4.1a.1.2 Void

## 9.4.2 Multiple PMI

### 9.4.2.1 Minimum requirement PUSCH 1-2 (Cell-Specific Reference Symbols)

#### 9.4.2.1.1 FDD

For the parameters specified in Table 9.4.2.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.1.1-2.

**Table 9.4.2.1.1-1: PMI test for single-layer (FDD)**

| Parameter  | Unit  | Test 1   |    |
|--|---|--|----|
| Bandwidth  | MHz   | 10   |    |
| Transmission mode  |   | 6  |    |
| Propagation channel  |   | EPA5   |    |
| Precoding granularity<br>(only for reporting and<br>following PMI) | PRB   | 6  |    |
| Correlation and<br>antenna configuration                           |   | Low 2 x 2  |    |
| Downlink<br>power<br>allocation                                    | $\rho_A$  | dB   | -3 |
|  | $\rho_B$  | dB   | -3 |
|  | $\sigma$  | dB   | 0  |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98  |    |
| Reporting mode   |   | PUSCH 1-2  |    |
| Reporting interval   | ms  | 1  |    |
| PMI delay  | ms  | 8  |    |
| Measurement channel  |   | R.11-3 FDD<br>for UE<br>Category 1,<br>R.11 FDD for<br>UE Category<br>$\geq 2$ |    |
| OCNG Pattern   |   | OP.1/2 FDD   |    |
| Max number of HARQ<br>transmissions                                |   | 4  |    |
| Redundancy version<br>coding sequence                              |   | {0,1,2,3}  |    |
| Note 1:  | For random precoder selection, the precoders shall be updated in each TTI (1 ms granularity).   |  |    |
| Note 2:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |  |    |
| Note 3:  | One/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2 shall be used.  |  |    |

**Table 9.4.2.1.1-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

### 9.4.2.1.2 TDD

For the parameters specified in Table 9.4.2.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.1.2-2.

**Table 9.4.2.1.2-1: PMI test for single-layer (TDD)**

| Parameter                        | Unit | Test 1 |
|----------------------------------|------|--------|
| Bandwidth                        | MHz  | 10     |
| Transmission mode                |      | 6      |
| Uplink downlink<br>configuration |      | 1      |

|   |          |              |   |
|---|----------|--------------|---|
| Special subframe configuration  |          |              | 4   |
| Propagation channel   |          |              | EPA5  |
| Precoding granularity (only for reporting and following PMI)  |          | PRB          | 6   |
| Correlation and antenna configuration   |          |              | Low 2 x 2   |
| Downlink power allocation   | $\rho_A$ | dB           | -3  |
|   | $\rho_B$ | dB           | -3  |
|   | $\sigma$ | dB           | 0   |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98   |
| Reporting mode  |          |              | PUSCH 1-2   |
| Reporting interval  |          | ms           | 1   |
| PMI delay   |          | ms           | 10 or 11  |
| Measurement channel   |          |              | R.11-3 TDD for UE Category 1<br>R.11 TDD for UE Category $\geq 2$ |
| OCNG Pattern  |          |              | OP.1/2 TDD  |
| Max number of HARQ transmissions  |          |              | 4   |
| Redundancy version coding sequence  |          |              | {0,1,2,3}   |
| ACK/NACK feedback mode  |          |              | Multiplexing  |
| <p>Note 1: For random precoder selection, the precoders shall be updated in each available downlink transmission instance.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: One/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2 shall be used.</p> |          |              |   |

**Table 9.4.2.1.2-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

## 9.4.2.2 Minimum requirement PUSCH 2-2 (Cell-Specific Reference Symbols)

### 9.4.2.2.1 FDD

For the parameters specified in Table 9.4.2.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.2.1-2.

**Table 9.4.2.2.1-1: PMI test for single-layer (FDD)**

| Parameter           | Unit | Test 1 |
|---------------------|------|--------|
| Bandwidth           | MHz  | 10     |
| Transmission mode   |      | 6      |
| Propagation channel |      | EVA5   |

|   |          |              |               |
|---|----------|--------------|---------------|
| Correlation and antenna configuration   |          |              | Low 4 x 2     |
| Downlink power allocation   | $\rho_A$ | dB           | -6            |
|   | $\rho_B$ | dB           | -6            |
|   | $\sigma$ | dB           | 3             |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98           |
| PMI delay   |          | ms           | 8             |
| Reporting mode  |          |              | PUSCH 2-2     |
| Reporting interval  |          | ms           | 1             |
| Measurement channel   |          |              | R.14-2 FDD    |
| OCNG Pattern  |          |              | OP.1/2 FDD    |
| Subband size ( $k$ )  |          | RBs          | 3 (full size) |
| Number of preferred subbands ( $M$ )  |          |              | 5             |
| Max number of HARQ transmissions  |          |              | 4             |
| Redundancy version coding sequence  |          |              | {0,1,2,3}     |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)   |          |              |               |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF# $n$ based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4) |          |              |               |

**Table 9.4.2.2.1-2: Minimum requirement (FDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

#### 9.4.2.2.2 TDD

For the parameters specified in Table 9.4.2.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.2.2-2.

**Table 9.4.2.2.2-1: PMI test for single-layer (TDD)**

| Parameter                             | Unit     | Test 1       |               |
|---------------------------------------|----------|--------------|---------------|
| Bandwidth                             | MHz      | 10           |               |
| Transmission mode                     |          | 6            |               |
| Uplink downlink configuration         |          | 1            |               |
| Special subframe configuration        |          | 4            |               |
| Propagation channel                   |          | EVA5         |               |
| Correlation and antenna configuration |          | Low 4 x 2    |               |
| Downlink power allocation             | $\rho_A$ | dB           | -6            |
|                                       | $\rho_B$ | dB           | -6            |
|                                       | $\sigma$ | dB           | 3             |
| $N_{oc}^{(j)}$                        |          | dB[mW/15kHz] | -98           |
| PMI delay                             |          | ms           | 10            |
| Reporting mode                        |          |              | PUSCH 2-2     |
| Reporting interval                    |          | ms           | 1             |
| Measurement channel                   |          |              | R.14-2 TDD    |
| OCNG Pattern                          |          |              | OP.1/2 TDD    |
| Subband size ( $k$ )                  |          | RBs          | 3 (full size) |
| Number of preferred subbands ( $M$ )  |          |              | 5             |



|   |  |              |
|---|--|--------------|
| Max number of HARQ transmissions  |  | 4            |
| Redundancy version coding sequence  |  | {0,1,2,3}    |
| ACK/NACK feedback mode  |  | Multiplexing |
| <p>Note 1: For random precoder selection, the precoders shall be updated in each available downlink transmission instance.</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> |  |              |

**Table 9.4.2.2-2 Minimum requirement (TDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.15     |
| UE Category | $\geq 1$ |

### 9.4.2.3 Minimum requirement PUSCH 1-2 (CSI Reference Symbol)

#### 9.4.2.3.1 FDD

For the parameters specified in Table 9.4.2.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.1-2.

**Table 9.4.2.3.1-1: PMI test for single-layer (FDD)**

| Parameter  | Unit         | Test 1                              |    |
|--|--------------|-------------------------------------|----|
| Bandwidth  | MHz          | 10                                  |    |
| Transmission mode  |              | 9                                   |    |
| Propagation channel  |              | EVA5                                |    |
| Precoding granularity (only for reporting and following PMI)                           | PRB          | 6                                   |    |
| Correlation and antenna configuration  |              | Low<br>ULA 4 x 2                    |    |
| Cell-specific reference signals  |              | Antenna ports<br>0,1                |    |
| CSI reference signals  |              | Antenna ports<br>15,...,18          |    |
| Beamforming model  |              | Annex B.4.3                         |    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |              | 5/ 1                                |    |
| CSI-RS reference signal configuration  |              | 8                                   |    |
| CodeBookSubsetRestriction bitmap   |              | 0x0000 0000<br>0000 FFFF            |    |
| Downlink power allocation  | $\rho_A$     | dB                                  | 0  |
|  | $\rho_B$     | dB                                  | 0  |
|  | $P_c$        | dB                                  | -3 |
|  | $\sigma$     | dB                                  | -3 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                                 |    |
| Reporting mode   |              | PUSCH 1-2                           |    |
| Reporting interval   | ms           | 5                                   |    |
| PMI delay  | ms           | 8                                   |    |
| Measurement channel  |              | R.45-1 FDD<br>for UE<br>Category 1, |    |

|                                    |   |   |
|------------------------------------|---|---|
|                                    |   | R.45 FDD for UE Category $\geq 2$                               |
| OCNG Pattern                       |   | OP.7 FDD for UE Category 1<br>OP.1 FDD for UE Category $\geq 2$ |
| Max number of HARQ transmissions   |   | 4   |
| Redundancy version coding sequence |   | {0,1,2,3}   |
| Note 1:                            | For random precoder selection, the precoders shall be updated in each TTI (1 ms granularity).   |   |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |   |
| Note 3:                            | Void.   |   |
| Note 4:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |   |

**Table 9.4.2.3.1-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.3      |
| UE Category | $\geq 1$ |

#### 9.4.2.3.2 TDD

For the parameters specified in Table 9.4.2.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.2-2.

**Table 9.4.2.3.2-1: PMI test for single-layer (TDD)**

| Parameter  | Unit | Test 1                   |
|--|------|--------------------------|
| Bandwidth  | MHz  | 10                       |
| Transmission mode  |      | 9                        |
| Uplink downlink configuration  |      | 1                        |
| Special subframe configuration   |      | 4                        |
| Propagation channel  |      | EVA5                     |
| Precoding granularity (only for reporting and following PMI)                           | PRB  | 6                        |
| Antenna configuration  |      | 8 x 2                    |
| Correlation modeling   |      | High, Cross polarized    |
| Cell-specific reference signals  |      | Antenna ports 0,1        |
| CSI reference signals  |      | Antenna ports 15,...,22  |
| Beamforming model  |      | Annex B.4.3              |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |      | 5/ 4                     |
| CSI-RS reference signal configuration  |      | 4                        |
| CodeBookSubsetRestriction bitmap   |      | 0x0000 0000<br>001F FFE0 |

|  |          |              |   |
|--|----------|--------------|---|
|  |          |              | 0000 0000<br>FFFF   |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |
|  | $\rho_B$ | dB           | 0   |
|  | Pc       | db           | -6  |
|  | $\sigma$ | dB           | -3  |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |
| Reporting mode   |          |              | PUSCH 1-2   |
| Reporting interval   |          | ms           | 5 (Note 4)  |
| PMI delay  |          | ms           | 10  |
| Measurement channel  |          |              | R.45-1 TDD for UE Category 1, R.45 TDD for UE Category $\geq 2$ |
| OCNG Pattern   |          |              | OP.7 TDD for UE Category 1<br>OP.1 TDD for UE Category $\geq 2$ |
| Max number of HARQ transmissions   |          |              | 4   |
| Redundancy version coding sequence   |          |              | {0,1,2,3}   |
| ACK/NACK feedback mode   |          |              | Multiplexing  |
| <p>Note 1: For random precoder selection, the precoders shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Void.</p> <p>Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.</p> <p>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4.</p> |          |              |   |

**Table 9.4.2.3.2-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 3.5      |
| UE Category | $\geq 1$ |

### 9.4.2.3.3 FDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.2.3.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.3-2.

**Table 9.4.2.3.3-1 PMI test for dual-layer (FDD)**

| Parameter             | Unit | Test 1 |
|-----------------------|------|--------|
| Bandwidth             | MHz  | 10     |
| Transmission mode     |      | 9      |
| Propagation channel   |      | EVA5   |
| Precoding granularity | PRB  | 6      |

|   |          |              |   |
|---|----------|--------------|---|
| (only for reporting and following PMI)  |          |              |   |
| Correlation and antenna configuration   |          |              | High XP 4 x 2   |
| Beamforming model   |          |              | Annex B.4.3   |
| Cell-specific reference signals   |          |              | Antenna ports 0,1   |
| CSI reference signals   |          |              | Antenna ports 15,...,18   |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / I_{\text{CSI-RS}}$   |          |              | 5/ 1  |
| CSI-RS reference signal configuration   |          |              | 8   |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0000 0000 FFFF<br>0000 FFFF 0000                              |
| Downlink power allocation   | $\rho_A$ | dB           | 0   |
|   | $\rho_B$ | dB           | 0   |
|   | $P_c$    | dB           | -3  |
|   | $\sigma$ | dB           | -3  |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98   |
| Reporting mode  |          |              | PUSCH1-2  |
| Reporting interval  |          | ms           | 5   |
| PMI delay (Note 2)  |          | ms           | 8   |
| Measurement channel   |          |              | R.45-1 FDD for UE Category 1, R.45 FDD for UE Category $\geq 2$ |
| Rank Number of PDSCH  |          |              | 2   |
| OCNG Pattern  |          |              | OP.7 FDD for UE Category 1<br>OP.1 FDD for UE Category $\geq 2$ |
| Max number of HARQ transmissions  |          |              | 4   |
| Redundancy version coding sequence  |          |              | {0,1,2,3}   |
| alternativeCodeBookEnable<br>dFor4TX-r12  |          |              | True  |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: Void.</p> <p>Note 4: PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4</p> |          |              |   |

Table 9.4.2.3.3-2 Minimum requirement (FDD)

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

## 9.4.2.3.4 TDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.2.3.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.4-2.

Table 9.4.2.3.4-1 PMI test for dual-layer (TDD)

| Parameter   | Unit  | Test 1  |    |
|---|---|---|----|
| Bandwidth   | MHz   | 10  |    |
| Transmission mode   |   | 9   |    |
| Uplink downlink configuration   |   | 1   |    |
| Special subframe configuration  |   | 4   |    |
| Propagation channel   |   | EVA5  |    |
| Precoding granularity (only for reporting and following PMI)                      | PRB   | 6   |    |
| Correlation and antenna configuration   |   | XP High 4 x 2   |    |
| Beamforming model   |   | Annex B.4.3   |    |
| Cell-specific reference signals   |   | Antenna ports 0,1   |    |
| CSI reference signals   |   | Antenna ports 15,...,18   |    |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / I_{\text{CSI-RS}}$ |   | 5/ 4  |    |
| CSI-RS reference signal configuration   |   | 4   |    |
| CodeBookSubsetRestriction bitmap  |   | 0x0000 0000 FFFF<br>0000 FFFF 0000                              |    |
| Downlink power allocation   | $\rho_A$  | dB  | 0  |
|   | $\rho_B$  | dB  | 0  |
|   | $P_c$   | dB  | -3 |
|   | $\sigma$  | dB  | -3 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz]  | -98   |    |
| Reporting mode  |   | PUSCH1-2  |    |
| Reporting interval  | ms  | 5   |    |
| PMI delay (Note 2)  | ms  | 10  |    |
| Measurement channel   |   | R.61-1 TDD for UE Category 1, R.61 TDD for UE Category $\geq 2$ |    |
| Rank Number of PDSCH  |   | 2   |    |
| OCNG Pattern  |   | OP.7 FDD for UE Category 1<br>OP.1 FDD for UE Category $\geq 2$ |    |
| Max number of HARQ transmissions  |   | 4   |    |
| Redundancy version coding sequence  |   | {0,1,2,3}   |    |
| ACK/NACK feedback mode  |   | Multiplexing  |    |
| alternativeCodeBookEnable<br>dFor4TX-r12  |   | True  |    |
| Note 1:   | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)   |   |    |
| Note 2:   | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |   |    |
| Note3:  | Void.   |   |    |
| Note 4:   | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |   |    |
| Note 5:   | Randomization of the principle beam direction shall be used as specified in B.2.3A.4.   |   |    |

**Table 9.4.2.3.4-2 Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

#### 9.4.2.3.5 FDD (with Class A 16Tx codebook)

For the parameters specified in Table 9.4.2.3.5-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.5-2.

**Table 9.4.2.3.5-1: PMI test for dual-layer (FDD)**

| Parameter  | Unit           | Test 1   |           |
|--|----------------|--|-----------|
| Bandwidth  | MHz            | 10   |           |
| Transmission mode  |                | 9  |           |
| Propagation channel  |                | EVA5   |           |
| Precoding granularity<br>(only for reporting and following PMI)                        | PRB            | 6  |           |
| Correlation and antenna configuration  |                | High 2D XP<br>16(2,4,2) x 2  |           |
| Cell-specific reference signals  |                | Antenna ports 0,1  |           |
| CSI reference signals  |                | Antenna ports<br>15,...,30   |           |
| Beamforming model  |                | Annex B.4.3  |           |
| CDM Type   |                | CDM4   |           |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |                | 5/ 1   |           |
| NZP-CSI-RS-Configuration-List  |                | {0,1}  |           |
| eMIMO-Type   |                | Class A  |           |
| codebookConfig-N1  |                | 2  |           |
| codebookConfig-N2  |                | 4  |           |
| codebook-Over-Sampling-RateConfig-O1   |                | 8  |           |
| codebook-Over-Sampling-RateConfig-O2   |                | 8  |           |
| Codebook-Config  |                | Note 5   |           |
| codebookSubsetRestriction-1  |                | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |           |
| codebookSubsetRestriction-2  |                | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 000000 FFFF 0000   |           |
| Downlink power allocation  | $\rho_A$       | dB   | 0         |
|  | $\rho_B$       | dB   | 0         |
|  | $P_c$          | dB   | -6        |
|  | $\sigma$       | dB   | -3        |
|  | $N_{oc}^{(j)}$ | dB[mW/15kHz]   | -98       |
| Reporting mode   |                |  | PUSCH 1-2 |
| Reporting interval   |                | ms   | 5         |
| PMI delay (Note 2)   |                | ms   | 8         |
| Measurement channel  |                |  | R.78 FDD  |

|                                    |   |           |
|------------------------------------|---|-----------|
| Rank Number of PDSCH               |   | 2         |
| OCNG Pattern                       |   | OP.1 FDD  |
| Max number of HARQ transmissions   |   | 4         |
| Redundancy version coding sequence |   | {0,1,2,3} |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |           |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |           |
| Note 3:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |           |
| Note 4:                            | Randomization of the principle beam direction shall be used as specified in B.2.3B.4.   |           |
| Note 5:                            | Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |           |

**Table 9.4.2.3.5-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 2.5      |
| UE Category | $\geq 2$ |

#### 9.4.2.3.6 TDD (with Class A 16Tx codebook)

For the parameters specified in Table 9.4.2.3.6-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.6-2.

**Table 9.4.2.3.6-1: PMI test for dual-layer (TDD)**

| Parameter  | Unit | Test 1  |
|--|------|---|
| Bandwidth  | MHz  | 10  |
| Transmission mode  |      | 9   |
| Uplink downlink configuration  |      | 1   |
| Special subframe configuration   |      | 4   |
| Propagation channel  |      | EVA5  |
| Precoding granularity (only for reporting and following PMI)                           | PRB  | 6   |
| Correlation and antenna configuration  |      | High 2D XP<br>16(2,4,2) x 2   |
| Cell-specific reference signals  |      | Antenna ports 0,1   |
| CSI reference signals  |      | Antenna ports<br>15,...,26  |
| Beamforming model  |      | Annex B.4.3   |
| CDM Type   |      | CDM4  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |      | 5/4   |
| NZP-CSI-RS-Configuration-List  |      | {0,1}   |
| eMIMO-Type   |      | Class A   |
| codebookConfig-N1  |      | 2   |
| codebookConfig-N2  |      | 4   |
| codebook-Over-Sampling-RateConfig-O1   |      | 8   |
| codebook-Over-Sampling-RateConfig-O2   |      | 8   |
| Codebook-Config  |      | Note 5  |
| codebookSubsetRestriction-1  |      | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |

|                                    |   |              |   |
|------------------------------------|---|--------------|---|
|                                    |   |              | FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2        |   |              | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 000000 FFFF 0000                        |
| Downlink power allocation          | $\rho_A$  | dB           | 0   |
|                                    | $\rho_B$  | dB           | 0   |
|                                    | Pc  | dB           | -6  |
|                                    | $\sigma$  | dB           | -3  |
| $N_{oc}^{(j)}$                     |   | dB[mW/15kHz] | -98   |
| Reporting mode                     |   |              | PUSCH 1-2   |
| Reporting interval                 |   | ms           | 5   |
| PMI delay (Note 2)                 |   | ms           | 10  |
| Measurement channel                |   |              | R.78 TDD  |
| Rank Number of PDSCH               |   |              | 2   |
| OCNG Pattern                       |   |              | OP.1 TDD  |
| Max number of HARQ transmissions   |   |              | 4   |
| Redundancy version coding sequence |   |              | {0,1,2,3}   |
| ACK/NACK feedback mode             |   |              | Multiplexing  |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |   |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |   |
| Note 3:                            | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |              |   |
| Note 4:                            | Randomization of the principle beam direction shall be used as specified in B.2.3B.4  |              |   |
| Note 5:                            | Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |              |   |

**Table 9.4.2.3.6-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 2.5      |
| UE Category | $\geq 2$ |

9.4.2.3.7 FDD (with Class A 32Tx codebook)

For the parameters specified in Table 9.4.2.3.7-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.7-2.

**Table 9.4.2.3.7-1: PMI test for dual-layer (FDD)**

| Parameter  | Unit | Test 1                      |
|--|------|-----------------------------|
| Bandwidth  | MHz  | 10                          |
| Transmission mode  |      | 9                           |
| Propagation channel  |      | EVA5                        |
| Precoding granularity (only for reporting and following PMI) | PRB  | 6                           |
| Correlation and antenna configuration                        |      | High 2D XP<br>32(4,4,2) x 2 |
| Cell-specific reference signals                              |      | Antenna ports 0,1           |



|   |                |                  |  |
|---|----------------|------------------|--|
| CSI reference signals   |                |                  | Antenna ports<br>15,...,46   |
| Beamforming model   |                |                  | Annex B.4.3  |
| CDM Type  |                |                  | CDM8   |
| CSI-RS periodicity and subframe<br>offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |                |                  | 5/ 1   |
| FrequencyDensityNonPrecoded   |                |                  | 1  |
| NWP-<br>TransmissionCombListNonprecoded   |                |                  | NA   |
| NWP-CSI-RS-Configuration-List   |                |                  | {0,1,2,3}  |
| eMIMO-Type  |                |                  | Class A  |
| codebookConfig-N1   |                |                  | 4  |
| codebookConfig-N2   |                |                  | 4  |
| codebook-Over-Sampling-<br>RateConfig-O1  |                |                  | 8  |
| codebook-Over-Sampling-<br>RateConfig-O2  |                |                  | 4  |
| Codebook-Config   |                |                  | Note 5   |
| codebookSubsetRestriction-1   |                |                  | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2   |                |                  | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   |
| Downlink power<br>allocation  | $\rho_A$       | dB               | 0  |
|   | $\rho_B$       | dB               | 0  |
|   | $P_C$          | dB               | -6   |
|   | $\sigma$       | dB               | -3   |
|   | $N_{oc}^{(j)}$ | dB[mW/15<br>kHz] | -98  |
| Reporting mode  |                |                  | PUSCH 1-2  |
| Reporting interval  |                | ms               | 5  |
| PMI delay (Note 2)  |                | ms               | 8  |
| Measurement channel   |                |                  | R.89 FDD   |
| Rank Number of PDSCH  |                |                  | 2  |
| OCNG Pattern  |                |                  | OP.1 FDD   |
| Max number of HARQ transmissions  |                |                  | 4  |
| Redundancy version coding<br>sequence   |                |                  | {0,1,2,3}  |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3B.4.</p> <p>Note 5: Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.</p> |                |                  |  |

**Table 9.4.2.3.7-2: Minimum requirement (FDD)**

| Parameter | Test 1 |
|-----------|--------|
| $\gamma$  | 4.5    |

|             |    |
|-------------|----|
| UE Category | ≥2 |
|-------------|----|

#### 9.4.2.3.8 TDD (with Class A 32Tx codebook)

For the parameters specified in Table 9.4.2.3.8-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.8-2.

**Table 9.4.2.3.8-1: PMI test for dual-layer (TDD)**

| Parameter   | Unit             | Test 1   |    |
|---|------------------|--|----|
| Bandwidth   | MHz              | 10   |    |
| Transmission mode   |                  | 9  |    |
| Uplink downlink configuration   |                  | 1  |    |
| Special subframe configuration  |                  | 4  |    |
| Propagation channel   |                  | EVA5   |    |
| Precoding granularity<br>(only for reporting and following PMI)                           | PRB              | 6  |    |
| Correlation and antenna configuration   |                  | High 2D XP<br>32(4,4,2) x 2  |    |
| Cell-specific reference signals   |                  | Antenna ports 0,1  |    |
| CSI reference signals   |                  | Antenna ports<br>15,...,46   |    |
| Beamforming model   |                  | Annex B.4.3  |    |
| CDM Type  |                  | CDM8   |    |
| CSI-RS periodicity and subframe<br>offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |                  | 5/ 4   |    |
| FrequencyDensityNonPrecoded   |                  | 1  |    |
| NZP-<br>TransmissionCombListNonprecoded   |                  | NA   |    |
| NZP-CSI-RS-Configuration-List   |                  | {0,1,2,3}  |    |
| eMIMO-Type  |                  | Class A  |    |
| codebookConfig-N1   |                  | 4  |    |
| codebookConfig-N2   |                  | 4  |    |
| codebook-Over-Sampling-<br>RateConfig-O1  |                  | 8  |    |
| codebook-Over-Sampling-<br>RateConfig-O2  |                  | 8  |    |
| Codebook-Config   |                  | Note 5   |    |
| codebookSubsetRestriction-1   |                  | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |    |
| codebookSubsetRestriction-2   |                  | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 0000 FFFF 0000   |    |
| Downlink power<br>allocation  | $\rho_A$         | dB   | 0  |
|   | $\rho_B$         | dB   | 0  |
|   | $P_c$            | dB   | -6 |
|   | $\sigma$         | dB   | -3 |
| $N_{oc}^{(j)}$  | dB[mW/1<br>5kHz] | -98  |    |
| Reporting mode  |                  | PUSCH 1-2  |    |
| Reporting interval  | ms               | 5  |    |
| PMI delay (Note 2)  | ms               | 10   |    |
| Measurement channel   |                  | R.89 TDD   |    |

|                                    |   |              |
|------------------------------------|---|--------------|
| Rank Number of PDSCH               |   | 2            |
| OCNG Pattern                       |   | OP.1 TDD     |
| Max number of HARQ transmissions   |   | 4            |
| Redundancy version coding sequence |   | {0,1,2,3}    |
| ACK/NACK feedback mode             |   | Multiplexing |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |
| Note 3:                            | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |              |
| Note 4:                            | Randomization of the principle beam direction shall be used as specified in B.2.3B.4  |              |
| Note 5:                            | Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |              |

**Table 9.4.2.3.8-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 4.5      |
| UE Category | $\geq 2$ |

#### 9.4.2.3.9 FDD (with Class A 16Tx advanced codebook)

For the parameters specified in Table 9.4.2.3.9-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.9-2.

**Table 9.4.2.3.9-1: PMI test for dual-layer (FDD)**

| Parameter  | Unit | Test 1  |
|--|------|---|
| Bandwidth  | MHz  | 10  |
| Transmission mode  |      | 9   |
| Propagation channel  |      | EVA5  |
| Precoding granularity (only for reporting and following PMI)                           | PRB  | 6   |
| Correlation and antenna configuration  |      | Medium 2D XP<br>16(2,4,2) x 2   |
| Cell-specific reference signals  |      | Antenna ports 0,1   |
| CSI reference signals  |      | Antenna ports<br>15,...,30  |
| Beamforming model  |      | Annex B.4.3   |
| CDM Type   |      | CDM4  |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |      | 5/ 1  |
| NZP-CSI-RS-Configuration-List  |      | {0,1}   |
| eMIMO-Type   |      | Class A   |
| <i>advancedCodebookEnabled</i>   |      | TRUE  |
| codebookConfig-N1  |      | 2   |
| codebookConfig-N2  |      | 4   |
| codebook-Over-Sampling-RateConfig-O1   |      | 8   |
| codebook-Over-Sampling-RateConfig-O2   |      | 8   |
| Codebook-Config  |      | Note 5  |
| codebookSubsetRestriction-1  |      | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |

|                                    |   |              |   |
|------------------------------------|---|--------------|---|
|                                    |   |              | FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2        |   |              | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 000000 FFFF 0000                        |
| Downlink power allocation          | $\rho_A$  | dB           | 0   |
|                                    | $\rho_B$  | dB           | 0   |
|                                    | $P_c$   | dB           | -6  |
|                                    | $\sigma$  | dB           | -3  |
|                                    | $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98   |
| Reporting mode                     |   |              | PUSCH 1-2   |
| Reporting interval                 |   | ms           | 5   |
| PMI delay (Note 2)                 |   | ms           | 8   |
| Measurement channel                |   |              | R.78 FDD  |
| Rank Number of PDSCH               |   |              | 2   |
| OCNG Pattern                       |   |              | OP.1 FDD  |
| Max number of HARQ transmissions   |   |              | 4   |
| Redundancy version coding sequence |   |              | {0,1,2,3}   |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |              |   |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |   |
| Note 3:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |              |   |
| Note 4:                            | Randomization of the dual-cluster beam directions shall be used as specified in B.2.3B.4A. The value of relative power ratio ( $\rho$ ) shall be fixed as 1 during the test.  |              |   |
| Note 5:                            | Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.   |              |   |

**Table 9.4.2.3.9-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.03     |
| UE Category | $\geq 2$ |

9.4.2.3.10 TDD (with Class A 16Tx advanced codebook)

For the parameters specified in Table 9.4.2.3.10-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.3.10-2.

**Table 9.4.2.3.10-1: PMI test for dual-layer (TDD)**

| Parameter  | Unit | Test 1 |
|--|------|--------|
| Bandwidth  | MHz  | 10     |
| Transmission mode  |      | 9      |
| Uplink downlink configuration                                |      | 1      |
| Special subframe configuration                               |      | 4      |
| Propagation channel  |      | EVA5   |
| Precoding granularity (only for reporting and following PMI) | PRB  | 6      |

|   |          |              |  |
|---|----------|--------------|--|
| Correlation and antenna configuration   |          |              | Medium 2D XP<br>16(2,4,2) x 2  |
| Cell-specific reference signals   |          |              | Antenna ports 0,1  |
| CSI reference signals   |          |              | Antenna ports<br>15,...,26   |
| Beamforming model   |          |              | Annex B.4.3  |
| CDM Type  |          |              | CDM4   |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |              | 5/4  |
| NZP-CSI-RS-Configuration-List   |          |              | {0,1}  |
| eMIMO-Type  |          |              | Class A  |
| <i>advancedCodebookEnabled</i>  |          |              | TRUE   |
| codebookConfig-N1   |          |              | 2  |
| codebookConfig-N2   |          |              | 4  |
| codebook-Over-Sampling-RateConfig-O1  |          |              | 8  |
| codebook-Over-Sampling-RateConfig-O2  |          |              | 8  |
| Codebook-Config   |          |              | Note 5   |
| codebookSubsetRestriction-1   |          |              | 0x02<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF<br>FFFF FFFF FFFF FFFF |
| codebookSubsetRestriction-2   |          |              | Codebook-Config 1:<br>0000 1111 0000<br>Codebook-Config 2,3,4:<br>0x 00 000000 FFFF 0000   |
| Downlink power allocation   | $\rho_A$ | dB           | 0  |
|   | $\rho_B$ | dB           | 0  |
|   | Pc       | dB           | -6   |
|   | $\sigma$ | dB           | -3   |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98  |
| Reporting mode  |          |              | PUSCH 1-2  |
| Reporting interval  |          | ms           | 5  |
| PMI delay (Note 2)  |          | ms           | 10   |
| Measurement channel   |          |              | R.78 TDD   |
| Rank Number of PDSCH  |          |              | 2  |
| OCNG Pattern  |          |              | OP.1 TDD   |
| Max number of HARQ transmissions  |          |              | 4  |
| Redundancy version coding sequence  |          |              | {0,1,2,3}  |
| ACK/NACK feedback mode  |          |              | Multiplexing   |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.</p> <p>Note 4: Randomization of the dual-cluster beam directions shall be used as specified in B.2.3B.4A. The value of relative power ratio (p) shall be fixed as 1 during the test.</p> <p>Note 5: Value of parameter codebookConfig shall be random selected one value from UE supported codebook configurations.</p> |          |              |  |

**Table 9.4.2.3.10-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.03     |
| UE Category | $\geq 2$ |

### 9.4.3 Void

## 9.5 Reporting of Rank Indicator (RI)

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI (CQI) reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission. Transmission mode 4 is used with the specified CodebookSubSetRestriction in section 9.5.1, transmission mode 9 is used with the specified CodebookSubSetRestriction in section 9.5.2 and transmission mode 3 is used with the specified CodebookSubSetRestriction in section 9.5.3, and transmission mode 10 is used with the specified CodebookSubSetRestriction in section 9.5.5.

For fixed rank 1 transmission in sections 9.5.1, 9.5.2 and 9.5.5, the RI and PMI reporting is restricted to two single-layer precoders, For fixed rank 2 transmission in sections 9.5.1, 9.5.2 and 9.5.5, the RI and PMI reporting is restricted to one two-layer precoder, For follow RI transmission in sections 9.5.1 and 9.5.2, the RI and PMI reporting is restricted to select the union of these precoders. Channels with low and high correlation are used to ensure that RI reporting reflects the channel condition.

For fixed rank 1 transmission in section 9.5.3, the RI reporting is restricted to single-layer, for fixed rank 2 transmission in section 9.5.3, the RI reporting is restricted to two-layers. For follow RI transmission in section 9.5.3, the RI reporting is either one or two layers.

### 9.5.1 Minimum requirement (Cell-Specific Reference Symbols)

#### 9.5.1.1 FDD

The minimum performance requirement in Table 9.5.1.1-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.5.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.1.1-2.

**Table 9.5.1.1-1: RI Test (FDD)**

| Parameter                                       | Unit     | Test 1  | Test 2 | Test 3 |
|---|----------|---|--------|--------|
| Bandwidth                                       | MHz      | 10  |        |        |
| PDSCH transmission mode                         |          | 4   |        |        |
| Downlink power allocation                       | $\rho_A$ | dB  | -3     |        |
|   | $\rho_B$ | dB  | -3     |        |
|   | $\sigma$ | dB  | 0      |        |
| Propagation condition and antenna configuration |          | 2 x 2 EPA5  |        |        |
| CodeBookSubsetRestriction bitmap                |          | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |        |        |
| Antenna correlation                             |          | Low   | Low    | High   |

| RI configuration  |              | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
|---|--------------|--------------------------|--------------------------|--------------------------|
| SNR   | dB           | 0                        | 20                       | 20                       |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98                      | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -98                      | -78                      | -78                      |
| Maximum number of HARQ transmissions  |              | 1                        |                          |                          |
| Reporting mode  |              | PUCCH 1-1 (Note 4)       |                          |                          |
| Physical channel for CQI/PMI reporting  |              | PUCCH Format 2           |                          |                          |
| PUCCH Report Type for CQI/PMI   |              | 2                        |                          |                          |
| Physical channel for RI reporting   |              | PUSCH (Note 3)           |                          |                          |
| PUCCH Report Type for RI  |              | 3                        |                          |                          |
| Reporting periodicity   | ms           | $N_{pd}=5$               |                          |                          |
| PMI and CQI delay   | ms           | 8                        |                          |                          |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 6                        |                          |                          |
| <i>ri-ConfigurationInd</i>  |              | 1 (Note 5)               |                          |                          |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 2: Reference measurement channel RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between RI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.</p> <p>Note 4: The bit field for precoding information in DCI format 2 shall be mapped as:</p> <ul style="list-style-type: none"> <li>• For reported RI = 1 and PMI = 0 &gt;&gt; precoding information bit field index = 1</li> <li>• For reported RI = 1 and PMI = 1 &gt;&gt; precoding information bit field index = 2</li> <li>• For reported RI = 2 and PMI = 0 &gt;&gt; precoding information bit field index = 0</li> </ul> <p>Note 5: To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.</p> |              |                          |                          |                          |

**Table 9.5.1.1-2: Minimum requirement (FDD)**

|             | Test 1   | Test 2   | Test 3   |
|-------------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      |
| $\gamma_2$  | 1        | N/A      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ |

### 9.5.1.2 TDD

The minimum performance requirement in Table 9.5.1.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.5.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.1.2-2.

**Table 9.5.1.2-1: RI Test (TDD)**

| Parameter               | Unit | Test 1 | Test 2 | Test 3 |
|-------------------------|------|--------|--------|--------|
| Bandwidth               | MHz  | 10     |        |        |
| PDSCH transmission mode |      | 4      |        |        |

|  |          |              |   |                          |                          |
|--|----------|--------------|---|--------------------------|--------------------------|
| Downlink power allocation  | $\rho_A$ | dB           | -3  |                          |                          |
|  | $\rho_B$ | dB           | -3  |                          |                          |
|  | $\sigma$ | dB           | 0   |                          |                          |
| Uplink downlink configuration  |          |              | 2   |                          |                          |
| Special subframe configuration   |          |              | 4   |                          |                          |
| Propagation condition and antenna configuration  |          |              | 2 x 2 EPA5  |                          |                          |
| CodeBookSubsetRestriction bitmap   |          |              | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |                          |
| Antenna correlation  |          |              | Low   | Low                      | High                     |
| RI configuration   |          |              | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR  |          | dB           | 0   | 20                       | 20                       |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -98   | -78                      | -78                      |
| Maximum number of HARQ transmissions   |          |              | 1   |                          |                          |
| Reporting mode   |          |              | PUSCH 3-1 (Note 3)  |                          |                          |
| Reporting interval   |          | ms           | 5   |                          |                          |
| PMI and CQI delay  |          | ms           | 10 or 11  |                          |                          |
| ACK/NACK feedback mode   |          |              | Bundling  |                          |                          |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |          |              |   |                          |                          |
| Note 2: Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |          |              |   |                          |                          |
| Note 3: Reported wideband CQI and PMI are used and sub-band CQI is discarded.  |          |              |   |                          |                          |

**Table 9.5.1.2-2: Minimum requirement (TDD)**

|             | Test 1   | Test 2   | Test 3   |
|-------------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      |
| $\gamma_2$  | 1        | N/A      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ |

## 9.5.2 Minimum requirement (CSI Reference Symbols)

### 9.5.2.1 FDD

The minimum performance requirement in Table 9.5.2.1-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.5.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.2.1-2.

**Table 9.5.2.1-1: RI Test (FDD)**

| Parameter                 | Unit     | Test 1 | Test 2 | Test 3 |
|---------------------------|----------|--------|--------|--------|
| Bandwidth                 | MHz      | 10     |        |        |
| PDSCH transmission mode   |          | 9      |        |        |
| Downlink power allocation | $\rho_A$ | dB     | 0      |        |
|                           | $\rho_B$ | dB     | 0      |        |



|  |          |              |   |                          |                          |
|--|----------|--------------|---|--------------------------|--------------------------|
|  | Pc       | dB           | 0   |                          |                          |
|  | $\sigma$ | dB           | 0   |                          |                          |
| Propagation condition and antenna configuration  |          |              | 2 x 2 EPA5  |                          |                          |
| Cell-specific reference signals  |          |              | Antenna ports 0   |                          |                          |
| Beamforming Model  |          |              | As specified in Section B.4.3   |                          |                          |
| CSI reference signals  |          |              | Antenna ports 15, 16  |                          |                          |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              | 5/1   |                          |                          |
| CSI reference signal configuration   |          |              | 6   |                          |                          |
| CodeBookSubsetRestriction bitmap   |          |              | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |                          |
| Antenna correlation  |          |              | Low   | Low                      | High                     |
| RI configuration   |          |              | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR  |          | dB           | 0   | 20                       | 20                       |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -98   | -78                      | -78                      |
| Maximum number of HARQ transmissions   |          |              | 1   |                          |                          |
| Reporting mode   |          |              | PUCCH 1-1   |                          |                          |
| Physical channel for CQI/PMI reporting   |          |              | PUSCH (Note 3)  |                          |                          |
| PUCCH Report Type for CQI/PMI  |          |              | 2   |                          |                          |
| Physical channel for RI reporting  |          |              | PUCCH Format 2  |                          |                          |
| PUCCH Report Type for RI   |          |              | 3   |                          |                          |
| Reporting periodicity  |          | ms           | $N_{pd} = 5$  |                          |                          |
| PMI and CQI delay  |          | ms           | 8   |                          |                          |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 2   |                          |                          |
| <i>ri-ConfigurationInd</i>   |          |              | 1 (Note 4)  |                          |                          |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 2: Reference measurement channel RC.9 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.</p> <p>Note 4: To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.</p> |          |              |   |                          |                          |

**Table 9.5.2.1-2: Minimum requirement (FDD)**

|             | Test 1   | Test 2   | Test 3   |
|-------------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      |
| $\gamma_2$  | 1        | N/A      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ |

**9.5.2.2 TDD**

The minimum performance requirement in Table 9.5.2.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.5.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.2.2-2.

**Table 9.5.2.2-1: RI Test (TDD)**

| Parameter  | Unit  | Test 1                   | Test 2  | Test 3                   |
|--|---|--------------------------|---|--------------------------|
| Bandwidth  | MHz   |                          | 10  |                          |
| PDSCH transmission mode  |   |                          | 9   |                          |
| Downlink power allocation  | $\rho_A$  | dB                       | 0   |                          |
|  | $\rho_B$  | dB                       | 0   |                          |
|  | $P_C$   | dB                       | 0   |                          |
|  | $\sigma$  | dB                       | 0   |                          |
| Uplink downlink configuration  |   |                          | 1   |                          |
| Special subframe configuration   |   |                          | 4   |                          |
| Propagation condition and antenna configuration  |   |                          | 2 x 2 EPA5  |                          |
| Cell-specific reference signals  |   |                          | Antenna ports 0   |                          |
| CSI reference signals  |   |                          | Antenna ports 15, 16  |                          |
| Beamforming Model  |   |                          | As specified in Section B.4.3   |                          |
| CSI reference signal configuration   |   |                          | 4   |                          |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   |                          | 5/4   |                          |
| CodeBookSubsetRestriction bitmap   |   |                          | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |
| Antenna correlation  |   | Low                      | Low   | High                     |
| RI configuration   |   | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI  | Fixed RI=1 and follow RI |
| SNR  | dB  | 0                        | 20  | 20                       |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98                      | -98   | -98                      |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]  | -98                      | -78   | -78                      |
| Maximum number of HARQ transmissions   |   |                          | 1   |                          |
| Reporting mode   |   |                          | PUCCH 1-1   |                          |
| Physical channel for CQI/ PMI reporting  |   |                          | PUSCH (Note 3)  |                          |
| PUCCH report type for CQI/ PMI   |   |                          | 2   |                          |
| Physical channel for RI reporting  |   |                          | PUCCH Format 2  |                          |
| Reporting periodicity  | ms  |                          | $N_{pd} = 5$  |                          |
| PMI and CQI delay  | ms  |                          | 10  |                          |
| ACK/NACK feedback mode   |   |                          | Bundling  |                          |
| <i>cqi-pmi-ConfigurationIndex</i>  |   |                          | 4   |                          |
| <i>ri-ConfigurationInd</i>   |   |                          | 1   |                          |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).                      |                          |   |                          |
| Note 2:  | Reference measurement channel RC.9 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |                          |   |                          |
| Note 3:  | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#3 and #8. |                          |   |                          |

**Table 9.5.2.2-2: Minimum requirement (TDD)**

|             | Test 1   | Test 2   | Test 3   |
|-------------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      |
| $\gamma_2$  | 1        | N/A      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ |

### 9.5.3 Minimum requirement (CSI measurements in case two CSI subframe sets are configured)

#### 9.5.3.1 FDD

The minimum performance requirement in Table 9.5.3.1-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$

For the parameters specified in Table 9.5.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.3.1-2.

**Table 9.5.3.1-1: RI Test (FDD)**

| Parameter                                       |                 | Unit         | Test 1  |  | Test 2  |  |
|---|-----------------|--------------|---|--|---|--|
|   |                 |              | Cell 1  | Cell 2                                       | Cell 1  | Cell 2                                       |
| Bandwidth                                       |                 | MHz          | 10  |  | 10  |  |
| PDSCH transmission mode                         |                 |              | 3   | Note 10                                      | 3   | Note 10                                      |
| Downlink power allocation                       | $\rho_A$        | dB           | -3  |  | -3  |  |
|   | $\rho_B$        | dB           | -3  |  | -3  |  |
|   | $\sigma$        | dB           | 0   |  | 0   |  |
| Propagation condition and antenna configuration |                 |              | 2 x 2 EPA5  |  | 2 x 2 EPA5  |  |
| CodeBookSubsetRestriction bitmap                |                 |              | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A  | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A  |
| Antenna correlation                             |                 |              | Low   |  | Low   |  |
| RI configuration                                |                 |              | Fixed RI=1 and follow RI  | N/A  | Fixed RI=1 and follow RI  | N/A  |
| $\widehat{E}_s / N_{oc2}$                       |                 | dB           | 0   | -12  | 20  | 6  |
| $N_{oc}^{(j)}$                                  | $N_{oc1}^{(j)}$ | dBmW/15kHz   | -98 (Note 3)  | N/A  | -102 (Note 3)   | N/A  |
|   | $N_{oc2}^{(j)}$ |              | -98 (Note 4)  | N/A  | -98 (Note 4)  | N/A  |
|   | $N_{oc3}^{(j)}$ |              | -98 (Note 5)  | N/A  | -94.8 (Note 5)  | N/A  |
| $\widehat{I}_{or}^{(j)}$                        |                 | dB[mW/15kHz] | -98   | -110   | -78   | -92  |
| Subframe Configuration                          |                 |              | Non-MBSFN   | Non-MBSFN                                    | Non-MBSFN   | Non-MBSFN                                    |
| Cell Id   |                 |              | 0   | 1  | 0   | 1  |
| Time Offset between Cells                       |                 | $\mu s$      | 2.5 (synchronous cells)   |  | 2.5 (synchronous cells)   |  |
| ABS Pattern (Note 6)                            |                 |              | N/A   | 10000000<br>10000000<br>10000000<br>10000000 | N/A   | 10000000<br>10000000<br>10000000<br>10000000 |

|   |  |  |          |  |          |
|---|--|--|----------|--|----------|
|   |  |  | 10000000 |  | 10000000 |
| RLM/RRM Measurement Subframe Pattern (Note 7) |  | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A      | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A      |
| CSI Subframe Sets (Note 8)                    | C <sub>CSI,0</sub>   | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A      | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A      |
|   | C <sub>CSI,1</sub>   | 01111111<br>01111111<br>01111111<br>01111111<br>01111111 |          | 01111111<br>01111111<br>01111111<br>01111111<br>01111111 |          |
| Number of control OFDM Symbols                |  | 3  | 3        | 3  | 3        |
| Maximum number of HARQ transmissions          |  | 1  |          | 1  |          |
| Reporting mode                                |  | PUCCH 1-0  |          | PUCCH 1-0  |          |
| Physical channel for CQI reporting            |  | PUCCH Format 2   |          | PUCCH Format 2   |          |
| PUCCH Report Type for CQI                     |  | 4  |          | 4  |          |
| Physical channel for RI reporting             |  | PUCCH Format 2   |          | PUCCH Format 2   |          |
| PUCCH Report Type for RI                      |  | 3  |          | 3  |          |
| Reporting periodicity                         | ms   | $N_{pd} = 10$  |          | $N_{pd} = 10$  |          |
| <i>cqi-pmi-ConfigurationIndex</i>             |  | 11   |          | 11   |          |
| <i>ri-ConfigurationInd</i>                    |  | 5  |          | 5  |          |
| <i>cqi-pmi-ConfigurationIndex2</i>            |  | 10   |          | 10   |          |
| <i>ri-ConfigurationInd2</i>                   |  | 2  |          | 2  |          |
| Cyclic prefix                                 |  | Normal   | Normal   | Normal   | Normal   |
| Note 1:                                       | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |  |          |  |          |
| Note 2:                                       | Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |  |          |  |          |
| Note 3:                                       | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.   |  |          |  |          |
| Note 4:                                       | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.  |  |          |  |          |
| Note 5:                                       | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS   |  |          |  |          |
| Note 6:                                       | ABS pattern as defined in [9].   |  |          |  |          |
| Note 7:                                       | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].   |  |          |  |          |
| Note 8:                                       | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].   |  |          |  |          |
| Note 9:                                       | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell 1 and Cell 2 is the same.  |  |          |  |          |
| Note 10:                                      | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5.  |  |          |  |          |

**Table 9.5.3.1-2: Minimum requirement (FDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma_1$  | 0.9      | 1.05     |
| UE Category | $\geq 2$ | $\geq 2$ |

9.5.3.2 TDD

The minimum performance requirement in Table 9.5.3.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ .

For the parameters specified in Table 9.5.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.3.2-2.

**Table 9.5.3.2-1: RI Test (TDD)**

| Parameter                                       |                | Unit          | Test1   |                                  | Test2   |                          |
|---|----------------|---------------|---|----------------------------------|---|--------------------------|
|   |                |               | Cell 1  | Cell 2                           | Cell 1  | Cell 2                   |
| Bandwidth                                       |                | MHz           | 10  |                                  | 10  |                          |
| PDSCH transmission mode                         |                |               | 3   | Note 11                          | 3   | Note 11                  |
| Uplink downlink configuration                   |                |               | 1   |                                  | 1   |                          |
| Special subframe configuration                  |                |               | 4   |                                  | 4   |                          |
| Downlink power allocation                       | $\rho_A$       | dB            | -3  |                                  | -3  |                          |
|   | $\rho_B$       | dB            | -3  |                                  | -3  |                          |
|   | $\sigma$       | dB            | 0   |                                  | 0   |                          |
| Propagation condition and antenna configuration |                |               | 2 x 2 EPA5  |                                  | 2 x 2 EPA5  |                          |
| CodeBookSubsetRestriction bitmap                |                |               | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A                              | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A                      |
| Antenna correlation                             |                |               | Low   |                                  | Low   |                          |
| RI configuration                                |                |               | Fixed RI=1 and follow RI  | N/A                              | Fixed RI=1 and follow RI  | N/A                      |
| $\hat{E}_s/N_{oc2}$                             |                | dB            | 0   | -12                              | 20  | 6                        |
| $N_{oc}^{(j)}$                                  | $N_{od}^{(j)}$ | dB[mW/15k Hz] | -98 (Note 4)  | N/A                              | -102 (Note 4)   | N/A                      |
|   | $N_{o2}^{(j)}$ |               | -98 (Note 5)  | N/A                              | -98 (Note 5)  | N/A                      |
|   | $N_{o3}^{(j)}$ |               | -98 (Note 6)  | N/A                              | -94.8 (Note 6)  | N/A                      |
| $\hat{I}_{or}^{(j)}$                            |                | dB[mW/15k Hz] | -98   | -110                             | -78   | -92                      |
| Subframe Configuration                          |                |               | Non-MBSFN   | Non-MBSFN                        | Non-MBSFN   | Non-MBSFN                |
| Cell Id   |                |               | 0   | 1                                | 0   | 1                        |
| Time Offset between Cells                       |                | $\mu s$       | 2.5 (synchronous cells)   |                                  | 2.5 (synchronous cells)   |                          |
| ABS Pattern (Note 7)                            |                |               | N/A   | 0000000<br>001<br>0000000<br>001 | N/A   | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 8)   |                |               | 00000000<br>01<br>00000000<br>01                                    | N/A                              | 0000000001<br>0000000001  | N/A                      |
| CSI Subframe Sets (Note 9)                      | $C_{csi,0}$    |               | 00000000<br>01<br>00000000<br>01                                    | N/A                              | 0000000001<br>0000000001  | N/A                      |
|   | $C_{csi,1}$    |               | 11001110<br>00<br>11001110<br>00                                    |                                  | 1100111000<br>1100111000  |                          |
| Number of control OFDM Symbols                  |                |               | 3   | 3                                | 3   | 3                        |
| Maximum number of HARQ transmissions            |                |               | 1   |                                  | 1   |                          |
| Reporting mode                                  |                |               | PUCCH 1-0   |                                  | PUCCH 1-0   |                          |

|   |  |                |        |                |        |
|---|--|----------------|--------|----------------|--------|
| Physical channel for $C_{CSI,0}$ CQI and RI reporting |  | PUCCH Format 2 |        | PUCCH Format 2 |        |
| PUCCH Report Type for CQI                             |  | 4              |        | 4              |        |
| Physical channel for $C_{CSI,1}$ CQI and RI reporting |  | PUSCH (Note 3) |        | PUSCH (Note 3) |        |
| PUCCH Report Type for RI                              |  | 3              |        | 3              |        |
| Reporting periodicity                                 | ms   | $N_{pd}=10$    |        | $N_{pd}=10$    |        |
| ACK/NACK feedback mode                                |  | Multiplexing   |        | Multiplexing   |        |
| <i>cqi-pmi-ConfigurationIndex</i>                     |  | 8              |        | 8              |        |
| <i>ri-ConfigurationInd</i>                            |  | 5              |        | 5              |        |
| <i>cqi-pmi-ConfigurationIndex2</i>                    |  | 9              |        | 9              |        |
| <i>ri-ConfigurationInd2</i>                           |  | 0              |        | 0              |        |
| Cyclic prefix   |  | Normal         | Normal | Normal         | Normal |
| Note 1:   | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).   |                |        |                |        |
| Note 2:   | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |                |        |                |        |
| Note 3:   | To avoid collisions between RI/CQI reports and HARQ-ACK it is necessary to report them on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI/CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |                |        |                |        |
| Note 4:   | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS   |                |        |                |        |
| Note 5:   | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.  |                |        |                |        |
| Note 6:   | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS   |                |        |                |        |
| Note 7:   | ABS pattern as defined in [9].   |                |        |                |        |
| Note 8:   | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].   |                |        |                |        |
| Note 9:   | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].   |                |        |                |        |
| Note 10:  | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell 1 and Cell 2 is the same.  |                |        |                |        |
| Note 11:  | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5.  |                |        |                |        |

Table 9.5.3.2-2: Minimum requirement (TDD)

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma$    | 0.9      | 1.05     |
| UE Category | $\geq 2$ | $\geq 2$ |

## 9.5.4 Minimum requirement (CSI measurements in case two CSI subframe sets are configured and CRS assistance information are configured)

### 9.5.4.1 FDD

For the parameters specified in Table 9.5.4.1-1, the minimum performance requirement in Table 9.5.4.1-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

In Table 9.5.4.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

Table 9.5.4.1-1: RI Test (FDD)

| Parameter                                       |             | Unit         | Cell 1  | Cell 2   | Cell 3   |
|---|-------------|--------------|---|--|--|
| Bandwidth                                       |             | MHz          | 10  | 10   | 10   |
| PDSCH transmission mode                         |             |              | 3   | As defined in Note 1                                     | As defined in Note 1                                     |
| Downlink power allocation                       | $\rho_A$    | dB           | -3  | -3   | -3   |
|   | $\rho_B$    | dB           | -3  | -3   | -3   |
|   | $\sigma$    | dB           | 0   | N/A  | N/A  |
| Propagation condition and antenna configuration |             |              | 2x2 EPA5 (Note 2)   | 2x2 EPA5 (Note 2)  | 2x2 EPA5 (Note 2)  |
| CodeBookSubsetRestriction bitmap                |             |              | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | As defined in Note 1                                     | As defined in Note 1                                     |
| $N_{oc}$ at antenna port                        | $N_{oc1}$   | dB[mW/15kHz] | -98 (Note 3)  | N/A  | N/A  |
|   | $N_{oc2}$   | dB[mW/15kHz] | -98 (Note 4)  | N/A  | N/A  |
|   | $N_{oc3}$   | dB[mW/15kHz] | -93 (Note 5)  | N/A  | N/A  |
| $\hat{E}_s / N_{oc2}$                           |             | dB           | Reference Value in Table 9.5.4.1-2 for each test                    | 12   | 10   |
| $\hat{I}_{or}^{(j)}$                            |             | dB[mW/15kHz] | Reference Value in Table 9.5.4.1-2 for each test                    | -86  | -88  |
| Subframe Configuration                          |             |              | Non-MBSFN   | Non-MBSFN  | Non-MBSFN  |
| Time Offset between Cells                       |             | $\mu$ s      | N/A   | 3  | -1   |
| Frequency shift between Cells                   |             | Hz           | N/A   | 300  | -100   |
| Cell Id   |             |              | 0   | 126  | 1  |
| ABS pattern (Note 6)                            |             |              | N/A   | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 |
| RLM/RRM Measurement Subframe Pattern (Note 7)   |             |              | 10000000<br>10000000<br>10000000<br>10000000<br>10000000            | N/A  | N/A  |
| CSI Subframe Sets (Note 8)                      | $C_{CSI,0}$ |              | 10000000<br>10000000<br>10000000<br>10000000<br>10000000            | N/A  | N/A  |
|   | $C_{CSI,1}$ |              | 01111111<br>01111111<br>01111111<br>01111111<br>01111111            | N/A  | N/A  |
| Number of control OFDM symbols                  |             |              | 3   | Note 9   | Note 9   |
| Maximum number of HARQ transmissions            |             |              | 1   | N/A  | N/A  |
| Reporting mode                                  |             |              | PUCCH 1-0   | N/A  | N/A  |
| Physical channel for CQI reporting              |             |              | PUCCH format 2  | N/A  | N/A  |
| PUCCH Report Type for CQI                       |             |              | 4   | N/A  | N/A  |
| Physical channel for RI reporting               |             |              | PUCCH Format 2  | N/A  | N/A  |
| PUCCH Report Type for RI                        |             |              | 3   | N/A  | N/A  |
| Reporting periodicity                           |             | ms           | $N_{pd} = 10$   | N/A  | N/A  |

|                                    |  |        |        |        |
|------------------------------------|--|--------|--------|--------|
| <i>cqi-pmi-ConfigurationIndex</i>  |  | 11     | N/A    | N/A    |
| <i>ri-ConfigurationInd</i>         |  | 5      | N/A    | N/A    |
| <i>cqi-pmi-ConfigurationIndex2</i> |  | 10     | N/A    | N/A    |
| <i>ri-ConfigurationInd2</i>        |  | 2      | N/A    | N/A    |
| Cyclic prefix                      |  | Normal | Normal | Normal |
| Note 1:                            | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern OP.5 FDD as defined in Annex A.5.1.5.  |        |        |        |
| Note 2:                            | The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  |        |        |        |
| Note 3:                            | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.  |        |        |        |
| Note 4:                            | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.  |        |        |        |
| Note 5:                            | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS   |        |        |        |
| Note 6:                            | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |        |        |        |
| Note 7:                            | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]  |        |        |        |
| Note 8:                            | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].   |        |        |        |
| Note 9:                            | The number of control OFDM symbols is not available for ABS and is 3 for the subframe indicated by "0" of ABS pattern.   |        |        |        |
| Note 10:                           | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).   |        |        |        |
| Note 11:                           | Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |        |        |        |
| Note 12:                           | The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.  |        |        |        |
| Note 13:                           | SIB-1 will not be transmitted in Cell2 and Cell 3 in this test.  |        |        |        |

**Table 9.5.4.1-2: Minimum requirement (FDD)**

|  | Test 1                                     | Test 2                            | Test 3                                     |
|--|--|-----------------------------------|--|
| $\hat{E}_s / N_{oc2}$ for Cell 1 (dB)          | 4  | 20                                | 20   |
| $\hat{I}_{or}^{(j)}$ for Cell 1 (dB[mW/15kHz]) | -94  | -78                               | -78  |
| Antenna correlation                            | High for Cell 1, low for Cell 2 and Cell 3 | Low for Cell 1, Cell 2 and Cell 3 | High for Cell 1, low for Cell 2 and Cell 3 |
| $\gamma_1$                                     | N/A  | 1.05                              | 0.9  |
| $\gamma_2$                                     | 1.05                                       | N/A                               | N/A  |
| UE Category                                    | $\geq 2$                                   | $\geq 2$                          | $\geq 2$                                   |

### 9.5.4.2 TDD

For the parameters specified in Table 9.5.4.2-1, the minimum performance requirement in Table 9.5.4.2-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

In Table 9.5.4.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 9.5.4.2-1: RI Test (TDD)**

| Parameter                     | Unit | Cell 1 | Cell 2               | Cell 3               |
|-------------------------------|------|--------|----------------------|----------------------|
| Bandwidth                     | MHz  | 10     | 10                   | 10                   |
| PDSCH transmission mode       |      | 3      | As defined in Note 1 | As defined in Note 1 |
| Uplink downlink configuration |      | 1      | 1                    | 1                    |



|   |             |              |   |                        |                        |
|---|-------------|--------------|---|------------------------|------------------------|
| Special subframe configuration                        |             |              | 4   | 4                      | 4                      |
| Downlink power allocation                             | $\rho_A$    | dB           | -3  | -3                     | -3                     |
|   | $\rho_B$    | dB           | -3  | -3                     | -3                     |
|   | $\sigma$    | dB           | 0   | N/A                    | N/A                    |
| Propagation condition and antenna configuration       |             |              | 2x2 EPA5 (Note 2)   | 2x2 EPA5 (Note 2)      | 2x2 EPA5 (Note 2)      |
| CodeBookSubsetRestriction bitmap                      |             |              | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | As defined in Note 1   | As defined in Note 1   |
| $N_{oc}$ at antenna port                              | $N_{oc1}$   | dB[mW/15kHz] | -98 (Note 3)  | N/A                    | N/A                    |
|   | $N_{oc2}$   | dB[mW/15kHz] | -98 (Note 4)  | N/A                    | N/A                    |
|   | $N_{oc3}$   | dB[mW/15kHz] | -93 (Note 5)  | N/A                    | N/A                    |
| $\hat{E}_s / N_{oc2}$                                 |             | dB           | Reference Value in Table 9.5.4.2-2 for each test                    | 12                     | 10                     |
| $\hat{i}_{or}^{(j)}$                                  |             | dB[mW/15kHz] | Reference Value in Table 9.5.4.2-2 for each test                    | -86                    | -88                    |
| Subframe Configuration                                |             |              | Non-MBSFN   | Non-MBSFN              | Non-MBSFN              |
| Time Offset between Cells                             |             | $\mu$ s      | N/A   | 3                      | -1                     |
| Frequency shift between Cells                         |             | Hz           | N/A   | 300                    | -100                   |
| Cell Id   |             |              | 0   | 126                    | 1                      |
| ABS pattern (Note 6)                                  |             |              | N/A   | 000000001<br>000000001 | 000000001<br>000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 7)         |             |              | 000000001<br>000000001  | N/A                    | N/A                    |
| CSI Subframe Sets (Note 8)                            | $C_{CSI,0}$ |              | 000000001<br>000000001  | N/A                    | N/A                    |
|   | $C_{CSI,1}$ |              | 1100111000<br>1100111000  | N/A                    | N/A                    |
| Number of control OFDM symbols                        |             |              | 3   | Note 9                 | Note 9                 |
| Maximum number of HARQ transmissions                  |             |              | 1   | N/A                    | N/A                    |
| Reporting mode  |             |              | PUCCH 1-0   | N/A                    | N/A                    |
| Physical channel for $C_{CSI,0}$ CQI and RI reporting |             |              | PUCCH format 2  | N/A                    | N/A                    |
| Physical channel for $C_{CSI,1}$ CQI and RI reporting |             |              | PUSCH (Note 14)   | N/A                    | N/A                    |
| PUCCH Report Type for CQI                             |             |              | 4   | N/A                    | N/A                    |
| PUCCH Report Type for RI                              |             |              | 3   | N/A                    | N/A                    |
| Reporting periodicity                                 |             | ms           | $N_{pd}=10$   | N/A                    | N/A                    |
| ACK/NACK feedback mode                                |             |              | Multiplexing  | N/A                    | N/A                    |
| <i>cqi-pmi-ConfigurationIndex</i>                     |             |              | 8   | N/A                    | N/A                    |
| <i>ri-ConfigurationInd</i>                            |             |              | 5   | N/A                    | N/A                    |
| <i>cqi-pmi-ConfigurationIndex2</i>                    |             |              | 9   | N/A                    | N/A                    |
| <i>ri-ConfigurationInd2</i>                           |             |              | 0   | N/A                    | N/A                    |
| Cyclic prefix   |             |              | Normal  | Normal                 | Normal                 |

- Note 1: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern OP.5 TDD as defined in Annex A.5.2.5.
- Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
- Note 3: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
- Note 4: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
- Note 5: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
- Note 6: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
- Note 7: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
- Note 8: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
- Note 9: The number of control OFDM symbols is not available for ABS and is 3 for the subframe indicated by "0" of ABS pattern.
- Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
- Note 11: Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.
- Note 12: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.
- Note 13: SIB-1 will not be transmitted in Cell2 and Cell 3 in this test.
- Note 14: To avoid collisions between RI/CQI reports and HARQ-ACK it is necessary to report them on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI/CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.

**Table 9.5.4.2-2: Minimum requirement (TDD)**

|  | <b>Test 1</b>                              | <b>Test 2</b>                     | <b>Test 3</b>                              |
|--|--|-----------------------------------|--|
| $\bar{E}_s / N_{oc2}$ for Cell 1 (dB)          | 4  | 20                                | 20   |
| $\hat{I}_{or}^{(j)}$ for Cell 1 (dB[mW/15kHz]) | -94  | -78                               | -78  |
| Antenna correlation                            | High for Cell 1, low for Cell 2 and Cell 3 | Low for Cell 1, Cell 2 and Cell 3 | High for Cell 1, low for Cell 2 and Cell 3 |
| $\gamma_1$                                     | N/A  | 1.05                              | 0.9  |
| $\gamma_2$                                     | 1.05                                       | N/A                               | N/A  |
| UE Category                                    | $\geq 2$                                   | $\geq 2$                          | $\geq 2$                                   |

### 9.5.5 Minimum requirement (with CSI process)

Each CSI process is associated with a CSI-RS resource and a CSI-IM resource as shown in Table 9.5.5-1.

For UE supports one CSI process, CSI process 0 is configured for Test 1 and Test 2, but CSI process 1 is not configured for Test 2. The corresponding  $\gamma$  requirements for Test 1 and Test 2 shall be fulfilled. The requirement on reported RI for CSI process 1 in Test 2 is not applicable.

For UE supports multiple CSI processes, CSI process 0 is configured for Test 1 and CSI processes 0 and 1 are configured for Test 2. The corresponding  $\gamma$  requirements for Test 1 and Test 2 shall be fulfilled, and also the requirement on reported RI for CSI process 1 in Test 2.

**Table 9.5.5-1: Configuration of CSI processes**

|                 | <b>CSI process 0</b> | <b>CSI process 1</b> |
|-----------------|----------------------|----------------------|
| CSI-RS resource | CSI-RS signal 0      | CSI-RS signal 1      |
| CSI-IM resource | CSI-IM resource 0    | CSI-IM resource 1    |

## 9.5.5.1 FDD

The minimum performance requirement in Table 9.5.5.1-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;
- c) For Test 2, the RI reported for CSI process 1 shall be the same as the most recent RI reported for CSI process 0 if UE is configured with multiple CSI processes.

For the parameters specified in Table 9.5.5.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.5.1-2.

Table 9.5.5.1-1: RI Test (FDD)

| Parameter  |              | Unit | Test 1                        |                             | Test 2                        |                              |
|--|--------------|------|-------------------------------|-----------------------------|-------------------------------|------------------------------|
|  |              |      | TP1                           | TP2                         | TP1                           | TP2                          |
| Bandwidth  |              | MHz  | 10 MHz                        |                             | 10 MHz                        |                              |
| Transmission mode  |              |      | 10                            | 10                          | 10                            | 10                           |
| Downlink power allocation  | $\rho_A$     | dB   | 0                             |                             | 0                             |                              |
|  | $\rho_B$     | dB   | 0                             |                             | 0                             |                              |
|  | $P_c$        | dB   | 0                             | 0                           | 0                             | 0                            |
|  | $\sigma$     | dB   | 0                             |                             | 0                             |                              |
| SNR  | dB           | 0    | 0                             | 20                          | 20                            |                              |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -98  | -98                           | -78                         | -78                           |                              |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98  |                               | -98                         |                               |                              |
| Propagation channel  |              |      | EPA 5 Low                     | EPA 5 Low                   | EPA 5 Low                     | EPA 5 High                   |
| Antenna configuration  |              |      | 2x2                           | 2x2                         | 2x2                           | 2x2                          |
| Beamforming Model  |              |      | As specified in Section B.4.3 |                             | As specified in Section B.4.3 |                              |
| Timing offset between TPs  |              | us   | 0                             |                             | 0                             |                              |
| Frequency offset between TPs   |              | Hz   | 0                             |                             | 0                             |                              |
| Cell-specific reference signals  |              |      | Antenna ports 0               |                             | Antenna ports 0               |                              |
| CSI-RS signal 0  |              |      | Antenna ports 15,16           | N/A                         | Antenna ports 15,16           | N/A                          |
| CSI-RS 0 periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              |      | 5/1                           | N/A                         | 5/1                           | N/A                          |
| CSI-RS 0 configuration   |              |      | 0                             | N/A                         | 0                             | N/A                          |
| CSI-RS signal 1  |              |      | N/A                           | Antenna ports 15,16         | N/A                           | Antenna ports 15,16          |
| CSI-RS 1 periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              |      | N/A                           | 5/1                         | N/A                           | 5/1                          |
| CSI-RS 1 configuration   |              |      | N/A                           | 3                           | N/A                           | 3                            |
| Zero-power CSI-RS 0 configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |              |      | N/A                           | 1 /<br>10000010000<br>00000 | N/A                           | 1] /<br>10000010000<br>00000 |
| Zero-power CSI-RS 1 configuration<br>$l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |              |      | 1 /<br>00110000000<br>00000   | N/A                         | 1 /<br>00110000000<br>00000   | N/A                          |
| CSI-IM 0 periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              |      | 5/1                           | N/A                         | 5/1                           | N/A                          |
| CSI-IM 0 configuration   |              |      | 2                             | N/A                         | 2                             | N/A                          |
| CSI-IM 1 periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |              |      | N/A                           | 5/1                         | N/A                           | 5/1                          |
| CSI-IM 1 configuration   |              |      | N/A                           | 6                           | N/A                           | 6                            |
| RI configuration   |              |      | Fixed RI=2<br>and follow RI   | N/A                         | Fixed RI=1<br>and follow RI   | N/A                          |
| Physical channel for CQI/PMI reporting                                     |              |      | PUSCH (Note 6)                | N/A                         | PUSCH (Note 6)                | PUSCH (Note 6)               |
| PUCCH Report Type for CQI/PMI  |              |      | 2                             | N/A                         | 2                             | 2                            |

|                                      |   |    |  |                        |  |                        |
|--------------------------------------|---|----|--|------------------------|--|------------------------|
| Physical channel for RI reporting    |   |    | PUCCH Format 2                                       | N/A                    | PUCCH Format 2                                       | PUCCH Format 2         |
| PUCCH Report Type for RI             |   |    | 3  | N/A                    | 3  | 3                      |
| CSI process 0<br>(Note 7)            | CSI-RS  |    | CSI-RS 0   | N/A                    | CSI-RS 0   | N/A                    |
|                                      | CSI-IM  |    | CSI-IM 0   | N/A                    | CSI-IM 0   | N/A                    |
|                                      | Reporting mode  |    | PUCCH 1-1  | N/A                    | PUCCH 1-1  | N/A                    |
|                                      | Reporting periodicity   | ms | $N_{pd} = 5$   | N/A                    | $N_{pd} = 5$   | N/A                    |
|                                      | CQI delay   | ms | 8  | N/A                    | 10   | N/A                    |
|                                      | <i>cqi-pmi-ConfigurationIndex</i>   |    | 6  | N/A                    | 6  | N/A                    |
|                                      | <i>ri-ConfigIndex</i>   |    | 1  | N/A                    | 1  | N/A                    |
| CSI process 1<br>(Note 7, Note 9)    | CSI-RS  |    | N/A  | N/A                    | N/A  | CSI-RS 1               |
|                                      | CSI-IM  |    | N/A  | N/A                    | N/A  | CSI-IM 1               |
|                                      | Reporting mode  |    | N/A  | N/A                    | N/A  | PUCCH 1-1              |
|                                      | Reporting periodicity   | ms | N/A  | N/A                    | N/A  | $N_{pd} = 5$           |
|                                      | CQI delay   | ms | N/A  | N/A                    | N/A  | 10                     |
|                                      | <i>cqi-pmi-ConfigurationIndex</i>   |    | N/A  | N/A                    | N/A  | 4                      |
|                                      | <i>ri-ConfigIndex</i>   |    | N/A  | N/A                    | N/A  | 1                      |
| CSI process for PDSCH scheduling     |   |    | CSI process 0  |                        | CSI process 0  |                        |
| Cell ID                              |   |    | 0  | 6                      | 0  | 6                      |
| Quasi-co-located CSI-RS              |   |    | CSI-RS 0   | CSI-RS 1               | CSI-RS 0   | CSI-RS 1               |
| Quasi-co-located CRS                 |   |    | Same Cell ID as Cell 1                               | Same Cell ID as Cell 2 | Same Cell ID as Cell 1                               | Same Cell ID as Cell 2 |
| PMI for subframe 2, 3, 4, 7, 8 and 9 |   |    | 010000 for fixed RI = 2<br>010011 for UE reported RI | 100000                 | 000011 for fixed RI = 1<br>010011 for UE reported RI | N/A                    |
| PMI for subframe 1 and 6             |   |    | 100000   | 100000                 | 100000   | N/A                    |
| Max number of HARQ transmissions     |   |    | 1  | N/A                    | 1  | N/A                    |
| Note 1:                              | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |    |  |                        |  |                        |
| Note 2:                              | 3 symbols allocated to PDCCH  |    |  |                        |  |                        |
| Note 3:                              | Reference measurement channel RC.13 FDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 2, 3, 4, 7, 8 and 9 from TP1.   |    |  |                        |  |                        |
| Note 4:                              | TM10 OCNG as specified in A.5.1.8 is transmitted on subframe 1 and 6 from TP1.  |    |  |                        |  |                        |
| Note 5:                              | TM10 OCNG as specified in A.5.1.8 is transmitted on subframe 1, 2, 3, 4, 6, 7, 8 and 9 from TP2 for Test 1; TP2 is blanked for Test 2.  |    |  |                        |  |                        |
| Note 6:                              | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5. |    |  |                        |  |                        |
| Note 7:                              | If UE supports multiple CSI processes, CSI process 0 is configured as 'RI-reference CSI process' for CSI process 1.   |    |  |                        |  |                        |
| Note 8:                              | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.   |    |  |                        |  |                        |
| Note 9:                              | If UE supports one CSI process, CSI process 1 is not configured in Test 2.  |    |  |                        |  |                        |

**Table 9.5.5.1-2: Minimum requirement (FDD)**

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma_1$  | N/A      | 1.0      |
| $\gamma_2$  | 1.0      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ |

**9.5.5.2 TDD**

The minimum performance requirement in Table 9.5.5.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

- c) For Test 2, the RI reported for CSI process 1 shall be the same as the most recent RI reported for CSI process 0 if UE is configured with multiple CSI processes.

For the parameters specified in Table 9.5.5.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.5.2-2.

**Table 9.5.5.2-1: RI Test (TDD)**

| Parameter   | Unit               | Test 1                        |                       | Test 2                        |                       |
|---|--------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
|   |                    | TP1                           | TP2                   | TP1                           | TP2                   |
| Bandwidth   | MHz                | 10 MHz                        |                       | 10 MHz                        |                       |
| Transmission mode   |                    | 10                            | 10                    | 10                            | 10                    |
| Downlink power allocation   | $\rho_A$           | 0                             |                       | 0                             |                       |
|   | $\rho_B$           | 0                             |                       | 0                             |                       |
|   | $P_c$              | 0                             | 0                     | 0                             | 0                     |
|   | $\sigma$           | 0                             |                       | 0                             |                       |
| Uplink downlink configuration   |                    | 2                             | 2                     | 2                             | 2                     |
| Special subframe configuration  |                    | 4                             | 4                     | 4                             | 4                     |
| SNR   | dB                 | 0                             | 0                     | 20                            | 20                    |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz]       | -98                           | -98                   | -78                           | -78                   |
| $N_{oc}^{(j)}$  | dB[mW/15kHz]       | -98                           |                       | -98                           |                       |
| Propagation channel   |                    | EPA 5 Low                     | EPA 5 Low             | EPA 5 Low                     | EPA 5 High            |
| Antenna configuration   |                    | 2x2                           | 2x2                   | 2x2                           | 2x2                   |
| Beamforming Model   |                    | As specified in Section B.4.3 |                       | As specified in Section B.4.3 |                       |
| Timing offset between TPs   | us                 | 0                             |                       | 0                             |                       |
| Frequency offset between TPs  | Hz                 | 0                             |                       | 0                             |                       |
| Cell-specific reference signals   |                    | Antenna ports 0               |                       | Antenna ports 0               |                       |
| CSI-RS signal 0   |                    | Antenna ports 15,16           | N/A                   | Antenna ports 15,16           | N/A                   |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                    | 5/3                           | N/A                   | 5/3                           | N/A                   |
| CSI-RS 0 configuration  |                    | 0                             | N/A                   | 0                             | N/A                   |
| CSI-RS signal 1   |                    | N/A                           | Antenna ports 15,16   | N/A                           | Antenna ports 15,16   |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                    | N/A                           | 5/3                   | N/A                           | 5/3                   |
| CSI-RS 1 configuration  |                    | N/A                           | 3                     | N/A                           | 3                     |
| Zero-power CSI-RS 0 configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                    | N/A                           | 3 / 10000010000 00000 | N/A                           | 3 / 10000010000 00000 |
| Zero-power CSI-RS 1 configuration $l_{CSI-RS} / ZeroPowerCSI-RS$ bitmap |                    | 3 / 00110000000 00000         | N/A                   | 3 / 00110000000 00000         | N/A                   |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                    | 5/3                           | N/A                   | 5/3                           | N/A                   |
| CSI-IM 0 configuration  |                    | 2                             | N/A                   | 2                             | N/A                   |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$ |                    | N/A                           | 5/3                   | N/A                           | 5/3                   |
| CSI-IM 1 configuration  |                    | N/A                           | 6                     | N/A                           | 6                     |
| RI configuration  |                    | Fixed RI=2 and follow RI      | N/A                   | Fixed RI=1 and follow RI      | N/A                   |
| CSI process 0 (Note 6, 7)   | CSI-RS             | CSI-RS 0                      |                       | CSI-RS 0                      |                       |
|   | CSI-IM             | CSI-IM 0                      |                       | CSI-IM 0                      |                       |
|   | Reporting mode     | PUSCH 3-1                     |                       | PUSCH 3-1                     |                       |
|   | Reporting Interval | ms                            | 5                     | ms                            | 5                     |
|   | CQI delay          | ms                            | 11                    | ms                            | 11                    |
| CSI process 1 (Note 6, 7, 8)  | CSI-RS             | N/A                           | N/A                   | N/A                           | CSI-RS 1              |
|   | CSI-IM             | N/A                           | N/A                   | N/A                           | CSI-IM 1              |
|   | Reporting mode     | N/A                           | N/A                   | N/A                           | PUSCH 3-1             |
|   | Reporting Interval | ms                            | N/A                   | ms                            | 5                     |

|                                  |   |    |  |                        |  |                        |
|----------------------------------|---|----|--|------------------------|--|------------------------|
|                                  | CQI delay   | ms | N/A  | N/A                    | N/A  | 11                     |
| CSI process for PDSCH scheduling |   |    | CSI process 0  |                        | CSI process 0  |                        |
| Cell ID                          |   |    | 0  | 6                      | 0  | 6                      |
| Quasi-co-located CSI-RS          |   |    | CSI-RS 0   | CSI-RS 1               | CSI-RS 0   | CSI-RS 1               |
| Quasi-co-located CRS             |   |    | Same Cell ID as Cell 1                               | Same Cell ID as Cell 2 | Same Cell ID as Cell 1                               | Same Cell ID as Cell 2 |
| PMI for subframe 4 and 9         |   |    | 010000 for fixed RI = 2<br>010011 for UE reported RI | 100000                 | 000011 for fixed RI = 1<br>010011 for UE reported RI | N/A                    |
| PMI for subframe 3 and 8         |   |    | 100000   | 100000                 | 100000   | N/A                    |
| Max number of HARQ transmissions |   |    | 1  | N/A                    | 1  | N/A                    |
| ACK/NACK feedback mode           |   |    | Multiplexing   | N/A                    | Multiplexing   | N/A                    |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |    |  |                        |  |                        |
| Note 2:                          | 3 symbols allocated to PDCCH  |    |  |                        |  |                        |
| Note 3:                          | Reference measurement channel RC.13 TDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 4 and 9 from TP1.   |    |  |                        |  |                        |
| Note 4:                          | TM10 OCNG as specified in A.5.2.8 is transmitted on subframe 3 and 8 from TP1.  |    |  |                        |  |                        |
| Note 5:                          | TM10 OCNG as specified in A.5.2.8 is transmitted on subframe 3, 4, 8 and 9 from TP2 for Test 1; TP2 is blanked for Test 2.  |    |  |                        |  |                        |
| Note 6:                          | Reported wideband CQI and PMI are used and sub-band CQI is discarded.   |    |  |                        |  |                        |
| Note 7:                          | If UE supports multiple CSI processes, CSI process 0 is configured as 'RI-reference CSI process' for CSI process 1.   |    |  |                        |  |                        |
| Note 8:                          | If UE supports one CSI process, CSI process 1 is not configured in Test 2.  |    |  |                        |  |                        |
| Note 9:                          | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#7 and #2.   |    |  |                        |  |                        |

Table 9.5.5.2-2: Minimum requirement (TDD)

|             | Test 1   | Test 2   |
|-------------|----------|----------|
| $\gamma_1$  | N/A      | 1.0      |
| $\gamma_2$  | 1.0      | N/A      |
| UE Category | $\geq 2$ | $\geq 2$ |

## 9.6 Additional requirements for carrier aggregation

This clause includes requirements for the reporting of channel state information (CSI) with the UE configured for carrier aggregation. The purpose is to verify that the channel state for each cell is correctly reported with multiple cells configured for periodic reporting.

### 9.6.1 Periodic reporting on multiple cells (Cell-Specific Reference Symbols)

#### 9.6.1.1 FDD

The following requirements apply to UE Category  $\geq 3$ . For CA with 2 DL CC, for the parameters specified in Table 9.6.1.1-1 and Table 9.6.1.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband CQI}_{\text{Pcell}} - \text{wideband CQI}_{\text{Scell}} \geq 2$$

for more than 90% of the time.

Table 9.6.1.1-1: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 2 DL CA)

| Parameter                 | Unit     | Pcell | Scell |
|---------------------------|----------|-------|-------|
| PDSCH transmission mode   |          |       | 1     |
| Downlink power allocation | $\rho_A$ | dB    | 0     |
|                           | $\rho_B$ | dB    | 0     |

|   |  |                |                                      |
|---|--|----------------|--------------------------------------|
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |
| SNR   | dB   | 10             | 4                                    |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -88            | -94                                  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |
| PUCCH Report Type                               |  | 4              |                                      |
| Reporting periodicity                           | ms   | $N_{pd} = 10$  |                                      |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 11             | 16 (shift of 5 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |                |                                      |
| Note 2:   | Void   |                |                                      |

**Table 9.6.1.1-2: PUCCH 1-0 static test (FDD, 2 DL CA)**

| Test number | Bandwidth combination   |
|-------------|---|
| 1           | 10MHz for both cells  |
| 2           | 20MHz for both cells  |
| 3           | 5MHz for both cells   |
| 4           | 5MHz for PCell and 10MHz for SCell  |
| 5           | 5MHz for PCell and 15MHz for SCell  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |
| Note 2:     | Mapping of PCell and SCell to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.  |

The following requirements for 3DL CA apply to UE Category  $\geq 5$ . For CA with 3 DL CC, for the parameters specified in Table 9.6.1.1-3 and Table 9.6.1.1-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

for more than 90% of the time.

The following requirements for 4DL CA apply to UE Category  $\geq 8$ . For CA with 4 DL CC, for the parameters specified in Table 9.6.1.1-3 and Table 9.6.1.1-5, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, and SCell 1 and SCell 3 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell3} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-3: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 3 and 4 DL CA)**

| Parameter                                       | Unit     | Pcell        | Scell1 | Scell2, 3 |
|---|----------|--------------|--------|-----------|
| PDSCH transmission mode                         |          | 1            |        |           |
| Downlink power allocation                       | $\rho_A$ | dB           | 0      |           |
|   | $\rho_B$ | dB           | 0      |           |
| Propagation condition and antenna configuration |          | AWGN (1 x 2) |        |           |

|                                    |   |                |                                      |  |
|------------------------------------|---|----------------|--------------------------------------|--|
| SNR                                | dB  | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$               | dB[mW/15kHz]  | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$                     | dB[mW/15kHz]  | -98            | -98                                  | -98  |
| Physical channel for CQI reporting |   | PUCCH Format 2 |                                      |  |
| PUCCH Report Type                  |   | 4              |                                      |  |
| Reporting periodicity              | ms  | $N_{pd} = 20$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 21             | 26 (shift of 5 ms relative to Pcell) | 31 for Scell2 (shift of 10 ms relative to Pcell) , 36 for Scell3 (shift of 15ms relative to Pcell) |
| Note 1:                            | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCN Pattern OP.1 FDD as described in Annex A.5.1.1. |                |                                      |  |
| Note 2:                            | Void  |                |                                      |  |

**Table 9.6.1.1-4: PUCCH 1-0 static test (FDD, 3 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 3x20  |
| 2           | 20+20+15  |
| 3           | 20+20+10  |
| 4           | 20+15+15  |
| 5           | 20+15+10  |
| 6           | 20+10+10  |
| 7           | 15+15+10  |
| 8           | 20+10+5   |
| 9           | 20+15+5   |
| 10          | 10+10+5   |
| 11          | 5+5+20  |
| 12          | 3x10  |
| 13          | 5+5+10  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.   |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

**Table 9.6.1.1-5: PUCCH 1-0 static test (FDD, 4 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 4x20  |
| 2           | 20+20+20+10   |
| 3           | 20+20+10+10   |
| 4           | 20+20+10+5  |
| 5           | 20+10+10+5  |
| 6           | 15+3x20   |
| 7           | 2x15+2x20   |
| 8           | 10+15+2x20  |
| 9           | 3x10+20   |
| 10          | 2x5+2x20  |
| 11          | 2x5+10+20   |
| 12          | 4x10  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth   |



as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 5DL CA apply to UE Category 8 and  $\geq 11$ . For CA with 5 DL CC, for the parameters specified in Table 9.6.1.1-6 and Table 9.6.1.1-7, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, and SCell 1 and SCell 4 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-6: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 5 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3, 4   |
|---|--|----------------|--------------------------------------|--|
| PDSCH transmission mode                         |  | 1              |                                      |  |
| Downlink power allocation                       | $\rho_A$   | dB             |                                      |  |
|   | $\rho_B$   | dB             |                                      |  |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |  |
| SNR   | dB   | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98  |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |  |
| PUCCH Report Type                               |  | 4              |                                      |  |
| Reporting periodicity                           | ms   | $N_{pd} = 40$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 41             | 46 (shift of 5 ms relative to Pcell) | 51 for Scell 2 (shift of 10 ms relative to Pcell), 56 for Scell 3 (shift of 15ms relative to Pcell), 61 for Scell4 (shift of 20ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNB Pattern OP.1 FDD as described in Annex A.5.1.1. |                |                                      |  |
| Note 2:   | Void   |                |                                      |  |

**Table 9.6.1.1-7: PUCCH 1-0 static test (FDD, 5 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 5x20  |
| 2           | 15+4x20   |
| 3           | 10+4x20   |
| 4           | 2x10+3x20   |
| 5           | 5+10+3x20   |
| 6           | 3x10+2x20   |
| 7           | 4x10+20   |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs  |

shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 6DL CA apply to UE Category 8 and  $\geq 11$ . For CA with 6 DL CC, for the parameters specified in Table 9.6.1.1-8 and Table 9.6.1.1-9, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, SCell 1 and SCell 4, and SCell 1 and SCell 5 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-8: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 6 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3, 4, 5   |
|---|--|----------------|--------------------------------------|---|
| PDSCH transmission mode                         |  | 1              |                                      |   |
| Downlink power allocation                       | $\rho_A$   | dB             |                                      |   |
|   | $\rho_B$   | dB             |                                      |   |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |   |
| SNR   | dB   | 12             | 6                                    | 0   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98   |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |   |
| PUCCH Report Type                               |  | 4              |                                      |   |
| Reporting periodicity                           | ms   | $N_{pd} = 40$  |                                      |   |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 41             | 46 (shift of 5 ms relative to Pcell) | 51 for Scell 2 (shift of 10 ms relative to Pcell), 56 for Scell 3 (shift of 15ms relative to Pcell), 61 for Scell4 (shift of 20ms relative to Pcell), 66 for Scell5 (shift of 25ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |                |                                      |   |
| Note 2:   | Void   |                |                                      |   |

**Table 9.6.1.1-9: PUCCH 1-0 static test (FDD, 6 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 6x20  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.   |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

The following requirements for 7DL CA apply to UE Category 8 and  $\geq 11$ . For CA with 7 DL CC, for the parameters specified in Table 9.6.1.1-10 and Table 9.6.1.1-11, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, SCell 1 and SCell 4, SCell 1 and SCell 5, and SCell 1 and SCell 6 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell6}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-10: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 7 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3, 4, 5, 6   |
|---|--|----------------|--------------------------------------|--|
| PDSCH transmission mode                         |  | 1              |                                      |  |
| Downlink power allocation                       | $\rho_A$   | dB             |                                      |  |
|   | $\rho_B$   | dB             |                                      |  |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |  |
| SNR   | dB   | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98  |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |  |
| PUCCH Report Type                               |  | 4              |                                      |  |
| Reporting periodicity                           | ms   | $N_{pd} = 40$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 41             | 46 (shift of 5 ms relative to Pcell) | 51 for Scell 2 (shift of 10 ms relative to Pcell), 56 for Scell 3 (shift of 15ms relative to Pcell), 61 for Scell4 (shift of 20ms relative to Pcell), 66 for Scell5 (shift of 25ms relative to Pcell), 71 for Scell6 (shift of 30ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNB Pattern OP.1 FDD as described in Annex A.5.1.1. |                |                                      |  |
| Note 2:   | Void   |                |                                      |  |

**Table 9.6.1.1-11: PUCCH 1-0 static test (FDD, 7 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 7x20  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.   |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

### 9.6.1.2 TDD

The following requirements apply to UE Category  $\geq 3$ . For CA with 2 DL CC, for the parameters specified in Table 9.6.1.2-1 and Table 9.6.1.2-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband CQI}_{\text{Pcell}} - \text{wideband CQI}_{\text{Scell}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-1: PUCCH 1-0 static test on multiple cells (TDD, 2 DL CA)**

| Parameter                                       |  | Unit         | Pcell          | Scell                                |
|---|--|--------------|----------------|--------------------------------------|
| PDSCH transmission mode                         |  |              | 1              |                                      |
| Uplink downlink configuration                   |  |              | 2              |                                      |
| Special subframe configuration                  |  |              | 4              |                                      |
| Downlink power allocation                       | $\rho_A$   | dB           | 0              |                                      |
|   | $\rho_B$   | dB           | 0              |                                      |
| Propagation condition and antenna configuration |  |              | AWGN (1 x 2)   |                                      |
| SNR   |  | dB           | 10             | 4                                    |
| $\hat{I}_{or}^{(j)}$                            |  | dB[mW/15kHz] | -88            | -94                                  |
| $N_{oc}^{(j)}$                                  |  | dB[mW/15kHz] | -98            | -98                                  |
| Physical channel for CQI reporting              |  |              | PUCCH Format 2 |                                      |
| PUCCH Report Type                               |  |              | 4              |                                      |
| Reporting periodicity                           |  | ms           | $N_{pd} = 10$  |                                      |
| <i>cqi-pmi-ConfigurationIndex</i>               |  |              | 8              | 13 (shift of 5 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |              |                |                                      |
| Note 2:   | Void   |              |                |                                      |

**Table 9.6.1.2-2: PUCCH 1-0 static test (TDD, 2 DL CA)**

| Test number | Bandwidth combination   |
|-------------|---|
| 1           | 20MHz for both cells  |
| 2           | 15MHz for PCell and 20MHz for SCell   |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |
| Note 2:     | Mapping of PCell and Scell to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.  |

The following requirements for 3DL CA apply to UE Category  $\geq 5$ . For CA with 3 DL CC, for the parameters specified in Table 9.6.1.2-3 and Table 9.6.1.2-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

for more than 90% of the time.

The following requirements for 4DL CA apply to UE Category  $\geq 8$ . For CA with 4 DL CC, for the parameters specified in Table 9.6.1.2-3 and Table 9.6.1.2-5, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2

on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, and SCell 1 and SCell 3 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-3: PUCCH 1-0 static test on multiple cells (TDD, 3 and 4 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3   |
|---|--|----------------|--------------------------------------|---|
| PDSCH transmission mode                         |  |                | 1                                    |   |
| Uplink downlink configuration                   |  |                | 2                                    |   |
| Special subframe configuration                  |  |                | 4                                    |   |
| Downlink power allocation                       | $\rho_A$   | dB             | 0                                    |   |
|   | $\rho_B$   | dB             | 0                                    |   |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |   |
| SNR   | dB   | 12             | 6                                    | 0   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98   |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |   |
| PUCCH Report Type                               |  | 4              |                                      |   |
| Reporting periodicity                           | ms   | $N_{pd} = 20$  |                                      |   |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 18             | 23 (shift of 5 ms relative to Pcell) | 28 (shift of 10 ms relative to Pcell) , 33 for Scell3 (shift of 15ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNB Pattern OP.1 TDD as described in Annex A.5.2.1. |                |                                      |   |
| Note 2:   | Void   |                |                                      |   |

**Table 9.6.1.2-4: PUCCH 1-0 static test (TDD, 3 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 3x20  |
| 2           | 20+20+15  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.   |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

**Table 9.6.1.2-5: PUCCH 1-0 static test (TDD, 4 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 4x20  |
| 2           | 20+20+20+15   |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is |

Note 2: defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 5DL CA apply to UE Category 8 and ≥11. For CA with 5 DL CC, for the parameters specified in Table 9.6.1.2-6 and Table 9.6.1.2-7, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, and SCell 1 and SCell 4 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-6: Parameters for PUCCH 1-0 static test on multiple cells (TDD, 5 DL CA)**

| Parameter                                       |          | Unit   | Pcell          | Scell1                               | Scell2, 3, 4   |
|---|----------|--|----------------|--------------------------------------|--|
| PDSCH transmission mode                         |          |  | 1              |                                      |  |
| Uplink downlink configuration                   |          |  | 2              |                                      |  |
| Special subframe configuration                  |          |  | 4              |                                      |  |
| Downlink power allocation                       | $\rho_A$ | dB   | 0              |                                      |  |
|   | $\rho_B$ | dB   | 0              |                                      |  |
| Propagation condition and antenna configuration |          |  | AWGN (1 x 2)   |                                      |  |
| SNR   |          | dB   | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$                            |          | dB[mW/15kHz]   | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$                                  |          | dB[mW/15kHz]   | -98            | -98                                  | -98  |
| Physical channel for CQI reporting              |          |  | PUCCH Format 2 |                                      |  |
| PUCCH Report Type                               |          |  | 4              |                                      |  |
| Reporting periodicity                           |          | ms   | $N_{pd} = 40$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |          |  | 38             | 43 (shift of 5 ms relative to Pcell) | 48 (shift of 10 ms relative to Pcell), 53 for Scell3 (shift of 15ms relative to Pcell), 5 for Scell4 (shift of 20ms relative to Pcell) |
| Note 1:   |          | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNB Pattern OP.1 TDD as described in Annex A.5.2.1. |                |                                      |  |
| Note 2:   |          | Void   |                |                                      |  |

**Table 9.6.1.2-7: PUCCH 1-0 static test (TDD, 5 DL CA)**

| Test number   | Bandwidth combination (MHz) |
|---|-----------------------------|
| 1   | 5x20                        |
| 2   | 15+4x20                     |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |                             |

Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 6DL CA apply to UE Category 8 and ≥11. For CA with 6 DL CC, for the parameters specified in Table 9.6.1.2-8 and Table 9.6.1.2-9, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, SCell 1 and SCell 4, and SCell 1 and SCell 5 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq [2]$$

for more than 90% of the time.

**Table 9.6.1.2-8: Parameters for PUCCH 1-0 static test on multiple cells (TDD, 6 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3, 4, 5  |
|---|--|----------------|--------------------------------------|--|
| PDSCH transmission mode                         |  |                |                                      | 1  |
| Uplink downlink configuration                   |  |                |                                      | 2  |
| Special subframe configuration                  |  |                |                                      | 4  |
| Downlink power allocation                       | $\rho_A$   | dB             |                                      | 0  |
|   | $\rho_B$   | dB             |                                      | 0  |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |  |
| SNR   | dB   | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98  |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |  |
| PUCCH Report Type                               |  | 4              |                                      |  |
| Reporting periodicity                           | ms   | $N_{pd} = 40$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 38             | 43 (shift of 5 ms relative to Pcell) | 48 (shift of 10 ms relative to Pcell), 53 for Scell3 (shift of 15ms relative to Pcell), 58 for Scell4 (shift of 20ms relative to Pcell), 63 for Scell5 (shift of 25ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |                |                                      |  |
| Note 2:   | Void   |                |                                      |  |

**Table 9.6.1.2-9: PUCCH 1-0 static test (TDD, 6 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 6x20  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. |

Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 7DL CA apply to UE Category 8 and  $\geq 11$ . For CA with 7 DL CC, for the parameters specified in Table 9.6.1.2-10 and Table 9.6.1.2-11, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2, SCell 1 and SCell 3, SCell 1 and SCell 4, SCell 1 and SCell 5, SCell 1 and SCell 6 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq [2]$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell6}} \geq [2]$$

for more than 90% of the time.

**Table 9.6.1.2-10: Parameters for PUCCH 1-0 static test on multiple cells (TDD, 7 DL CA)**

| Parameter                                       | Unit   | Pcell          | Scell1                               | Scell2, 3, 4, 5, 6  |
|---|--|----------------|--------------------------------------|---|
| PDSCH transmission mode                         |  |                |                                      | 1   |
| Uplink downlink configuration                   |  |                |                                      | 2   |
| Special subframe configuration                  |  |                |                                      | 4   |
| Downlink power allocation                       | $\rho_A$   | dB             |                                      | 0   |
|   | $\rho_B$   | dB             |                                      | 0   |
| Propagation condition and antenna configuration |  | AWGN (1 x 2)   |                                      |   |
| SNR   | dB   | 12             | 6                                    | 0   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -86            | -92                                  | -98   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            | -98                                  | -98   |
| Physical channel for CQI reporting              |  | PUCCH Format 2 |                                      |   |
| PUCCH Report Type                               |  | 4              |                                      |   |
| Reporting periodicity                           | ms   | $N_{pd} = 40$  |                                      |   |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 38             | 43 (shift of 5 ms relative to Pcell) | 48 (shift of 10 ms relative to Pcell), 53 for Scell3 (shift of 15ms relative to Pcell), 58 for Scell4 (shift of 20ms relative to Pcell), 63 for Scell5 (shift of 25ms relative to Pcell), 68 for Scell6 (shift of 30ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |                |                                      |   |
| Note 2:   | Void   |                |                                      |   |

**Table 9.6.1.2-11: PUCCH 1-0 static test (TDD, 7 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 7x20  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is |



Note 2: defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

### 9.6.1.3 TDD-FDD CA with FDD PCell

The following requirements apply to UE Category  $\geq 5$ . For TDD-FDD CA with FDD PCell with 2 DL CC, for the parameters specified in Table 9.6.1.3-1 and Table 9.6.1.3-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-1: Parameters for PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 2 DL CA)**

| Parameter                                       |   | Unit         | PCell          | SCell                                |
|---|---|--------------|----------------|--------------------------------------|
| PDSCH transmission mode                         |   |              | 1              |                                      |
| Uplink downlink configuration                   |   |              | N/A            | 2                                    |
| Special subframe configuration                  |   |              | N/A            | 4                                    |
| Downlink power allocation                       | $\rho_A$  | dB           | 0              |                                      |
|   | $\rho_B$  | dB           | 0              |                                      |
| Propagation condition and antenna configuration |   |              | AWGN (1 x 2)   |                                      |
| SNR   |   | dB           | 10             | 4                                    |
| $\hat{I}_{or}^{(j)}$                            |   | dB[mW/15kHz] | -88            | -94                                  |
| $N_{oc}^{(j)}$                                  |   | dB[mW/15kHz] | -98            | -98                                  |
| Physical channel for CQI reporting              |   |              | PUCCH Format 2 |                                      |
| PUCCH Report Type                               |   |              | 4              |                                      |
| Reporting periodicity                           |   | ms           | $N_{pd} = 10$  |                                      |
| <i>cqi-pmi-ConfigurationIndex</i>               |   |              | 9              | 14 (shift of 5 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |              |                |                                      |
| Note 2:   | Void  |              |                |                                      |
| Note 3:   | Void  |              |                |                                      |

**Table 9.6.1.3-2: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 2 DL CA)**

| Test number | Bandwidth combination  |
|-------------|--|
| 1           | 20MHz for FDD cell and 20MHz for TDD cell  |
| 2           | 10MHz for FDD cell and 20MHz for TDD cell  |
| 3           | 15MHz for FDD cell and 20MHz for TDD cell  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. |

The following requirements for 3DL CA apply to UE Category  $\geq 5$ . For TDD-FDD CA with FDD PCell with 3 DL CC, for the parameters specified in Table 9.6.1.3-3 and Table 9.6.1.3-4, and using the downlink physical channels specified

in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

for more than 90% of the time.

The following requirements for 4DL CA apply to UE Category  $\geq 8$ . For TDD-FDD CA with FDD PCell with 4 DL CC, for the parameters specified in Table 9.6.1.3-3 and Table 9.6.1.3-5, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, and SCell1 and SCell3 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-3: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 3 and 4 DL CA)**

| Parameter   |          | Unit         | PCell          | SCell1                               | SCell2, SCell3   |
|---|----------|--------------|----------------|--------------------------------------|--|
| PDSCH transmission mode   |          |              | 1              |                                      |  |
| Uplink downlink configuration   |          |              | N/A            | 2 for TDD Cell<br>N/A for FDD Cell   |  |
| Special subframe configuration  |          |              | N/A            | 4 for TDD Cell<br>N/A for FDD Cell   |  |
| Downlink power allocation   | $\rho_A$ | dB           | 0              |                                      |  |
|   | $\rho_B$ | dB           | 0              |                                      |  |
| Propagation condition and antenna configuration   |          |              | AWGN (1 x 2)   |                                      |  |
| SNR   |          | dB           | 12             | 6                                    | 0  |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -86            | -92                                  | -98  |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98            | -98                                  | -98  |
| Physical channel for CQI reporting  |          |              | PUCCH Format 2 |                                      |  |
| PUCCH Report Type   |          |              | 4              |                                      |  |
| Reporting periodicity   |          | ms           | $N_{pd} = 20$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |              | 19             | 24 (shift of 5 ms relative to Pcell) | 29 for SCell 2 (shift of 10 ms relative to Pcell) , 34 for SCell 3 (shift of 15ms relative to PCell) |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1.<br>Note 2: Void<br>Note 3: Void |          |              |                |                                      |  |

**Table 9.6.1.3-4: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 3 DL CA)**

| Test number | Bandwidth combination (MHz)                  |
|-------------|--|
| 1           | 20MHz for FDD cell and 2x20MHz for TDD cell  |
| 2           | 15MHz for FDD cell and 2x20MHz for TDD cell  |
| 3           | 10MHz for FDD cell and 2x20MHz for TDD cell  |
| 4           | 2x20MHz for FDD cell and 20MHz for TDD cell  |
| 5           | 20+15MHz for FDD cell and 20MHz for TDD cell |
| 6           | 20+10MHz for FDD cell and 20MHz for TDD cell |
| 7           | 2x10MHz for FDD cell and 20MHz for TDD cell  |
| 8           | 10MHz for FDD cell and 15+20MHz for TDD cell |
| 9           | 10+15MHz for FDD cell and 20MHz for TDD cell |

Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.

Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

**Table 9.6.1.3-5: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 4 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 20MHz for FDD cell and 3x20MHz for TDD cell   |
| 2           | 2x20MHz for FDD cell and 2x20MHz for TDD cell   |
| 3           | 20+15MHz for FDD cell and 2x20MHz for TDD cell  |
| 4           | 2x15MHz for FDD cell and 2x20MHz for TDD cell   |
| 5           | 2x20+15MHz for FDD cell and 20MHz for TDD cell  |
| 6           | 2x15+20MHz for FDD cell and 20MHz for TDD cell  |
| 7           | 2x20+10MHz for FDD cell and 20MHz for TDD cell  |
| 8           | 3x20MHz for FDD cell and 20MHz for TDD cell   |
| 9           | 10MHz for FDD cell and 3x20MHz for TDD cell   |
| 10          | 2x10MHz for FDD cell and 2x20MHz for TDD cell   |
| 11          | 2x10MHz for FDD cell and 20+15MHz for TDD cell  |
| 12          | 10+20MHz for FDD cell and 2x20MHz for TDD cell  |
| 13          | 10+15MHz for FDD cell and 2x20MHz for TDD cell  |
| 14          | 10+15+20MHz for FDD cell and 20MHz for TDD cell   |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.  |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

The following requirements for 5DL CA apply to UE Category 8 and ≥11. For TDD-FDD CA with FDD PCell with 5 DL CC, for the parameters specified in Table 9.6.1.3-6 and Table 9.6.1.3-7, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3, and SCell 1 and SCell 4 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-6: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 5 DL CA)**

| Parameter                                       | Unit         | PCell        | SCell1                             | SCell2, SCell3, SCell4 |
|---|--------------|--------------|------------------------------------|------------------------|
| PDSCH transmission mode                         |              | 1            |                                    |                        |
| Uplink downlink configuration                   |              | N/A          | 2 for TDD Cell<br>N/A for FDD Cell |                        |
| Special subframe configuration                  |              | N/A          | 4 for TDD Cell<br>N/A for FDD Cell |                        |
| Downlink power allocation                       | $\rho_A$     | dB           |                                    |                        |
|   | $\rho_B$     | dB           |                                    |                        |
| Propagation condition and antenna configuration |              | AWGN (1 x 2) |                                    |                        |
| SNR   | dB           | 12           | 6                                  | 0                      |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -86          | -92                                | -98                    |

|                                    |   |                |                                      |   |
|------------------------------------|---|----------------|--------------------------------------|---|
| $N_{oc}^{(j)}$                     | dB[mW/15kHz]  | -98            | -98                                  | -98   |
| Physical channel for CQI reporting |   | PUCCH Format 2 |                                      |   |
| PUCCH Report Type                  |   | 4              |                                      |   |
| Reporting periodicity              | ms  | $N_{pd} = 40$  |                                      |   |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 39             | 44 (shift of 5 ms relative to Pcell) | 49 for SCell 2 (shift of 10 ms relative to Pcell), 54 for SCell 3 (shift of 15 ms relative to Pcell), 59 for SCell 4 (shift of 20 ms relative to Pcell) |
| Note 1:                            | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |                |                                      |   |
| Note 2:                            | Void  |                |                                      |   |
| Note 3:                            | Void  |                |                                      |   |

**Table 9.6.1.3-7: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 5 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 15MHz+2x20MHz for FDD cell and 2x20MHz for TDD cell   |
| 2           | 2x15MHz+20MHz for FDD cell and 2x20MHz for TDD cell   |
| 3           | 4x20(FDD)+20(TDD)MHz  |
| 4           | 3x20(FDD)+2x20(TDD)MHz  |
| 5           | 2x20(FDD)+3x20(TDD)NA   |
| 6           | 20(FDD)+4x20(TDD)MHz  |
| 7           | 10(FDD)+4x20(TDD)MHz  |
| 8           | 2x10(FDD)+3x20(TDD)MH   |
| 9           | 10+20(FDD)+3x20(TDD)MHz   |
| 10          | 10+2x20(FDD)+2x20(TDD)MHz   |
| 11          | 10+15+20(FDD)+2x20(TDD)MHz  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.  |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

The following requirements for 6DL CA apply to UE Category 8 and ≥11. For TDD-FDD CA with FDD PCell with 6 DL CC, for the parameters specified in Table 9.6.1.3-8 and Table 9.6.1.3-9, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3, SCell 1 and SCell 4, and SCell 1 and SCell 5 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell3} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell4} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell5} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-8: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 6 DL CA)**

| Parameter                      | Unit | PCell | SCell1                             | SCell2, SCell3, SCell4, SCell5 |
|--------------------------------|------|-------|------------------------------------|--------------------------------|
| PDSCH transmission mode        |      | 1     |                                    |                                |
| Uplink downlink configuration  |      | N/A   | 2 for TDD Cell<br>N/A for FDD Cell |                                |
| Special subframe configuration |      | N/A   | 4 for TDD Cell<br>N/A for FDD Cell |                                |

|   |              |     |                                      |  |  |
|---|--------------|-----|--------------------------------------|--|--|
| Downlink power allocation   | $\rho_A$     | dB  | 0                                    |  |  |
|   | $\rho_B$     | dB  | 0                                    |  |  |
| Propagation condition and antenna configuration   |              |     | AWGN (1 x 2)                         |  |  |
| SNR   | dB           | 12  | 6                                    | 0  |  |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -86 | -92                                  | -98  |  |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98 | -98                                  | -98  |  |
| Physical channel for CQI reporting  |              |     | PUCCH Format 2                       |  |  |
| PUCCH Report Type   |              |     | 4                                    |  |  |
| Reporting periodicity   |              | ms  | $N_{pd} = 40$                        |  |  |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 39  | 44 (shift of 5 ms relative to Pcell) | 49 for SCell 2 (shift of 10 ms relative to Pcell), 54 for SCell 3 (shift of 15 ms relative to Pcell), 59 for SCell 4 (shift of 20 ms relative to Pcell), 64 for SCell 5 (shift of 25 ms relative to Pcell) |  |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1.<br>Note 2: Void<br>Note 3: Void |              |     |                                      |  |  |

**Table 9.6.1.3-9: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 6 DL CA)**

| Test number   | Bandwidth combination (MHz) |
|---|-----------------------------|
| 1   | 1x20(FDD)+5x20(TDD)         |
| 2   | 2x20(FDD)+4x20(TDD)         |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.<br>Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |                             |

The following requirements for 7DL CA apply to UE Category 8 and  $\geq 11$ . For TDD-FDD CA with FDD PCell with 7 DL CC, for the parameters specified in Table 9.6.1.3-10 and Table 9.6.1.3-11, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3, SCell 1 and SCell 4, SCell 1 and SCell 5, SCell 1 and SCell 6 reported shall be such that

$$\begin{aligned} \text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} &\geq 2 \\ \text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} &\geq 2 \\ \text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell3} &\geq 2 \\ \text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell4} &\geq 2 \\ \text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell5} &\geq 2 \\ \text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell6} &\geq 2 \end{aligned}$$

for more than 90% of the time.

**Table 9.6.1.3-10: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 7 DL CA)**

| Parameter                     | Unit | PCell | SCell1         | SCell2, SCell3, SCell4, SCell5, SCell6 |  |
|-------------------------------|------|-------|----------------|--|--|
| PDSCH transmission mode       |      | 1     |                |  |  |
| Uplink downlink configuration |      | N/A   | 2 for TDD Cell |  |  |

|   |          |                |               |  |   |
|---|----------|----------------|---------------|--|---|
| Special subframe configuration  |          |                | N/A           | N/A for FDD Cell<br>4 for TDD Cell<br>N/A for FDD Cell |   |
| Downlink power allocation   | $\rho_A$ | dB             | 0             |  |   |
|   | $\rho_B$ | dB             | 0             |  |   |
| Propagation condition and antenna configuration   |          | AWGN (1 x 2)   |               |  |   |
| SNR   |          | dB             | 12            | 6  | 0   |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz]   | -86           | -92  | -98   |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz]   | -98           | -98  | -98   |
| Physical channel for CQI reporting  |          | PUCCH Format 2 |               |  |   |
| PUCCH Report Type   |          | 4              |               |  |   |
| Reporting periodicity   |          | ms             | $N_{pd} = 40$ |  |   |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |                | 39            | 44 (shift of 5 ms relative to Pcell)                   | 49 for SCell 2 (shift of 10 ms relative to Pcell), 54 for SCell 3 (shift of 15 ms relative to Pcell), 59 for SCell 4 (shift of 20 ms relative to Pcell), 64 for SCell 5 (shift of 25 ms relative to Pcell), 69 for SCell 6 (shift of 30 ms relative to Pcell) |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNB Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1.<br>Note 2: Void<br>Note 3: Void |          |                |               |  |   |

**Table 9.6.1.3-11: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 7 DL CA)**

| Test number   | Bandwidth combination (MHz) |
|---|-----------------------------|
| 1   | 1x20(FDD)+6x20(TDD)         |
| 2   | 2x20(FDD)+5x20(TDD)         |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.<br>Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |                             |

**9.6.1.4 TDD-FDD CA with TDD PCell**

The following requirements apply to UE Category  $\geq 5$ . For TDD-FDD CA with TDD PCell with 2 DL CC, for the parameters specified in Table 9.6.1.4-1 and Table 9.6.1.4-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-1: Parameters for PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 2 DL CA)**

| Parameter                      | Unit     | PCell | SCell |
|--------------------------------|----------|-------|-------|
| PDSCH transmission mode        |          |       | 1     |
| Uplink downlink configuration  |          | 2     | N/A   |
| Special subframe configuration |          | 4     | N/A   |
|                                | $\rho_A$ | dB    | 0     |

|   |   |              |                |                                      |
|---|---|--------------|----------------|--------------------------------------|
| Downlink power allocation                       | $\rho_B$  | dB           | 0              |                                      |
| Propagation condition and antenna configuration |   |              | AWGN (1 x 2)   |                                      |
| SNR   |   | dB           | 10             | 4                                    |
| $\hat{I}_{or}^{(j)}$                            |   | dB[mW/15kHz] | -88            | -94                                  |
| $N_{oc}^{(j)}$                                  |   | dB[mW/15kHz] | -98            | -98                                  |
| Physical channel for CQI reporting              |   |              | PUCCH Format 2 |                                      |
| PUCCH Report Type                               |   |              | 4              |                                      |
| Reporting periodicity                           |   | ms           | $N_{pd} = 10$  |                                      |
| <i>cqi-pmi-ConfigurationIndex</i>               |   |              | 8              | 13 (shift of 5 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |              |                |                                      |
| Note 2:   | Void  |              |                |                                      |
| Note 3:   | Void  |              |                |                                      |

**Table 9.6.1.4-2: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 2 DL CA)**

| Test number | Bandwidth combination  |
|-------------|--|
| 1           | 20MHz for TDD cell and 20MHz for FDD cell  |
| 2           | 20MHz for TDD cell and 10MHz for FDD cell  |
| 3           | 20MHz for TDD cell and 15MHz for FDD cell  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. |

The following requirements for 3DL CA apply to UE Category  $\geq 5$ . For TDD-FDD CA with TDD PCell with 3 DL CC, for the parameters specified in Table 9.6.1.4-3 and Table 9.6.1.4-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

for more than 90% of the time.

The following requirements for 4DL CA apply to UE Category  $\geq 8$ . For TDD-FDD CA with TDD PCell with 4 DL CC, for the parameters specified in Table 9.6.1.4-3 and Table 9.6.1.4-5, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, and SCell1 and SCell3 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell3} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-3: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 3 and 4 DL CA)**

| Parameter                      | Unit | PCell | SCell1                             | SCell2, SCell3 |
|--------------------------------|------|-------|------------------------------------|----------------|
| PDSCH transmission mode        |      | 1     |                                    |                |
| Uplink downlink configuration  |      | 2     | 2 for TDD Cell<br>N/A for FDD Cell |                |
| Special subframe configuration |      | 4     | 4 for TDD Cell<br>N/A for FDD Cell |                |

|  |              |     |                |                                      |  |
|--|--------------|-----|----------------|--------------------------------------|--|
| Downlink power allocation  | $\rho_A$     | dB  | 0              |                                      |  |
|  | $\rho_B$     | dB  | 0              |                                      |  |
| Propagation condition and antenna configuration  |              |     | AWGN (1 x 2)   |                                      |  |
| SNR  | dB           | 12  | 6              | 0                                    |  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -86 | -92            | -98                                  |  |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98 | -98            | -98                                  |  |
| Physical channel for CQI reporting   |              |     | PUCCH Format 2 |                                      |  |
| PUCCH Report Type  |              |     | 4              |                                      |  |
| Reporting periodicity  |              | ms  | $N_{pd} = 20$  |                                      |  |
| <i>cqi-pmi-ConfigurationIndex</i>  |              |     | 18             | 23 (shift of 5 ms relative to Pcell) | 28 for SCell 2 (shift of 10 ms relative to Pcell) , 33 for SCell 3 (shift of 15ms relative to PCell) |
| <p>Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1.</p> <p>Note 2: Void</p> <p>Note 3: Void</p> |              |     |                |                                      |  |

**Table 9.6.1.4-4: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 3 DL CA)**

| Test number  | Bandwidth combination (MHz)                  |
|--|--|
| 1  | 2x20MHz for TDD cell and 20MHz for FDD cell  |
| 2  | 2x20MHz for TDD cell and 15MHz for FDD cell  |
| 3  | 2x20MHz for TDD cell and 10MHz for FDD cell  |
| 4  | 2x20MHz for FDD cell and 20MHz for TDD cell  |
| 5  | 20+15MHz for FDD cell and 20MHz for TDD cell |
| 6  | 20+10MHz for FDD cell and 20MHz for TDD cell |
| 7  | 2x10MHz for FDD cell and 20MHz for TDD cell  |
| 8  | 10MHz for FDD cell and 15+20MHz for TDD cell |
| 9  | 10+15MHz for FDD cell and 20MHz for TDD cell |
| <p>Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.</p> <p>Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.</p> |  |

**Table 9.6.1.4-5: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 4 DL CA)**

| Test number   | Bandwidth combination (MHz)                     |
|---|---|
| 1   | 3x20MHz for TDD cell and 20MHz for FDD cell     |
| 2   | 2x20MHz for FDD cell and 2x20MHz for TDD cell   |
| 3   | 20+15MHz for FDD cell and 2x20MHz for TDD cell  |
| 4   | 2x15MHz for FDD cell and 2x20MHz for TDD cell   |
| 5   | 2x20+15MHz for FDD cell and 20MHz for TDD cell  |
| 6   | 2x15+20MHz for FDD cell and 20MHz for TDD cell  |
| 7   | 2x20+10MHz for FDD cell and 20MHz for TDD cell  |
| 8   | 3x20MHz for FDD cell and 20MHz for TDD cell     |
| 9   | 10MHz for FDD cell and 3x20MHz for TDD cell     |
| 10  | 2x10MHz for FDD cell and 2x20MHz for TDD cell   |
| 11  | 2x10MHz for FDD cell and 20+15MHz for TDD cell  |
| 12  | 10+20MHz for FDD cell and 2x20MHz for TDD cell  |
| 13  | 10+15MHz for FDD cell and 2x20MHz for TDD cell  |
| 14  | 10+15+20MHz for FDD cell and 20MHz for TDD cell |
| <p>Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.</p> |   |



Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping.

The following requirements for 5DL CA apply to UE Category 8 and  $\geq 11$ . For TDD-FDD CA with TDD PCell with 5 DL CC, for the parameters specified in Table 9.6.1.4-6 and Table 9.6.1.4-7, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3 and SCell 1 and SCell 4 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-6: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 5 DL CA)**

| Parameter                                       | Unit  | PCell          | SCell1   | SCell2, SCell3, SCell4  |
|---|---|----------------|--|---|
| PDSCH transmission mode                         |   |                |  | 1   |
| Uplink downlink configuration                   |   | 2              | 2 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |   |
| Special subframe configuration                  |   | 4              | 4 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |   |
| Downlink power allocation                       | $\rho_A$  | dB             | 0  |   |
|   | $\rho_B$  | dB             | 0  |   |
| Propagation condition and antenna configuration |   | AWGN (1 x 2)   |  |   |
| SNR   | dB  | 12             | 6  | 0   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]  | -86            | -92  | -98   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]  | -98            | -98  | -98   |
| Physical channel for CQI reporting              |   | PUCCH Format 2 |  |   |
| PUCCH Report Type                               |   | 4              |  |   |
| Reporting periodicity                           | ms  | $N_{pd} = 40$  |  |   |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 38             | 43 (shift of 5 ms relative to Pcell)                 | 48 for SCell 2 (shift of 10 ms relative to Pcell), 53 for SCell 3 (shift of 15 ms relative to Pcell), 58 for SCell 4 (shift of 20 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |                |  |   |
| Note 2:   | Void  |                |  |   |
| Note 3:   | Void  |                |  |   |

**Table 9.6.1.4-7: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 5 DL CA)**

| Test number | Bandwidth combination (MHz)                         |
|-------------|---|
| 1           | 15MHz+2x20MHz for FDD cell and 2x20MHz for TDD cell |
| 2           | 2x15MHz+20MHz for FDD cell and 2x20MHz for TDD cell |
| 3           | 4x20(FDD)+20(TDD)MHz                                |
| 4           | 3x20(FDD)+2x20(TDD)MHz                              |
| 5           | 2x20(FDD)+3x20(TDD)NA                               |
| 6           | 20(FDD)+4x20(TDD)MHz                                |
| 7           | 10(FDD)+4x20(TDD)MHz                                |
| 8           | 2x10(FDD)+3x20(TDD)MH                               |
| 9           | 10+20(FDD)+3x20(TDD)MHz                             |

|         |   |
|---------|---|
| 10      | 10+2x20(FDD)+2x20(TDD)MHz   |
| 11      | 10+15+20(FDD)+2x20(TDD)MHz  |
| Note 1: | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.  |
| Note 2: | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

The following requirements for 6DL CA apply to UE Category 8 and  $\geq 11$ . For TDD-FDD CA with TDD PCell with 6 DL CC, for the parameters specified in Table 9.6.1.4-8 and Table 9.6.1.4-9, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3, SCell1 and SCell4, and SCell1 and SCell5 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-8: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 6 DL CA)**

| Parameter                                       | Unit  | PCell          | SCell1   | SCell2, SCell3, SCell4, SCell5   |
|---|---|----------------|--|--|
| PDSCH transmission mode                         |   | 1              |  |  |
| Uplink downlink configuration                   |   | 2              | 2 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |  |
| Special subframe configuration                  |   | 4              | 4 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |  |
| Downlink power allocation                       | $\rho_A$  | dB             | 0  |  |
|   | $\rho_B$  | dB             | 0  |  |
| Propagation condition and antenna configuration |   | AWGN (1 x 2)   |  |  |
| SNR   | dB  | 12             | 6  | 0  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]  | -86            | -92  | -98  |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]  | -98            | -98  | -98  |
| Physical channel for CQI reporting              |   | PUCCH Format 2 |  |  |
| PUCCH Report Type                               |   | 4              |  |  |
| Reporting periodicity                           | ms  | $N_{pd} = 40$  |  |  |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 38             | 43 (shift of 5 ms relative to Pcell)                 | 48 for SCell 2 (shift of 10 ms relative to Pcell), 53 for SCell 3 (shift of 15 ms relative to Pcell), 58 for SCell 4 (shift of 20 ms relative to Pcell), 63 for SCell 5 (shift of 25 ms relative to Pcell) |
| Note 1:   | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |                |  |  |
| Note 2:   | Void  |                |  |  |
| Note 3:   | Void  |                |  |  |

**Table 9.6.1.4-9: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 6 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 1x20(FDD)+ 5x20(TDD)MHz   |
| 2           | 2x20(FDD)+4x20(TDD)MHz  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.  |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

The following requirements for 7DL CA apply to UE Category 8 and  $\geq 11$ . For TDD-FDD CA with TDD PCell with 7 DL CC, for the parameters specified in Table 9.6.1.4-10 and Table 9.6.1.4-11, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, SCell1 and SCell3, SCell1 and SCell4, SCell1 and SCell5, and SCell1 and SCell6 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell3}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell4}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell5}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell6}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-10: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 7 DL CA)**

| Parameter                                       | Unit         | PCell          | SCell1   | SCell2, SCell3, SCell4, SCell5  |
|---|--------------|----------------|--|---|
| PDSCH transmission mode                         |              | 1              |  |   |
| Uplink downlink configuration                   |              | 2              | 2 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |   |
| Special subframe configuration                  |              | 4              | 4 if SCell1 is TDD Cell<br>N/A if SCell1 is FDD Cell |   |
| Downlink power allocation                       | $\rho_A$     | dB             | 0  |   |
|   | $\rho_B$     | dB             | 0  |   |
| Propagation condition and antenna configuration |              | AWGN (1 x 2)   |  |   |
| SNR   | dB           | 12             | 6  | 0   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -86            | -92  | -98   |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98            | -98  | -98   |
| Physical channel for CQI reporting              |              | PUCCH Format 2 |  |   |
| PUCCH Report Type                               |              | 4              |  |   |
| Reporting periodicity                           | ms           | $N_{pd} = 40$  |  |   |
| <i>cqi-pmi-ConfigurationIndex</i>               |              | 38             | 43 (shift of 5 ms relative to Pcell)                 | 48 for SCell 2 (shift of 10 ms relative to Pcell), 53 for SCell 3 (shift of 15 ms relative to Pcell), 58 for SCell 4 (shift of 20 ms relative to Pcell), 63 for SCell 5 (shift of 25 ms relative to Pcell), 68 for SCell 5 (shift of 30 ms relative to Pcell) |

|         |   |
|---------|---|
| Note 1: | 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. |
| Note 2: | Void  |
| Note 3: | Void  |

**Table 9.6.1.4-11: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 7 DL CA)**

| Test number | Bandwidth combination (MHz)   |
|-------------|---|
| 1           | 1x20(FDD)+ 6x20(TDD)MHz   |
| 2           | 2x20(FDD)+5x20(TDD)MHz  |
| Note 1:     | The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3.  |
| Note 2:     | If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. Mapping of PCell and SCells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. |

## 9.7 CSI reporting (Single receiver antenna)

The number of receiver antennas  $N_{RX}$  assumed for the minimum performance requirement in this clause is 1.

### 9.7.1 CQI reporting definition under AWGN conditions

#### 9.7.1.1 FDD and half-duplex FDD

The following requirements apply to UE DL Category 0. For the parameters specified in Table 9.7.1.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.16 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.7.1.1-1: PUCCH 1-0 static test (FDD and half-duplex FDD)**

| Parameter                                       | Unit  | Test 1         |     | Test 2 |     |
|---|---|----------------|-----|--------|-----|
| Bandwidth                                       | MHz   | 10             |     |        |     |
| PDSCH transmission mode                         |   | 1              |     |        |     |
| Downlink power allocation                       | $\rho_A$  | dB             |     | 0      |     |
|   | $\rho_B$  | dB             |     | 0      |     |
|   | $\sigma$  | dB             |     | 0      |     |
| Propagation condition and antenna configuration |   | AWGN (1 x 1)   |     |        |     |
| SNR (Note 2)                                    | dB  | 0              | 1   | 6      | 7   |
| $\hat{I}_{or}^{(j)}$<br>or                      | dB[mW/15kHz]  | -98            | -97 | -92    | -91 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]  | -98            |     | -98    |     |
| Max number of HARQ transmissions                |   | 1              |     |        |     |
| Physical channel for CQI reporting              |   | PUCCH Format 2 |     |        |     |
| PUCCH Report Type                               |   | 4              |     |        |     |
| Reporting periodicity                           | ms  | $N_{pd} = 40$  |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 41             |     |        |     |
| Note 1:   | Reference measurement channel RC.16 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/OP.2 FDD as described in Annex A.5.1.1/A.5.1.2. |                |     |        |     |
| Note 2:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.                   |                |     |        |     |

### 9.7.1.2 TDD

The following requirements apply to UE DL Category 0. For the parameters specified in Table 9.7.1.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.16 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.7.1.2-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       | Unit   | Test 1         |     | Test 2 |     |
|---|--|----------------|-----|--------|-----|
| Bandwidth                                       | MHz  | 10             |     |        |     |
| PDSCH transmission mode                         |  | 1              |     |        |     |
| Uplink downlink configuration                   |  | 2              |     |        |     |
| Special subframe configuration                  |  | 4              |     |        |     |
| Downlink power allocation                       | $\rho_A$   | dB             | 0   |        |     |
|   | $\rho_B$   | dB             | 0   |        |     |
|   | $\sigma$   | dB             | 0   |        |     |
| Propagation condition and antenna configuration |  | AWGN (1 x 1)   |     |        |     |
| SNR (Note 2)                                    | dB   | 0              | 1   | 6      | 7   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz]   | -98            | -97 | -92    | -91 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz]   | -98            |     | -98    |     |
| Max number of HARQ transmissions                |  | 1              |     |        |     |
| Physical channel for CQI reporting              |  | PUSCH (Note 3) |     |        |     |
| PUCCH Report Type                               |  | 4              |     |        |     |
| Reporting periodicity                           | ms   | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 3              |     |        |     |
| ACK/NACK feedback mode                          |  | Multiplexing   |     |        |     |
| Note 1:   | Reference measurement channel RC.16 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/OP.2 TDD as described in Annex A.5.2.1/A.5.2.2.  |                |     |        |     |
| Note 2:   | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                |     |        |     |
| Note 3:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |                |     |        |     |

### 9.7.1.3 FDD (Category 1bis UE)

The following requirements apply to UE DL Category 1bis. For the parameters specified in Table 9.7.1.3-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.4 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.7.1.3-1: PUCCH 1-0 static test (FDD)**

| Parameter               | Unit | Test 1 | Test 2 |
|-------------------------|------|--------|--------|
| Bandwidth               | MHz  | 10     |        |
| PDSCH transmission mode |      | 1      |        |

|   |          |   |                |     |     |     |
|---|----------|---|----------------|-----|-----|-----|
| Downlink power allocation                       | $\rho_A$ | dB  | 0              |     |     |     |
|   | $\rho_B$ | dB  | 0              |     |     |     |
|   | $\sigma$ | dB  | 0              |     |     |     |
| Propagation condition and antenna configuration |          |   | AWGN (1 x 1)   |     |     |     |
| SNR (Note 2)                                    |          | dB  | 0              | 1   | 6   | 7   |
| $\hat{I}_{or}^{(j)}$                            |          | dB[mW/15kHz]  | -98            | -97 | -92 | -91 |
| $N_{oc}^{(j)}$                                  |          | dB[mW/15kHz]  | -98            |     | -98 |     |
| Max number of HARQ transmissions                |          |   | 1              |     |     |     |
| Physical channel for CQI reporting              |          |   | PUCCH Format 2 |     |     |     |
| PUCCH Report Type                               |          |   | 4              |     |     |     |
| Reporting periodicity                           |          | ms  | $N_{pd} = 5$   |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |          |   | 6              |     |     |     |
| Note 1:   |          | Reference measurement channel RC.4 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2. |                |     |     |     |
| Note 2:   |          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.     |                |     |     |     |

#### 9.7.1.4 TDD (Category 1bis UE)

The following requirements apply to UE DL Category 1bis. For the parameters specified in Table 9.7.1.4-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.4 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI - 1) shall be less than or equal to 0.1.

**Table 9.7.1.4-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       |          | Unit         | Test 1         |     | Test 2 |     |
|---|----------|--------------|----------------|-----|--------|-----|
| Bandwidth                                       |          | MHz          | 10             |     |        |     |
| PDSCH transmission mode                         |          |              | 1              |     |        |     |
| Uplink downlink configuration                   |          |              | 2              |     |        |     |
| Special subframe configuration                  |          |              | 4              |     |        |     |
| Downlink power allocation                       | $\rho_A$ | dB           | 0              |     |        |     |
|   | $\rho_B$ | dB           | 0              |     |        |     |
|   | $\sigma$ | dB           | 0              |     |        |     |
| Propagation condition and antenna configuration |          |              | AWGN (1 x 1)   |     |        |     |
| SNR (Note 2)                                    |          | dB           | 0              | 1   | 6      | 7   |
| $\hat{I}_{or}^{(j)}$                            |          | dB[mW/15kHz] | -98            | -97 | -92    | -91 |
| $N_{oc}^{(j)}$                                  |          | dB[mW/15kHz] | -98            |     | -98    |     |
| Max number of HARQ transmissions                |          |              | 1              |     |        |     |
| Physical channel for CQI reporting              |          |              | PUSCH (Note 3) |     |        |     |
| PUCCH Report Type                               |          |              | 4              |     |        |     |
| Reporting periodicity                           |          | ms           | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |          |              | 3              |     |        |     |
| ACK/NACK feedback mode                          |          |              | Multiplexing   |     |        |     |

|         |  |
|---------|--|
| Note 1: | Reference measurement channel RC.4 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/OP.2 TDD as described in Annex A.5.2.1/A.5.2.2.   |
| Note 2: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 3: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |

## 9.7.2 CQI reporting under fading conditions

### 9.7.2.1 FDD and half-duplex FDD

For the parameters specified in Table 9.7.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.1-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD and in each available downlink transmission instance for half-duplex FDD.

**Table 9.7.2.1-1 Sub-band test for single antenna transmission (FDD and half-duplex FDD)**

| Parameter  |          | Unit         | Test 1  |     | Test 2 |     |
|--|----------|--------------|---|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode  |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |     |        |     |
|  | $\rho_B$ | dB           | 0   |     |        |     |
|  | $\sigma$ | dB           | 0   |     |        |     |
| SNR (Note 3)   |          | dB           | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5 \text{ Hz}$ |     |        |     |
| Antenna configuration  |          |              | 1 x 1   |     |        |     |
| Reporting interval   |          | ms           | 8   |     |        |     |
| CQI delay  |          | ms           | 8   |     |        |     |
| Reporting mode   |          |              | PUSCH 3-0   |     |        |     |
| Sub-band size  |          | RB           | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.16 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |          |              |   |     |        |     |

**Table 9.7.2.1-2 Minimum requirement (FDD and half-duplex FDD)**

|                | Test 1 | Test 2 |
|----------------|--------|--------|
| $\alpha$ [%]   | 2      | 2      |
| $\beta$ [%]    | 55     | 55     |
| $\gamma$       | 1.1    | 1.1    |
| UE DL Category | 0      | 0      |

### 9.7.2.2 TDD

For the parameters specified in Table 9.7.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.2-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

**Table 9.7.2.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter  |          | Unit         | Test 1  |     | Test 2 |     |
|--|----------|--------------|---|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode  |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0   |     |        |     |
|  | $\rho_B$ | dB           | 0   |     |        |     |
|  | $\sigma$ | dB           | 0   |     |        |     |
| Uplink downlink configuration  |          |              | 2   |     |        |     |
| Special subframe configuration   |          |              | 4   |     |        |     |
| SNR (Note 3)   |          | dB           | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel  |          |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |        |     |
| Antenna configuration  |          |              | 1 x 1   |     |        |     |
| Reporting interval   |          | ms           | 5   |     |        |     |
| CQI delay  |          | ms           | 10 or 11  |     |        |     |
| Reporting mode   |          |              | PUSCH 3-0   |     |        |     |
| Sub-band size  |          | RB           | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions   |          |              | 1   |     |        |     |
| ACK/NACK feedback mode   |          |              | Multiplexing  |     |        |     |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |          |              |   |     |        |     |



|         |  |
|---------|--|
| Note 2: | Reference measurement channel RC.16 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.          |

**Table 9.7.2.2-2 Minimum requirement (TDD)**

|                | Test 1 | Test 2 |
|----------------|--------|--------|
| $\alpha$ [%]   | 2      | 2      |
| $\beta$ [%]    | 55     | 55     |
| $\gamma$       | 1.1    | 1.1    |
| UE DL Category | 0      | 0      |

### 9.7.2.3 FDD (Category 1bis UE)

The following requirements apply to UE DL Category 1bis. For the parameters specified in Table 9.7.2.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.3-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI.

**Table 9.7.2.3-1 Sub-band test for single antenna transmission (FDD)**

| Parameter                        | Unit   | Test 1  |     | Test 2 |     |
|----------------------------------|--|---|-----|--------|-----|
| Bandwidth                        | MHz  | 10 MHz  |     |        |     |
| Transmission mode                |  | 1 (port 0)  |     |        |     |
| Downlink power allocation        | $\rho_A$   | dB  |     |        |     |
|                                  | $\rho_B$   | dB  |     |        |     |
|                                  | $\sigma$   | dB  |     |        |     |
| SNR (Note 3)                     | dB   | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$             | dB[mW/15kHz]   | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$                   | dB[mW/15kHz]   | -98   |     | -98    |     |
| Propagation channel              |  | Clause B.2.4 with $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5$ Hz |     |        |     |
| Antenna configuration            |  | 1 x 1   |     |        |     |
| Reporting interval               | ms   | 5   |     |        |     |
| CQI delay                        | ms   | 8   |     |        |     |
| Reporting mode                   |  | PUSCH 3-0   |     |        |     |
| Sub-band size                    | RB   | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions |  | 1   |     |        |     |
| Note 1:                          | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |   |     |        |     |

|         |  |
|---------|--|
| Note 2: | Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNNG Pattern OP.2 FDD as described in Annex A.5.1.2. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.      |

**Table 9.7.2.3-2 Minimum requirement (FDD)**

|                | Test 1 | Test 2 |
|----------------|--------|--------|
| $\alpha$ [%]   | 2      | 2      |
| $\beta$ [%]    | 55     | 55     |
| $\gamma$       | 1.15   | 1.15   |
| UE DL Category | 1bis   | 1bis   |

### 9.7.2.4 TDD (Category 1bis UE)

The following requirements apply to UE DL Category 1bis. For the parameters specified in Table 9.7.2.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.4-2 and by the following

- a sub-band differential CQI offset level of 0 shall be reported at least  $\alpha$  % of the time but less than  $\beta$  % for each sub-band;
- the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set  $S$  shall be  $\geq \gamma$ ;
- when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

**Table 9.7.2.4-1 Sub-band test for single antenna transmission (TDD)**

| Parameter                        |          | Unit         | Test 1  |     | Test 2 |     |
|----------------------------------|----------|--------------|---|-----|--------|-----|
| Bandwidth                        |          | MHz          | 10 MHz  |     |        |     |
| Transmission mode                |          |              | 1 (port 0)  |     |        |     |
| Downlink power allocation        | $\rho_A$ | dB           | 0   |     |        |     |
|                                  | $\rho_B$ | dB           | 0   |     |        |     |
|                                  | $\sigma$ | dB           | 0   |     |        |     |
| Uplink downlink configuration    |          |              | 2   |     |        |     |
| Special subframe configuration   |          |              | 4   |     |        |     |
| SNR (Note 3)                     |          | dB           | 8   | 9   | 13     | 14  |
| $\hat{I}_{or}^{(j)}$             |          | dB[mW/15kHz] | -90   | -89 | -85    | -84 |
| $N_{oc}^{(j)}$                   |          | dB[mW/15kHz] | -98   |     | -98    |     |
| Propagation channel              |          |              | Clause B.2.4 with $\tau_d = 0.45$<br>$\mu s, a = 1, f_D = 5$ Hz |     |        |     |
| Antenna configuration            |          |              | 1 x 1   |     |        |     |
| Reporting interval               |          | ms           | 5   |     |        |     |
| CQI delay                        |          | ms           | 10 or 11  |     |        |     |
| Reporting mode                   |          |              | PUSCH 3-0   |     |        |     |
| Sub-band size                    |          | RB           | 6 (full size)   |     |        |     |
| Max number of HARQ transmissions |          |              | 1   |     |        |     |
| ACK/NACK feedback mode           |          |              | Multiplexing  |     |        |     |

|         |  |
|---------|--|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |
| Note 2: | Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.  |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |

**Table 9.7.2.4-2 Minimum requirement (TDD)**

|                | Test 1 | Test 2 |
|----------------|--------|--------|
| $\alpha$ [%]   | 2      | 2      |
| $\beta$ [%]    | 55     | 55     |
| $\gamma$       | 1.15   | 1.15   |
| UE DL Category | 1bis   | 1bis   |

## 9.8 CSI reporting (UE supporting coverage enhancement)

The requirements in this sub-clause are defined based on the simulation results with UE DL Category M1 unless otherwise stated.

The requirements of UE DL Category M1 in 9.8.1 and 9.8.2 are applicable for UE DL Category M2 and UE DL Category 0.

The requirements of UE DL Category M1 in 9.8.3 and 9.8.4 are applicable for UE DL Category M2.

The requirements in 9.8.5 are defined based on the simulation results with Non-BL UEs, and they are applicable for non-BL UEs supporting coverage enhancement.

### 9.8.1 CQI reporting definition under AWGN conditions

#### 9.8.1.1 FDD and half-duplex FDD

The following requirements apply to UE supporting coverage enhancement. For the parameters specified in Table 9.8.1.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.23 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI - 1) shall be less than or equal to 0.1.

**Table 9.8.1.1-1: PUCCH 1-0 static test (FDD and half-duplex FDD)**

| Parameter                                       | Unit         | Test 1       |     |
|---|--------------|--------------|-----|
| Bandwidth                                       | MHz          | 10           |     |
| PDSCH transmission mode                         |              | 1            |     |
| Downlink power allocation                       | $\rho_A$     | dB           | 0   |
|   | $\rho_B$     | dB           | 0   |
|   | $\sigma$     | dB           | 0   |
|   | $\delta$     | dB           | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1) |     |
| SNR (Note 2)                                    | dB           | 5            | 6   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -93          | -92 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98          | -98 |

|   |  |                |
|---|--|----------------|
| Max number of HARQ transmissions                                    |  | 1              |
| Physical channel for CQI reporting                                  |  | PUSCH (Note 4) |
| PUCCH Report Type   |  | 4              |
| Reporting periodicity   | ms   | $N_{pd} = 10$  |
| CQI delay   | ms   | 10             |
| <i>cqi-pmi-ConfigurationIndex</i>                                   |  | 12             |
| Frequency hopping   |  | Disabled       |
| Frequency hopping interval (interval-FDD)                           |  | N/A            |
| Starting OFDM symbol (startSymbolBR)                                |  | 3              |
| PDSCH repetition level  |  | 1              |
| MPDCCH repetition level   |  | 1              |
| Beamforming Precoder for MPDCCH                                     |  | No precoding   |
| Precoder update granularity for MPDCCH                              |  | N/A            |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR) |  | 1111111111     |
| Note 1:   | Reference measurement channel RC.23 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD and two sided dynamic OCNG pattern OP.2 FDD as described in Annex A.5.1.1 and A.5.1.2.   |                |
| Note 2:   | The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                |
| Note 3:   | DC subcarrier puncturing shall be considered.  |                |
| Note 4:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5. |                |

### 9.8.1.2 TDD

The following requirements apply to UE supporting coverage enhancement. For the parameters specified in Table 9.7.3.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.23 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.8.1.2-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       | Unit         | Test 1         |     |
|---|--------------|----------------|-----|
| Bandwidth                                       | MHz          | 10             |     |
| PDSCH transmission mode                         |              | 1              |     |
| Downlink power allocation                       | $\rho_A$     | dB             | 0   |
|   | $\rho_B$     | dB             | 0   |
|   | $\sigma$     | dB             | 0   |
|   | $\delta$     | dB             | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1)   |     |
| SNR (Note 2)                                    | dB           | 4              | 5   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -94            | -93 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98            | -98 |
| Max number of HARQ transmissions                |              | 1              |     |
| Physical channel for CQI reporting              |              | PUSCH (Note 3) |     |
| PUCCH Report Type                               |              | 4              |     |

|   |  |              |
|---|--|--------------|
| Reporting periodicity   | ms   | $N_{pd} = 5$ |
| <i>cqi-pmi-ConfigurationIndex</i>                                   |  | 3            |
| Frequency hopping   |  | Disabled     |
| Frequency hopping interval (interval-TDD)                           |  | N/A          |
| Starting OFDM symbol (startSymbolLC)                                |  | 3            |
| PDSCH repetition level  |  | 1            |
| ACK/NACK feedback mode  |  | Multiplexing |
| MPDCCH repetition level   |  | 1            |
| Beamforming Precoder for MPDCCH                                     |  | No precoding |
| Precoder update granularity for MPDCCH                              |  | N/A          |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR) |  | 1011110111   |
| Note 1:   | Reference measurement channel RC.23 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD and two sided dynamic OCNG pattern OP.2 TDD as described in Annex A.5.2.1 and A.5.2.2.   |              |
| Note 2:   | The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |              |
| Note 3:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |              |
| Note 4:   | DC subcarrier puncturing shall be considered.  |              |

## 9.8.2 UE-selected subband CQI

### 9.8.2.1 FDD and half-duplex FDD

The following requirements apply to UE supporting coverage enhancement. For the parameters specified in Table 9.8.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.8.2.1-2 and by the following

- a) the ratio of the throughput obtained when transmitting on the best narrowband reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected narrowband within the set of narrowbands in which MPDCCH is monitored shall be  $\geq \gamma$ ;

The requirements only apply for narrowbands of full size and the random scheduling across the narrowbands is done by selecting a new narrowband in each TTI for FDD and half-duplex FDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the narrowband size.

**Table 9.8.2.1-1 Sub-band test for single antenna transmission (FDD and half-duplex FDD)**

| Parameter                 |          | Unit         | Test 1     |     |
|---------------------------|----------|--------------|------------|-----|
| Bandwidth                 |          | MHz          | 10 MHz     |     |
| Transmission mode         |          |              | 1 (port 0) |     |
| Downlink power allocation | $\rho_A$ | dB           | 0          |     |
|                           | $\rho_B$ | dB           | 0          |     |
|                           | $\sigma$ | dB           | 0          |     |
|                           | $\delta$ | dB           | 0          |     |
| SNR (Note 3)              |          | dB           | 5          | 6   |
| $\hat{I}_{or}^{(j)}$      |          | dB[mW/15kHz] | -93        | -92 |
| $N_{oc}^{(j)}$            |          | dB[mW/15kHz] | -98        | -98 |

|   |          |   |
|---|----------|---|
| Propagation channel   |          | Clause B.2.4 with $\tau_d = 0.45 \mu\text{s}$ ,<br>$a = 1$ , $f_D = 1 \text{ Hz}$ |
| Reporting interval  | ms       | 10  |
| CQI delays for each narrowband  | ms       | 11, 12, 13, 14  |
| Reporting mode  |          | PUSCH 2-0   |
| Max number of HARQ transmissions  |          | 1   |
| Number of preferred subbands ( $M$ )  |          | 1   |
| Number of narrowbands   |          | 4   |
| Frequency hopping   |          | Enabled   |
| Frequency hopping offset  |          | 1   |
| Starting OFDM symbol (startSymbolBR)  |          | 3   |
| Maximum number of MPDCCH repetitions (mpdcch-NumRepetition)   |          | 4   |
| MPDCCH repetition level (Note 6)  |          | 1   |
| PDSCH repetition level  |          | 1   |
| MPDCCH narrowband ( <i>mpdcch-Narrowband</i> )  |          | 7 (Note 5)  |
| MPDCCH hopping interval (interval-FDD)  |          | 1   |
| Start subframe configuration for MPDCCH (mpdcch-startSF-UeSS)   |          | 2.5   |
| Beamforming Precoder for MPDCCH   |          | No precoding  |
| Precoder update granularity for MPDCCH  |          | N/A   |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)   |          | 111111111   |
| $R^{\text{CSI}}$<br>(csi-NumRepetitionCE)   | Subframe | 1   |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#<math>n</math> based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported narrowband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.25 FDD according to Table A.4-1 with one sided and dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level</p> <p>Note 4: DC subcarrier puncturing shall be considered</p> <p>Note 5: For RRC parameter setting, mpdcch-narrowband is set to 8.</p> <p>Note 6: DCI format 6-1A is scheduled in the subframe k2 according to TS36.213 subclause 9.1.5.</p> |          |   |

Table 9.8.2.1-2 Minimum requirement (FDD and half-duplex FDD)

|                | Test 1       |
|----------------|--------------|
| $\gamma$       | 1.3          |
| UE DL Category | M1, $\geq 0$ |

### 9.8.2.2 TDD

The following requirements apply to UE supporting coverage enhancement. For the parameters specified in Table 9.8.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.8.2.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting on the best narrowband reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected narrowband within the set of narrowbands in which MPDCCH is monitored shall be  $\geq \gamma$ ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new narrowband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the narrowband size.

**Table 9.8.2.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter   | Unit         | Test 1  |     |
|---|--------------|---|-----|
| Bandwidth   | MHz          | 10 MHz  |     |
| Transmission mode   |              | 1 (port 0)  |     |
| Downlink power allocation                                   | $\rho_A$     | dB  | 0   |
|   | $\rho_B$     | dB  | 0   |
|   | $\sigma$     | dB  | 0   |
|   | $\delta$     | dB  | 0   |
| Uplink downlink configuration                               |              | 2   |     |
| Special subframe configuration                              |              | 4   |     |
| SNR (Note 3)  | dB           | 5   | 6   |
| $\hat{I}_{or}^{(j)}$  | dB[mW/15kHz] | -93   | -92 |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98   | -98 |
| Propagation channel   |              | Clause B.2.4 with $\tau_d = 0.45 \mu\text{s}$ ,<br>$a = 1$ , $f_D = 1 \text{ Hz}$ |     |
| Reporting interval  | ms           | 20  |     |
| CQI delay   | ms           | 23, 24, 25, 28  |     |
| Reporting mode  |              | PUSCH 2-0   |     |
| Max number of HARQ transmissions                            |              | 1   |     |
| Number of preferred subbands ( $M$ )                        |              | 1   |     |
| ACK/NACK feedback mode                                      |              | Multiplexing  |     |
| Number of narrowbands                                       |              | 4   |     |
| Frequency hopping   |              | Enabled   |     |
| Frequency hopping offset                                    |              | 1   |     |
| Starting OFDM symbol (startSymbolBR)                        |              | 3   |     |
| Maximum number of MPDCCH repetitions (mpdcch-NumRepetition) |              | 4   |     |
| PDSCH repetition level                                      |              | 1   |     |
| MPDCCH narrowband (mpdcch-Narrowband)                       |              | 7 (Note 5)  |     |
| MPDCCH hopping interval (interval-TDD)                      |              | 1   |     |
| Start subframe configuration for                            |              | 5   |     |

|  |          |              |
|--|----------|--------------|
| MPDCCH (mpdcch-startSF-UeSS)   |          |              |
| Beamforming Precoder for MPDCCH  |          | No precoding |
| Precoder update granularity for MPDCCH   |          | N/A          |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)  |          | 1011110111   |
| $R^{CSI}$ (csi-NumRepetitionCE)  | Subframe | 1            |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.25 TDD according to Table A.4-1 with one sided and dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 3: The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 4: DC subcarrier puncturing shall be considered</p> <p>Note 5: For RRC parameter setting, mpdcch-narroband is set to 8.</p> <p>Note 6: DCI format 6-1A is scheduled in the subframe k2 according to TS36.213 subclause 9.1.5.</p> <p>Note 7: In the case CQI reports and HARQ-ACK collide, CQI reports and HARQ-ACK will be multiplexed.</p> |          |              |

**Table 9.8.2.2-2 Minimum requirement (TDD)**

|             | Test 1       |
|-------------|--------------|
| $\gamma$    | 1.3          |
| UE Category | M1, $\geq 0$ |

### 9.8.3 CQI reporting definition for UE supporting 64QAM under AWGN

#### 9.8.3.1 FDD and half-duplex FDD

The following requirements apply to UE supporting *ce-ModeA-r13* and *ce-PDSCH-64QAM-r15*. For the parameters specified in Table 9.8.3.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.31 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.8.3.1-1: PUCCH 1-0 static test (FDD and half-duplex FDD)**

| Parameter                                       | Unit         | Test 1       |     |
|---|--------------|--------------|-----|
| Bandwidth                                       | MHz          | 10           |     |
| PDSCH transmission mode                         |              | 1            |     |
| Downlink power allocation                       | $\rho_A$     | dB           | 0   |
|   | $\rho_B$     | dB           | 0   |
|   | $\sigma$     | dB           | 0   |
|   | $\delta$     | dB           | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1) |     |
| SNR (Note 2)                                    | dB           | 11           | 12  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -87          | -86 |



|  |              |                |     |
|--|--------------|----------------|-----|
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98            | -98 |
| Max number of HARQ transmissions   |              | 1              |     |
| Physical channel for CQI reporting   |              | PUSCH (Note 4) |     |
| PUCCH Report Type  |              | 4              |     |
| Reporting periodicity  | ms           | $N_{pd} = 10$  |     |
| CQI delay  | ms           | 10             |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 12             |     |
| Frequency hopping  |              | Disabled       |     |
| Frequency hopping interval (interval-FDD)  |              | N/A            |     |
| Starting OFDM symbol (startSymbolBR)   |              | 3              |     |
| PDSCH repetition level   |              | 1              |     |
| MPDCCH repetition level  |              | 1              |     |
| Beamforming Precoder for MPDCCH  |              | No precoding   |     |
| Precoder update granularity for MPDCCH   |              | N/A            |     |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)  |              | 1111111111     |     |
| <p>Note 1: Reference measurement channel RC.31 FDD according to Table A.4-1 with one sided dynamic OCNB Pattern OP.1 FDD and two sided dynamic OCNB pattern OP.2 FDD as described in Annex A.5.1.1 and A.5.1.2.</p> <p>Note 2: The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: DC subcarrier puncturing shall be considered.</p> <p>Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5.</p> |              |                |     |

9.8.3.2 TDD

The following requirements apply to UE supporting supporting *ce-ModeA-r13* and *ce-PDSCH-64QAM-r15*. For the parameters specified in Table 9.8.3.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.31 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI - 1) shall be less than or equal to 0.1.

Table 9.8.3.2-1: PUCCH 1-0 static test (TDD)

| Parameter                                       | Unit         | Test 1       |     |
|---|--------------|--------------|-----|
| Bandwidth                                       | MHz          | 10           |     |
| PDSCH transmission mode                         |              | 1            |     |
| Downlink power allocation                       | $\rho_A$     | dB           | 0   |
|   | $\rho_B$     | dB           | 0   |
|   | $\sigma$     | dB           | 0   |
|   | $\delta$     | dB           | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1) |     |
| SNR (Note 2)                                    | dB           | 11           | 12  |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -87          | -86 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98          | -98 |
| Max number of HARQ transmissions                |              | 1            |     |

|   |  |                |
|---|--|----------------|
| Physical channel for CQI reporting                                  |  | PUSCH (Note 3) |
| PUCCH Report Type   |  | 4              |
| Reporting periodicity   | ms   | $N_{pd} = 5$   |
| <i>cqi-pmi-ConfigurationIndex</i>                                   |  | 3              |
| Frequency hopping   |  | Disabled       |
| Frequency hopping interval (interval-TDD)                           |  | N/A            |
| Starting OFDM symbol (startSymbolLC)                                |  | 3              |
| PDSCH repetition level  |  | 1              |
| ACK/NACK feedback mode  |  | Multiplexing   |
| MPDCCH repetition level   |  | 1              |
| Beamforming Precoder for MPDCCH                                     |  | No precoding   |
| Precoder update granularity for MPDCCH                              |  | N/A            |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR) |  | 1011110111     |
| Note 1:   | Reference measurement channel RC.31 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD and two sided dynamic OCNG pattern OP.2 TDD as described in Annex A.5.2.1 and A.5.2.2.   |                |
| Note 2:   | The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                |
| Note 3:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |                |
| Note 4:   | DC subcarrier puncturing shall be considered.  |                |

## 9.8.4 CQI reporting definition for UE supporting alternative table under AWGN

### 9.8.4.1 FDD and half-duplex FDD

The following requirements apply to UE supporting *ce-ModeA-r13* and *ce-CQI-AlternativeTable-r15*. For the parameters specified in Table 9.8.4.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.32 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.8.4.1-1: PUCCH 1-0 static test (FDD and half-duplex FDD)**

| Parameter                                       | Unit         | Test 1       |     |
|---|--------------|--------------|-----|
| Bandwidth                                       | MHz          | 10           |     |
| PDSCH transmission mode                         |              | 1            |     |
| Downlink power allocation                       | $\rho_A$     | dB           | 0   |
|   | $\rho_B$     | dB           | 0   |
|   | $\sigma$     | dB           | 0   |
|   | $\delta$     | dB           | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1) |     |
| SNR (Note 2)                                    | dB           | 5            | 6   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -93          | -92 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98          | -98 |

|   |  |                |
|---|--|----------------|
| Max number of HARQ transmissions                                    |  | 1              |
| Physical channel for CQI reporting                                  |  | PUSCH (Note 4) |
| PUCCH Report Type   |  | 4              |
| Reporting periodicity   | ms   | $N_{pd} = 10$  |
| CQI delay   | ms   | 10             |
| <i>cqi-pmi-ConfigurationIndex</i>                                   |  | 12             |
| Frequency hopping   |  | Disabled       |
| Frequency hopping interval (interval-FDD)                           |  | N/A            |
| Starting OFDM symbol (startSymbolBR)                                |  | 3              |
| PDSCH repetition level  |  | 1              |
| MPDCCH repetition level   |  | 1              |
| Beamforming Precoder for MPDCCH                                     |  | No precoding   |
| Precoder update granularity for MPDCCH                              |  | N/A            |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR) |  | 1111111111     |
| Note 1:   | Reference measurement channel RC.32 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD and two sided dynamic OCNG pattern OP.2 FDD as described in Annex A.5.1.1 and A.5.1.2.   |                |
| Note 2:   | The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                |
| Note 3:   | DC subcarrier puncturing shall be considered.  |                |
| Note 4:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#1 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5. |                |

### 9.8.4.2 TDD

The following requirements apply to UE supporting *ce-ModeA-r13* and *ce-CQI-AlternativeTable-r15*. For the parameters specified in Table 9.8.4.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.32 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.8.4.2-1: PUCCH 1-0 static test (TDD)**

| Parameter                                       | Unit         | Test 1         |     |
|---|--------------|----------------|-----|
| Bandwidth                                       | MHz          | 10             |     |
| PDSCH transmission mode                         |              | 1              |     |
| Downlink power allocation                       | $\rho_A$     | dB             | 0   |
|   | $\rho_B$     | dB             | 0   |
|   | $\sigma$     | dB             | 0   |
|   | $\delta$     | dB             | 0   |
| Propagation condition and antenna configuration |              | AWGN (1 x 1)   |     |
| SNR (Note 2)                                    | dB           | 5              | 6   |
| $\hat{I}_{or}^{(j)}$                            | dB[mW/15kHz] | -93            | -92 |
| $N_{oc}^{(j)}$                                  | dB[mW/15kHz] | -98            | -98 |
| Max number of HARQ transmissions                |              | 1              |     |
| Physical channel for CQI reporting              |              | PUSCH (Note 3) |     |
| PUCCH Report Type                               |              | 4              |     |

|   |  |              |
|---|--|--------------|
| Reporting periodicity   | ms   | $N_{pd} = 5$ |
| <i>cqi-pmi-ConfigurationIndex</i>                                   |  | 3            |
| Frequency hopping   |  | Disabled     |
| Frequency hopping interval (interval-TDD)                           |  | N/A          |
| Starting OFDM symbol (startSymbolLC)                                |  | 3            |
| PDSCH repetition level  |  | 1            |
| ACK/NACK feedback mode  |  | Multiplexing |
| MPDCCH repetition level   |  | 1            |
| Beamforming Precoder for MPDCCH                                     |  | No precoding |
| Precoder update granularity for MPDCCH                              |  | N/A          |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR) |  | 1011110111   |
| Note 1:   | Reference measurement channel RC.32 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD and two sided dynamic OCNG pattern OP.2 TDD as described in Annex A.5.2.1 and A.5.2.2.   |              |
| Note 2:   | The minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |              |
| Note 3:   | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. MPDCCH DCI format 6-0A shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. |              |
| Note 4:   | DC subcarrier puncturing shall be considered.  |              |

### 9.8.5 PMI reporting with PUCCH 1-1 (CSI Reference Symbol)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements are specified in terms of the ratio

$$\gamma = \frac{t_{ue}}{t_{rnd}}$$

In the definition of  $\gamma$ ,  $t_{ue}$  is 70% of the maximum throughput obtained at  $SNR_{follow}$  using the precoders configured according to the UE reports, and  $t_{rnd}$  is the throughput measured at  $SNR_{follow}$  with random precoding.

#### 9.8.5.1 FDD

For the parameters specified in Table 9.8.5.1-1 and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.8.5.1-2.

**Table 9.8.5.1-1 PMI test for single-layer (FDD)**

| Parameter                 | Unit     | Test 1 |    |
|---------------------------|----------|--------|----|
| Bandwidth                 | MHz      | 10     |    |
| Transmission mode         |          | 9      |    |
| Propagation channel       |          | EPA5   |    |
| Precoding granularity     | PRB      | 6      |    |
| Downlink power allocation | $\rho_A$ | dB     | 0  |
|                           | $\rho_B$ | dB     | 0  |
|                           | $\sigma$ | dB     | -3 |
|                           | $\delta$ | dB     | 0  |

|  |              |   |
|--|--------------|---|
| $N_{OC}^{(j)}$   | dB[mW/15kHz] | -98                                     |
| Correlation and antenna configuration  |              | High XP 8 x 2                           |
| Beamforming model  |              | Annex B.4.3                             |
| Cell-specific reference signals  |              | Antenna ports 0,1                       |
| CSI reference signals  |              | Antenna ports 15,...,22                 |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |              | 5/1                                     |
| CSI-RS reference signal configuration  |              | 0                                       |
| CodeBookSubsetRestriction bitmap   |              | 0x0000 0000 001F<br>FFE0 0000 0000 FFFF |
| Reporting mode   |              | PUCCH 1-1 submode1                      |
| Reporting interval   | ms           | 5                                       |
| PMI delay (Note 2)   | ms           | 10                                      |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 3)                          |
| PUCCH Report Type for CQI/second PMI   |              | 2b                                      |
| PUCCH Report Type for RI/ first PMI  |              | 2a                                      |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 4                                       |
| Measurement channel  |              | R.108 FDD                               |
| OCNG Pattern   |              | OP.1 FDD                                |
| Max number of HARQ transmissions   |              | 4                                       |
| Redundancy version coding sequence   |              | {0,1,2,3}                               |
| ce-csi-rs-feedback-config  |              | Configured                              |
| Frequency hopping  |              | Disabled                                |
| Frequency hopping interval<br>(interval-FDD)   |              | N/A                                     |
| Starting OFDM symbol (startSymbolBR)   |              | 3                                       |
| PDSCH repetition level   |              | 1                                       |
| MPDCCH repetition level  |              | 1                                       |
| Beamforming Precoder for MPDCCH  |              | No precoding                            |
| Precoder update granularity for MPDCCH   |              | N/A                                     |
| BL/CE DL subframe configuration (fdd-DownlinkOrTddSubframeBitmapBR)  |              | 1111111111                              |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.</p> <p>Note 4: PDSCH_RA = 0dB, PDSCH_RB = 0dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4</p> |              |   |

**Table 9.8.5.1-2 Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

9.8.5.2 TDD

For the parameters specified in Table 9.8.5.2-1 and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.8.5.2-2.

**Table 9.8.5.2-1 PMI test for single-layer (TDD)**

| Parameter                      | Unit | Test 1 |
|--------------------------------|------|--------|
| Bandwidth                      | MHz  | 10     |
| Transmission mode              |      | 9      |
| Uplink downlink configuration  |      | 1      |
| Special subframe configuration |      | 4      |

|  |   |              |                                    |
|--|---|--------------|------------------------------------|
| Propagation channel  |   |              | EPA5                               |
| Precoding granularity  |   | PRB          | 6                                  |
| Downlink power allocation  | $\rho_A$  | dB           | 0                                  |
|  | $\rho_B$  | dB           | 0                                  |
|  | $P_c$   | dB           | -3                                 |
|  | $\sigma$  | dB           | 0                                  |
| $N_{\rho c}^{(j)}$   |   | dB[mW/15kHz] | -98                                |
| Correlation and antenna configuration  |   |              | High XP 8 x 2                      |
| Beamforming model  |   |              | Annex B.4.3                        |
| Cell-specific reference signals  |   |              | Antenna ports 0,1                  |
| CSI reference signals  |   |              | Antenna ports 15,...,22            |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |   |              | 5/4                                |
| CSI-RS reference signal configuration  |   |              | 6                                  |
| CodeBookSubsetRestriction bitmap   |   |              | 0x0000 0000 001F<br>FFE0 0000 FFFF |
| Reporting mode   |   |              | PUCCH 1-1 submode1                 |
| Reporting interval   |   | ms           | 5                                  |
| PMI delay (Note 2)   |   | ms           | 15                                 |
| Physical channel for CQI/PMI reporting   |   |              | PUSCH (Note 3)                     |
| PUCCH Report Type for CQI/second PMI   |   |              | 2b                                 |
| PUCCH Report Type for RI/ first PMI  |   |              | 2a                                 |
| <i>cqi-pmi-ConfigurationIndex</i>  |   |              | 4                                  |
| Measurement channel  |   |              | R.108 TDD                          |
| OCNG Pattern   |   |              | OP.1 TDD                           |
| Max number of HARQ transmissions   |   |              | 4                                  |
| Redundancy version coding sequence   |   |              | {0,1,2,3}                          |
| ACK/NACK feedback mode   |   |              | Multiplexing                       |
| ce-csi-rs-feedback-config  |   |              | Configured                         |
| Frequency hopping  |   |              | Disabled                           |
| Frequency hopping interval<br>(interval-TDD)   |   |              | N/A                                |
| Starting OFDM symbol (startSymbolBR)   |   |              | 3                                  |
| PDSCH repetition level   |   |              | 1                                  |
| MPDCCH repetition level  |   |              | 1                                  |
| Beamforming Precoder for MPDCCH  |   |              | No precoding                       |
| Precoder update granularity for MPDCCH   |   |              | N/A                                |
| BL/CE DL subframe configuration (fdd-<br>DownlinkOrTddSubframeBitmapBR)                |   |              | 1011110111                         |
| Note 1:  | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)   |              |                                    |
| Note 2:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). |              |                                    |
| Note 3:  | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.  |              |                                    |
| Note 4:  | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.   |              |                                    |
| Note 5:  | Randomization of the principle beam direction shall be used as specified in B.2.3A.4.   |              |                                    |

Table 9.8.5.2-2 Minimum requirement (TDD)

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| UE Category | $\geq 1$ |

## 9.9 CSI reporting for 4Rx UE

### 9.9.1 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 36.213 [6]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

#### 9.9.1.1 Minimum requirement PUCCH 1-0 with Rank 1 (Cell-Specific Reference Symbols)

##### 9.9.1.1.1 FDD

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.9.1.1.1-1, using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1 FDD / RC.4 FDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.9.1.1.1-1: PUCCH 1-0 static test (FDD)**

| Parameter   |          | Unit         | Test 1         |     | Test 2 |     |
|---|----------|--------------|----------------|-----|--------|-----|
| Bandwidth   |          | MHz          |                |     | 10     |     |
| PDSCH transmission mode   |          |              |                |     | 1      |     |
| Downlink power allocation   | $\rho_A$ | dB           |                |     | 0      |     |
|   | $\rho_B$ | dB           |                |     | 0      |     |
|   | $\sigma$ | dB           |                |     | 0      |     |
| Propagation condition and antenna configuration   |          |              | AWGN (1 x 4)   |     |        |     |
| SNR (Note 2)  |          | dB           | -2             | -1  | 4      | 5   |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -100           | -99 | -94    | -93 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98            |     | -98    |     |
| Max number of HARQ transmissions  |          |              | 1              |     |        |     |
| Physical channel for CQI reporting  |          |              | PUCCH Format 2 |     |        |     |
| PUCCH Report Type   |          |              | 4              |     |        |     |
| Reporting periodicity   |          | ms           | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |              | 6              |     |        |     |
| Note 1: Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.4 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2. |          |              |                |     |        |     |
| Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |          |              |                |     |        |     |

##### 9.9.1.1.2 TDD

The following requirements apply to UE Category  $\geq 1$ . For the parameters specified in Table 9.9.1.1.2-1, using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1/RC.4 TDD in Table A.4-1 shall be in the range of  $\pm 1$  of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.9.1.1.2-1: PUCCH 1-0 static test (TDD)**

| Parameter   |          | Unit         | Test 1         |     | Test 2 |     |
|---|----------|--------------|----------------|-----|--------|-----|
| Bandwidth   |          | MHz          |                |     | 10     |     |
| PDSCH transmission mode   |          |              |                |     | 1      |     |
| Uplink downlink configuration   |          |              |                |     | 2      |     |
| Special subframe configuration  |          |              |                |     | 4      |     |
| Downlink power allocation   | $\rho_A$ | dB           |                |     | 0      |     |
|   | $\rho_B$ | dB           |                |     | 0      |     |
|   | $\sigma$ | dB           |                |     | 0      |     |
| Propagation condition and antenna configuration   |          |              | AWGN (1 x 4)   |     |        |     |
| SNR (Note 2)  |          | dB           | -2             | -1  | 4      | 5   |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -100           | -99 | -94    | -93 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98            |     | -98    |     |
| Max number of HARQ transmissions  |          |              | 1              |     |        |     |
| Physical channel for CQI reporting  |          |              | PUSCH (Note 3) |     |        |     |
| PUCCH Report Type   |          |              | 4              |     |        |     |
| Reporting periodicity   |          | ms           | $N_{pd} = 5$   |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |              | 3              |     |        |     |
| ACK/NACK feedback mode  |          |              | Multiplexing   |     |        |     |
| <p>Note 1: Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, except for category 1 UE use RC.4 TDD with two sided dynamic OCNG Pattern OP.2 TDD as described in Annex A.5.2.2.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> |          |              |                |     |        |     |

**9.9.1.2 Minimum requirement PUCCH 1-1 with Rank 2 (CSI Reference Symbols)**

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

**9.9.1.2.1 FDD**

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.9.1.2.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set {median  $\text{CQI}_1 - 1$ , median  $\text{CQI}_1$ , median  $\text{CQI}_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.9.1.2.1-1: PUCCH 1-1 static test (FDD)**

| Parameter | Unit | Test 1 | Test 2 |
|-----------|------|--------|--------|
|-----------|------|--------|--------|



|  |   |                               |     |     |     |
|--|---|-------------------------------|-----|-----|-----|
| Bandwidth  | MHz   | 10                            |     |     |     |
| PDSCH transmission mode  |   | 9                             |     |     |     |
| Downlink power allocation  | $\rho_A$  | dB                            | 0   |     |     |
|  | $\rho_B$  | dB                            | 0   |     |     |
|  | $P_c$   | dB                            | -3  |     |     |
|  | $\sigma$  | dB                            | -3  |     |     |
| Cell-specific reference signals  |   | Antenna ports 0, 1            |     |     |     |
| CSI reference signals  |   | Antenna ports 15,...,18       |     |     |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |   | 5/1                           |     |     |     |
| CSI reference signal configuration                                       |   | 0                             |     |     |     |
| Propagation condition and antenna configuration                          |   | Clause B.1 (4 x 4)            |     |     |     |
| Beamforming Model  |   | As specified in Section B.4.3 |     |     |     |
| CodeBookSubsetRestriction bitmap   |   | 0x0000 0000 0100 0000         |     |     |     |
| SNR (Note 2)   | dB  | 5                             | 6   | 11  | 12  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]  | -93                           | -92 | -87 | -86 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98                           |     | -98 |     |
| Max number of HARQ transmissions   |   | 1                             |     |     |     |
| Physical channel for CQI/PMI reporting                                   |   | PUSCH (Note3)                 |     |     |     |
| PUCCH Report Type for CQI/PMI  |   | 2                             |     |     |     |
| Physical channel for RI reporting  |   | PUCCH Format 2                |     |     |     |
| PUCCH Report Type for RI   |   | 3                             |     |     |     |
| Reporting periodicity  | ms  | $N_{pd} = 5$                  |     |     |     |
| CQI delay  | ms  | 8                             |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 2                             |     |     |     |
| <i>ri-ConfigIndex</i>  |   | 1                             |     |     |     |
| Note 1:  | Reference measurement channel RC.7 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.   |                               |     |     |     |
| Note 2:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                               |     |     |     |
| Note 3:  | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5. |                               |     |     |     |

9.9.1.2.2 TDD

The following requirements apply to UE Category  $\geq 2$ . For the parameters specified in table 9.9.1.2.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> -1, median CQI<sub>1</sub>, median CQI<sub>1</sub> +1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

Table 9.9.1.2.2-1: PUCCH 1-1 submode 1 static test (TDD)

| Parameter                      | Unit | Test 1 | Test 2 |
|--------------------------------|------|--------|--------|
| Bandwidth                      | MHz  | 10     |        |
| PDSCH transmission mode        |      | 9      |        |
| Uplink downlink configuration  |      | 2      |        |
| Special subframe configuration |      | 4      |        |

|  |          |  |                                      |     |     |     |
|--|----------|--|--------------------------------------|-----|-----|-----|
| Downlink power allocation  | $\rho_A$ | dB   | 0                                    |     |     |     |
|  | $\rho_B$ | dB   | 0                                    |     |     |     |
|  | $P_c$    | dB   | -6                                   |     |     |     |
|  | $\sigma$ | dB   | -3                                   |     |     |     |
| CRS reference signals  |          |  | Antenna ports 0, 1                   |     |     |     |
| CSI reference signals  |          |  | Antenna ports 15,...,22              |     |     |     |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          |  | 5/ 3                                 |     |     |     |
| CSI reference signal configuration   |          |  | 0                                    |     |     |     |
| Propagation condition and antenna configuration  |          |  | Clause B.1 (8 x 4)                   |     |     |     |
| Beamforming Model  |          |  | As specified in Section B.4.3        |     |     |     |
| CodeBookSubsetRestriction bitmap   |          |  | 0x0000 0000 0020 0000 0000 0001 0000 |     |     |     |
| SNR (Note 2)   |          | dB   | 2                                    | 3   | 8   | 9   |
| $\hat{I}_{or}^{(j)}$<br>or   |          | dB[mW/15kHz]   | -96                                  | -95 | -90 | -89 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz]   | -98                                  |     | -98 |     |
| Max number of HARQ transmissions   |          |  | 1                                    |     |     |     |
| Physical channel for CQI/PMI reporting   |          |  | PUSCH (Note 3)                       |     |     |     |
| PUCCH Report Type for CQI/second PMI   |          |  | 2b                                   |     |     |     |
| Physical channel for RI reporting  |          |  | PUSCH                                |     |     |     |
| PUCCH Report Type for RI/ first PMI  |          |  | 5                                    |     |     |     |
| Reporting periodicity  |          | ms   | $N_{pd} = 5$                         |     |     |     |
| CQI delay  |          | ms   | 10 or 11                             |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |  | 3                                    |     |     |     |
| <i>ri-ConfigIndex</i>  |          |  | 805 (Note 4)                         |     |     |     |
| ACK/NACK feedback mode   |          |  | Multiplexing                         |     |     |     |
| Note 1:  |          | Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |                                      |     |     |     |
| Note 2:  |          | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |                                      |     |     |     |
| Note 3:  |          | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.  |                                      |     |     |     |
| Note 4:  |          | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |                                      |     |     |     |

### 9.9.1.3 Minimum requirement PUCCH 1-1 with Rank 4 (Cell-Specific Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

#### 9.9.1.3.1 FDD

The following requirements apply to UE Category  $\geq 5$ . For the parameters specified in table 9.9.1.3.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $CQI_1$  shall be within the set {median  $CQI_1 - 1$ , median  $CQI_1$ , median  $CQI_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $CQI_1$  shall be used to determine the median  $CQI$  values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $CQI_0 - 1$  and median  $CQI_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $CQI_0 + 1$  and median  $CQI_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.9.1.3.1-1: PUCCH 1-1 static test (FDD)**

| Parameter   |          | Unit         | Test 1                |     | Test 2 |     |
|---|----------|--------------|-----------------------|-----|--------|-----|
| Bandwidth   |          | MHz          | 10                    |     |        |     |
| PDSCH transmission mode   |          |              | 4                     |     |        |     |
| Downlink power allocation   | $\rho_A$ | dB           | -6                    |     |        |     |
|   | $\rho_B$ | dB           | -6                    |     |        |     |
|   | $\sigma$ | dB           | 0                     |     |        |     |
| Propagation condition and antenna configuration   |          |              | Clause B.1 (4 x 4)    |     |        |     |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0002 0000 0000 0000 |     |        |     |
| SNR (Note 2)  |          | dB           | 5                     | 6   | 11     | 12  |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -93                   | -92 | -87    | -86 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98                   |     | -98    |     |
| Max number of HARQ transmissions  |          |              | 1                     |     |        |     |
| Physical channel for CQI/PMI reporting  |          |              | PUCCH Format 2        |     |        |     |
| PUCCH Report Type for CQI/PMI   |          |              | 2                     |     |        |     |
| PUCCH Report Type for RI  |          |              | 3                     |     |        |     |
| Reporting periodicity   |          | ms           | $N_{pd} = 5$          |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |              | 6                     |     |        |     |
| <i>ri-ConfigIndex</i>   |          |              | 1 (Note 3)            |     |        |     |
| <p>Note 1: Reference measurement channel RC.21 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: It is intended to have UL collisions between RI reports and HARQ-ACK, since the RI reports shall not be used by the eNB in this test.</p> |          |              |                       |     |        |     |

### 9.9.1.3.2 TDD

The following requirements apply to UE Category  $\geq 5$ . For the parameters specified in table 9.9.1.3.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband  $CQI_1$  shall be within the set {median  $CQI_1 - 1$ , median  $CQI_1$ , median  $CQI_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $CQI_1$  shall be used to determine the median  $CQI$  values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $CQI_0 - 1$  and median  $CQI_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $CQI_0 + 1$  and median  $CQI_1 + 1$  shall be greater than or equal to 0.1.

**Table 9.9.1.3.2-1: PUCCH 1-1 static test (TDD)**

| Parameter                     |  | Unit | Test 1 |  | Test 2 |  |
|-------------------------------|--|------|--------|--|--------|--|
| Bandwidth                     |  | MHz  | 10     |  |        |  |
| PDSCH transmission mode       |  |      | 4      |  |        |  |
| Uplink downlink configuration |  |      | 2      |  |        |  |

|  |              |                       |     |     |     |
|--|--------------|-----------------------|-----|-----|-----|
| Special subframe configuration   |              | 4                     |     |     |     |
| Downlink power allocation  | $\rho_A$     | dB                    | -6  |     |     |
|  | $\rho_B$     | dB                    | -6  |     |     |
|  | $\sigma$     | dB                    | 0   |     |     |
| Propagation condition and antenna configuration  |              | Clause B.1 (4x4)      |     |     |     |
| CodeBookSubsetRestriction bitmap   |              | 0x0002 0000 0000 0000 |     |     |     |
| SNR (Note 2)   | dB           | 5                     | 6   | 11  | 12  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -93                   | -92 | -87 | -86 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98                   |     | -98 |     |
| Max number of HARQ transmissions   |              | 1                     |     |     |     |
| Physical channel for CQI/PMI reporting   |              | PUSCH (Note 3)        |     |     |     |
| PUCCH Report Type  |              | 2                     |     |     |     |
| Reporting periodicity  | ms           | $N_{pd} = 5$          |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 3                     |     |     |     |
| <i>ri-ConfigIndex</i>  |              | 805 (Note 4)          |     |     |     |
| ACK/NACK feedback mode   |              | Multiplexing          |     |     |     |
| <p>Note 1: Reference measurement channel RC.21 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> <p>Note 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.</p> |              |                       |     |     |     |

9.9.1.4 Minimum requirement PUCCH 1-1 with Rank 3 (CSI Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

9.9.1.4.1 FDD

The following requirements apply to UE Category  $\geq 5$ . For the parameters specified in table 9.9.1.4.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set {median  $\text{CQI}_1 - 1$ , median  $\text{CQI}_1$ , median  $\text{CQI}_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

Table 9.9.1.4.1-1: PUCCH 1-1 static test (FDD)

| Parameter | Unit | Test 1 | Test 2 |
|-----------|------|--------|--------|
|-----------|------|--------|--------|

|  |   |                               |     |     |     |
|--|---|-------------------------------|-----|-----|-----|
| Bandwidth  | MHz   | 10                            |     |     |     |
| PDSCH transmission mode  |   | 9                             |     |     |     |
| Downlink power allocation  | $\rho_A$  | dB                            | 0   |     |     |
|  | $\rho_B$  | dB                            | 0   |     |     |
|  | $P_c$   | dB                            | -3  |     |     |
|  | $\sigma$  | dB                            | -3  |     |     |
| Cell-specific reference signals  |   | Antenna ports 0, 1            |     |     |     |
| CSI reference signals  |   | Antenna ports 15,...,18       |     |     |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |   | 5/1                           |     |     |     |
| CSI reference signal configuration                                       |   | 0                             |     |     |     |
| Propagation condition and antenna configuration                          |   | Clause B.1 (4 x 4)            |     |     |     |
| Beamforming Model  |   | As specified in Section B.4.3 |     |     |     |
| CodeBookSubsetRestriction bitmap   |   | 0x0000 0020 0000 0000         |     |     |     |
| SNR (Note 2)   | dB  | 5                             | 6   | 11  | 12  |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]  | -93                           | -92 | -87 | -86 |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98                           |     | -98 |     |
| Max number of HARQ transmissions   |   | 1                             |     |     |     |
| Physical channel for CQI/PMI reporting                                   |   | PUSCH (Note3)                 |     |     |     |
| PUCCH Report Type for CQI/PMI  |   | 2                             |     |     |     |
| Physical channel for RI reporting  |   | PUCCH Format 2                |     |     |     |
| PUCCH Report Type for RI   |   | 3                             |     |     |     |
| Reporting periodicity  | ms  | $N_{pd} = 5$                  |     |     |     |
| CQI delay  | ms  | 8                             |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 2                             |     |     |     |
| <i>ri-ConfigIndex</i>  |   | 1                             |     |     |     |
| Note 1:  | Reference measurement channel RC.22 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |                               |     |     |     |
| Note 2:  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.   |                               |     |     |     |
| Note 3:  | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5. |                               |     |     |     |

9.9.1.4.2 TDD

The following requirements apply to UE Category  $\geq 5$ . For the parameters specified in table 9.9.1.4.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband  $\text{CQI}_1$  shall be within the set {median  $\text{CQI}_1 - 1$ , median  $\text{CQI}_1$ , median  $\text{CQI}_1 + 1$ } for more than 90% of the time, where the resulting wideband values  $\text{CQI}_1$  shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 - 1$  and median  $\text{CQI}_1 - 1$  shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median  $\text{CQI}_0 + 1$  and median  $\text{CQI}_1 + 1$  shall be greater than or equal to 0.1.

Table 9.9.1.4.2-1: PUCCH 1-1 static test (TDD)

| Parameter                      | Unit | Test 1 | Test 2 |
|--------------------------------|------|--------|--------|
| Bandwidth                      | MHz  | 10     |        |
| PDSCH transmission mode        |      | 9      |        |
| Uplink downlink configuration  |      | 2      |        |
| Special subframe configuration |      | 4      |        |

|   |          |              |                               |     |     |     |
|---|----------|--------------|-------------------------------|-----|-----|-----|
| Downlink power allocation   | $\rho_A$ | dB           | 0                             |     |     |     |
|   | $\rho_B$ | dB           | 0                             |     |     |     |
|   | $P_c$    | dB           | -3                            |     |     |     |
|   | $\sigma$ | dB           | -3                            |     |     |     |
| CRS reference signals   |          |              | Antenna ports 0, 1            |     |     |     |
| CSI reference signals   |          |              | Antenna ports 15,...,18       |     |     |     |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |              | 5/ 3                          |     |     |     |
| CSI reference signal configuration  |          |              | 0                             |     |     |     |
| Propagation condition and antenna configuration   |          |              | Clause B.1 (4 x 4)            |     |     |     |
| Beamforming Model   |          |              | As specified in Section B.4.3 |     |     |     |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0000 0020 0000 0000         |     |     |     |
| SNR (Note 2)  |          | dB           | 5                             | 6   | 11  | 12  |
| $\hat{I}_{or}^{(j)}$<br>or  |          | dB[mW/15kHz] | -93                           | -92 | -87 | -86 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98                           |     | -98 |     |
| Max number of HARQ transmissions  |          |              | 1                             |     |     |     |
| Physical channel for CQI/PMI reporting  |          |              | PUSCH (Note 3)                |     |     |     |
| PUCCH Report Type for CQI/ PMI  |          |              | 2                             |     |     |     |
| Physical channel for RI reporting   |          |              | PUSCH                         |     |     |     |
| PUCCH Report Type for RI  |          |              | 3                             |     |     |     |
| Reporting periodicity   |          | ms           | $N_{pd} = 5$                  |     |     |     |
| CQI delay   |          | ms           | 10 or 11                      |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>   |          |              | 3                             |     |     |     |
| <i>ri-ConfigIndex</i>   |          |              | 805 (Note 4)                  |     |     |     |
| ACK/NACK feedback mode  |          |              | Multiplexing                  |     |     |     |
| <p>Note 1: Reference measurement channel RC.22 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</p> <p>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> <p>Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.</p> <p>Note 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.</p> |          |              |                               |     |     |     |

## 9.9.2 CQI reporting definition under fading conditions

### 9.9.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol) for enhanced receiver Type A

The purpose of the test is to verify that the reporting of the channel quality is based on the receiver of the enhanced Type A. Performance requirements are specified in terms of the relative increase of the throughput obtained when the transport format is that indicated by the reported CQI subject to an interference model compared to the case with a white Gaussian noise model, and a requirement on the minimum BLER of the transmitted transport formats indicated by the reported CQI subject to an interference model.

#### 9.9.2.1.1 FDD

For the parameters specified in Table 9.9.2.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.9.2.1.1-2 and by the following

- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;

- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.9.2.1.1-1 Fading test for single antenna (FDD)**

| Parameter  | Unit         | Cell 1         | Cell 2          |
|--|--------------|----------------|-----------------|
| Bandwidth  | MHz          | 10 MHz         |                 |
| Transmission mode  |              | 1 (port 0)     |                 |
| Cyclic Prefix  |              | Normal         | Normal          |
| Cell ID  |              | 0              | 1               |
| SINR (Note 8)  | dB           | -4             | N/A             |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98            | N/A             |
| Propagation channel  |              | EPA5           | Static (Note 7) |
| Correlation and antenna configuration  |              | Low (1 x 4)    | (1 x 4)         |
| DIP (Note 4)   | dB           | N/A            | -0.41           |
| Reference measurement channel  |              | Note 2         | R.2 FDD         |
| Reporting mode   |              | PUCCH 1-0      | N/A             |
| Reporting periodicity  | ms           | $N_{pd} = 2$   | N/A             |
| CQI delay  | ms           | 8              | N/A             |
| Physical channel for CQI reporting   |              | PUSCH (Note 3) | N/A             |
| PUCCH Report Type  |              | 4              | N/A             |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 1              | N/A             |
| Max number of HARQ transmissions   |              | 1              | N/A             |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> <p>Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.</p> <p>Note 8: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> |              |                |                 |

**Table 9.9.2.1.1-2 Minimum requirement (FDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

## 9.9.2.1.2 TDD

For the parameters specified in Table 9.9.2.1.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.9.2.1.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.9.2.1.2-1 Fading test for single antenna (TDD)**

| Parameter   | Unit         | Cell 1         | Cell 2          |
|---|--------------|----------------|-----------------|
| Bandwidth   | MHz          | 10 MHz         |                 |
| Transmission mode   |              | 1 (port 0)     |                 |
| Uplink downlink configuration   |              | 2              |                 |
| Special subframe configuration  |              | 4              |                 |
| Cyclic Prefix   |              | Normal         | Normal          |
| Cell ID   |              | 0              | 1               |
| SINR (Note 8)   | dB           | -4             | N/A             |
| $N_{oc}^{(j)}$  | dB[mW/15kHz] | -98            | -98             |
| Propagation channel   |              | EPA5           | Static (Note 7) |
| Correlation and antenna configuration   |              | Low (1 x 4)    | (1 x 4)         |
| DIP (Note 4)  | dB           | N/A            | -0.41           |
| Reference measurement channel   |              | Note 2         | R.2A TDD        |
| Reporting mode  |              | PUCCH 1-0      | N/A             |
| Reporting periodicity   | ms           | $N_{pd} = 5$   | N/A             |
| CQI delay   | ms           | 10 or 11       | N/A             |
| Physical channel for CQI reporting  |              | PUSCH (Note 3) | N/A             |
| PUCCH Report Type   |              | 4              | N/A             |
| <i>cqi-pmi-ConfigurationIndex</i>   |              | 3              | N/A             |
| Max number of HARQ transmissions  |              | 1              | N/A             |
| ACK/NACK feedback mode  |              | Multiplexing   | N/A             |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.</p> <p>Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> |              |                |                 |



|         |  |
|---------|--|
| Note 7: | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present. |
| Note 8: | SINR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.                                 |

**Table 9.3.5.1.2-2 Minimum requirement (TDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 1$ |

### 9.9.2.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbol) for enhanced receiver Type A

The purpose of the test is to verify that the reporting of the channel quality is based on the receiver of the enhanced Type A. Performance requirements are specified in terms of the relative increase of the throughput obtained when the transport format is that indicated by the reported CQI subject to an interference model compared to the case with a white Gaussian noise model, and a requirement on the minimum BLER of the transmitted transport formats indicated by the reported CQI subject to an interference model.

#### 9.9.2.2.1 FDD

For the parameters specified in Table 9.9.2.2.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.9.2.2.1-2 and by the following

- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.9.2.2.1-1 Fading test for single antenna (FDD)**

| Parameter                              | Unit               | Cell 1                                     | Cell 2             |
|--|--------------------|--|--------------------|
| Bandwidth                              | MHz                | 10 MHz                                     |                    |
| Transmission mode                      |                    | 9  |                    |
| Cyclic Prefix                          |                    | Normal                                     | Normal             |
| Cell ID                                |                    | 0  | 1                  |
| SINR (Note 8)                          | dB                 | -4   | N/A                |
| $N_{oc}^{(j)}$                         | dB[mW/15kHz]       | -98  | N/A                |
| Propagation channel                    |                    | EPA5                                       | Static (Note 7)    |
| Correlation and antenna configuration  |                    | Low (2 x 4)                                | (1 x 4)            |
| Beamforming Model                      |                    | As specified in Section B.4.3 (Note 9, 10) | N/A                |
| DIP (Note 4)                           | dB                 | N/A  | -0.41              |
| Cell-specific reference signals        |                    | Antenna ports 0,1                          | Antenna port 0     |
| CSI reference signals                  |                    | Antenna ports 15,16                        | N/A                |
| CSI-RS periodicity and subframe offset |                    | 5/1  | N/A                |
| CSI-RS reference signal configuration  |                    | 2  | N/A                |
| Zero-power CSI-RS configuration        | Subframes / bitmap | N/A  | 1 / 00100000000000 |

|   |    |                |         |
|---|----|----------------|---------|
| <i>I</i> <sub>CSI-RS / ZeroPowerCSI-RS</sub> bitmap   |    |                |         |
| CodeBookSubsetRestriction bitmap  |    | 001111         | N/A     |
| Reference measurement channel   |    | Note 2         | R.2 FDD |
| Reporting mode  |    | PUCCH 1-1      | N/A     |
| Reporting periodicity   | ms | $N_{pd} = 5$   | N/A     |
| CQI delay   | ms | 8              | N/A     |
| Physical channel for CQI/PMI reporting  |    | PUSCH (Note 3) | N/A     |
| PUCCH Report Type for CQI/PMI   |    | 2              | N/A     |
| PUCCH channel for RI reporting  |    | PUCCH Format 2 | N/A     |
| PUCCH Report Type for RI  |    | 3              | N/A     |
| <i>cqi-pmi-ConfigurationIndex</i>   |    | 2              | N/A     |
| <i>ri-ConfigIndex</i>   |    | 1              | N/A     |
| Max number of HARQ transmissions  |    | 1              | N/A     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)</p> <p>Note 2: Reference measurement channel RC.11 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.</p> <p>Note 4: The respective received power spectral density of each interfering cell relative to <math>N_{oc}</math> is defined by its associated DIP value as specified in clause B.5.1.</p> <p>Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Interfering cell is fully loaded.</p> <p>Note 6: Both cells are time-synchronous.</p> <p>Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.</p> <p>Note 8: SINR corresponds to <math>\hat{E}_s / N_{oc}</math> of Cell 1 as defined in clause 8.1.1.</p> <p>Note 9: The precoder in clause B.4.3 follows UE recommended PMI.</p> <p>Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> |    |                |         |

**Table 9.9.2.2.1-2 Minimum requirement (FDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 2$ |

9.9.2.2.2 TDD

For the parameters specified in Table 9.9.2.2.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.9.2.2.2-2 and by the following

- a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be  $\geq \gamma$ ;
- b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.9.2.2.2-1 Fading test for single antenna (TDD)**

| Parameter   | Unit                  | Cell 1                                      | Cell 2                      |
|---|-----------------------|---|-----------------------------|
| Bandwidth   | MHz                   | 10 MHz                                      |                             |
| Transmission mode   |                       | 9   |                             |
| Uplink downlink configuration   |                       | 2   |                             |
| Special subframe configuration  |                       | 4   |                             |
| Cyclic Prefix   |                       | Normal                                      | Normal                      |
| Cell ID   |                       | 0   | 1                           |
| SINR (Note 8)   | dB                    | -4  | N/A                         |
| $N_{oc}^{(j)}$  | dB[mW/15kHz]          | -98   | -98                         |
| Propagation channel   |                       | EPA5  | Static (Note 7)             |
| Correlation and antenna configuration   |                       | Low (2 x 4)                                 | (1 x 4)                     |
| Beamforming Model   |                       | As specified in Section B.4.3 (Note 10, 11) | N/A                         |
| DIP (Note 4)  | dB                    | N/A   | -0.41                       |
| Cell-specific reference signals   |                       | Antenna ports 0,1                           | Antenna port 0              |
| CSI reference signals   |                       | Antenna ports 15,16                         | N/A                         |
| CSI-RS periodicity and subframe offset  |                       | 5/3   | N/A                         |
| CSI-RS reference signal configuration   |                       | 2   | N/A                         |
| Zero-power CSI-RS configuration<br>$I_{CSI-RS}$ /<br>ZeroPowerCSI-RS<br>bitmap  | Subframes /<br>bitmap | N/A   | 3 /<br>001000000000<br>0000 |
| CodeBookSubsetRestriction<br>restriction bitmap   |                       | 001111                                      | N/A                         |
| Reference measurement channel   |                       | Note 2                                      | R.2A TDD                    |
| Reporting mode  |                       | PUCCH 1-1                                   | N/A                         |
| Reporting periodicity   | ms                    | $N_{pd} = 5$                                | N/A                         |
| CQI delay   | ms                    | 10  | N/A                         |
| Physical channel for CQI/PMI reporting  |                       | PUSCH (Note 3)                              | N/A                         |
| PUCCH Report Type for CQI/PMI   |                       | 2   | N/A                         |
| Physical channel for RI reporting   |                       | PUCCH Format 2                              | N/A                         |
| PUCCH Report Type for RI  |                       | 3   | N/A                         |
| $cqi-pmi$ -<br>ConfigurationIndex   |                       | 3   | N/A                         |
| $ri$ -ConfigIndex   |                       | 805 (Note 9)                                | N/A                         |
| Max number of HARQ transmissions  |                       | 1   | N/A                         |
| ACK/NACK feedback mode  |                       | Multiplexing                                | N/A                         |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later |                       |   |                             |

|          |   |
|----------|---|
|          | than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)   |
| Note 2:  | Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.  |
| Note 3:  | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#2 and #7.  |
| Note 4:  | The respective received power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated DIP value as specified in clause B.5.1.   |
| Note 5:  | Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Interfering cell is fully loaded.  |
| Note 6:  | Both cells are time-synchronous.  |
| Note 7:  | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.  |
| Note 8:  | SINR corresponds to $\hat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1.  |
| Note 9:  | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 10: | The precoder in clause B.4.3 follows UE recommended PMI.  |
| Note 11: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).   |

**Table 9.9.2.2-2 Minimum requirement (TDD)**

|             |          |
|-------------|----------|
| $\gamma$    | 1.8      |
| UE Category | $\geq 2$ |

### 9.9.3 Reporting of Precoding Matrix Indicator (PMI) for 4Rx UE

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 9 with 8 TX are specified in terms of the ratio

$$\gamma = \frac{t_{ue, follow 1, follow 2}}{t_{md1, md 2}}$$

In the definition of  $\gamma$ , for PUSCH 3-1 single PMI  $t_{follow 1, follow 2}$  is 70% of the maximum throughput obtained at

$SNR_{follow 1, follow 2}$  using the precoders configured according to the UE reports, and  $t_{md1, md2}$  is the throughput measured at  $SNR_{follow 1, follow 2}$  with random precoding .

## 9.9.3.1 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

## 9.9.3.1.1 TDD

For the parameters specified in Table 9.9.3.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.9.3.1.1-2.

**Table 9.9.3.1.1-1: PMI test for single-layer (TDD)**

| Parameter   |          | Unit         | Test 1  |
|---|----------|--------------|---|
| Bandwidth   |          | MHz          | 10  |
| Transmission mode   |          |              | 9   |
| Uplink downlink configuration   |          |              | 1   |
| Special subframe configuration  |          |              | 4   |
| Propagation channel   |          |              | EVA5  |
| Precoding granularity   |          | PRB          | 50  |
| Antenna configuration   |          |              | 8 x 4   |
| Correlation modeling  |          |              | High, Cross polarized                         |
| Cell-specific reference signals   |          |              | Antenna ports 0,1                             |
| CSI reference signals   |          |              | Antenna ports 15,...,22                       |
| Beamforming model   |          |              | Annex B.4.3                                   |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$  |          |              | 5/ 4  |
| CSI-RS reference signal configuration   |          |              | 0   |
| CodeBookSubsetRestriction bitmap  |          |              | 0x0000 0000<br>001F FFE0<br>0000 0000<br>FFFF |
| Downlink power allocation   | $\rho_A$ | dB           | 0   |
|   | $\rho_B$ | dB           | 0   |
|   | $P_c$    | dB           | -6  |
|   | $\sigma$ | dB           | -3  |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98   |
| Reporting mode  |          |              | PUSCH 3-1                                     |
| Reporting interval  |          | ms           | 5   |
| PMI delay (Note 2)  |          | ms           | 10  |
| Measurement channel   |          |              | R.45-2 TDD                                    |
| OCNG Pattern  |          |              | OP.1 TDD                                      |
| Max number of HARQ transmissions  |          |              | 4   |
| Redundancy version coding sequence  |          |              | {0,0,1,2}                                     |
| ACK/NACK feedback mode  |          |              | Multiplexing                                  |
| <p>Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).</p> <p>Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 3: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8.</p> |          |              |   |

|  |
|--|
| Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3A.4 |
|--|

**Table 9.9.3.1.1-2: Minimum requirement (TDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 2.5      |
| UE Category | $\geq 2$ |

## 9.9.4 Reporting of Rank Indicator (RI)

The purpose of this test for 4Rx UEs is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI (CQI) reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission. Transmission mode 4 is used with the specified CodebookSubSetRestriction in section 9.9.4.1, transmission mode 9 is used with the specified CodebookSubSetRestriction in section 9.9.4.2.

For the fixed rank 1 transmission with 2 Tx ports the RI and PMI reporting is restricted to two single-layer precoders, For fixed rank 2 transmission with 2 Tx ports the RI and PMI reporting is restricted to one two-layer precoder. For the follow RI transmission for rank 1 and 2 and 2 Tx ports the RI and PMI reporting is restricted to select the union of these precoders.

For the fixed rank 2 transmission with 4 Tx ports the RI and PMI reporting is restricted to any 2 Layer precoder, for the follow RI transmission the RI and PMI reporting is not restricted at all.

Channels with low and high correlation are used to ensure that RI reporting reflects the channel condition.

### 9.9.4.1 Minimum requirement (Cell-Specific Reference Symbols)

#### 9.9.4.1.1 FDD

The minimum performance requirement in Table 9.9.4.1.1-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.9.4.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.9.4.1.1-2.

**Table 9.9.4.1.1-1: RI Test (FDD)**

| Parameter                                       |          | Unit | Test 1  | Test 2                   | Test 3                   | Test 4                   |
|---|----------|------|---|--------------------------|--------------------------|--------------------------|
| Bandwidth                                       |          | MHz  | 10  |                          |                          |                          |
| PDSCH transmission mode                         |          |      | 4   |                          |                          |                          |
| Downlink power allocation                       | $\rho_A$ | dB   | -3  |                          |                          | -6                       |
|   | $\rho_B$ | dB   | -3  |                          |                          | -6                       |
|   | $\sigma$ | dB   | 0   |                          |                          | 3                        |
| Propagation condition and antenna configuration |          |      | 2 x 4 EPA5  |                          |                          | 4 x 4 EPA5               |
| Cell-specific reference signals                 |          |      | Antenna ports 0, 1  |                          |                          | Antenna ports 0-3        |
| CodeBookSubsetRestriction bitmap                |          |      | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |                          | Note 6                   |
| Antenna correlation                             |          |      | Low   | Low                      | High                     | Low                      |
| RI configuration                                |          |      | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI | Fixed RI=2 and follow RI |
| SNR   |          | dB   | -4  | 16                       | 16                       | 25                       |

|  |  |                    |     |     |     |
|--|--|--------------------|-----|-----|-----|
| $N_{oc}^{(j)}$                         | dB[mW/15kHz]   | -98                | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$                   | dB[mW/15kHz]   | -102               | -82 | -82 | -73 |
| Maximum number of HARQ transmissions   |  | 1                  |     |     |     |
| Reporting mode                         |  | PUCCH 1-1 (Note 4) |     |     |     |
| Physical channel for CQI/PMI reporting |  | PUCCH Format 2     |     |     |     |
| PUCCH Report Type for CQI/PMI          |  | 2                  |     |     |     |
| Physical channel for RI reporting      |  | PUSCH (Note 3)     |     |     |     |
| PUCCH Report Type for RI               |  | 3                  |     |     |     |
| Reporting periodicity                  | ms   | $N_{pd}= 5$        |     |     |     |
| PMI and CQI delay                      | ms   | 8                  |     |     |     |
| <i>cqi-pmi-ConfigurationIndex</i>      |  | 6                  |     |     |     |
| <i>ri-ConfigurationInd</i>             |  | 1 (Note 5)         |     |     |     |
| Note 1:                                | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).   |                    |     |     |     |
| Note 2:                                | Reference measurement channel RC.2 FDD / RC.21 FDD respectively for Test 1-3 / 4 according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.  |                    |     |     |     |
| Note 3:                                | To avoid collisions between RI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.   |                    |     |     |     |
| Note 4:                                | The bit field for precoding information in DCI format 2 shall be mapped as: <ul style="list-style-type: none"> <li>• For reported RI = 1 and PMI = 0 &gt;&gt; precoding information bit field index = 1</li> <li>• For reported RI = 1 and PMI = 1 &gt;&gt; precoding information bit field index = 2</li> <li>• For reported RI = 2 and PMI = 0 &gt;&gt; precoding information bit field index = 0</li> </ul> |                    |     |     |     |
| Note 5:                                | To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.  |                    |     |     |     |
| Note 6:                                | The following precoders are allowed in Test 4:<br>"0x0000 0000 FFFF 0000" for RI=2<br>"0xFFFF FFFF FFFF FFFF" for UE reported RI   |                    |     |     |     |

**Table 9.9.4.1.1-2: Minimum requirement (FDD)**

|             | Test 1   | Test 2   | Test 3   | Test 4   |
|-------------|----------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      | N/A      |
| $\gamma_2$  | 1        | N/A      | N/A      | 1.1      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 5$ |

9.9.4.1.2 TDD

The minimum performance requirement in Table 9.9.4.1.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.9.4.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.9.4.1.2-2.

**Table 9.9.4.1.2-1: RI Test (TDD)**

| Parameter                 | Unit     | Test 1 | Test 2 | Test 3 | Test 4 |
|---------------------------|----------|--------|--------|--------|--------|
| Bandwidth                 | MHz      | 10     |        |        |        |
| PDSCH transmission mode   |          | 4      |        |        |        |
| Downlink power allocation | $\rho_A$ | dB     | -3     |        | -6     |
|                           | $\rho_B$ | dB     | -3     |        | -6     |

|   |  |              |   |                           |                          |                          |
|---|--|--------------|---|---------------------------|--------------------------|--------------------------|
|   | $\sigma$   | dB           | 0   |                           |                          | 3                        |
| Uplink downlink configuration                   |  |              | 2   |                           |                          |                          |
| Special subframe configuration                  |  |              | 4   |                           |                          |                          |
| Propagation condition and antenna configuration |  |              | 2 x 4 EPA5  |                           |                          | 4 x 4 EPA5               |
| Cell-specific reference signals                 |  |              | Antenna ports 0, 1  |                           |                          | Antenna ports 0-3        |
| CodeBookSubsetRestriction bitmap                |  |              | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                           |                          | Note 4                   |
| Antenna correlation                             |  |              | Low   | Low                       | High                     | Low                      |
| RI configuration                                |  |              | Fixed RI=2 and follow RI  | Fixed RI= 1 and follow RI | Fixed RI=1 and follow RI | Fixed RI=2 and follow RI |
| SNR   |  | dB           | -4  | 16                        | 16                       | 25                       |
| $N_{oc}^{(j)}$                                  |  | dB[mW/15kHz] | -98   | -98                       | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$                            |  | dB[mW/15kHz] | -102  | -82                       | -82                      | -73                      |
| Maximum number of HARQ transmissions            |  |              | 1   |                           |                          |                          |
| Reporting mode                                  |  |              | PUSCH 3-1 (Note 3)  |                           |                          |                          |
| Reporting interval                              |  | ms           | 5   |                           |                          |                          |
| PMI and CQI delay                               |  | ms           | 10 or 11  |                           |                          |                          |
| ACK/NACK feedback mode                          |  |              | Bundling  |                           |                          |                          |
| Note 1:   | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |              |   |                           |                          |                          |
| Note 2:   | Reference measurement channel RC.2 TDD / RC.21 TDD respectively for Test 1-3 / 4 according to Table A.4-1 with one sided dynamic OCNB Pattern OP.1 TDD as described in Annex A.5.2.1.  |              |   |                           |                          |                          |
| Note 3:   | Reported wideband CQI and PMI are used and sub-band CQI is discarded.  |              |   |                           |                          |                          |
| Note 4:   | The following precoders are allowed in Test 4:<br>"0x0000 0000 FFFF 0000" for RI=2<br>"0xFFFF FFFF FFFF FFFF" for UE reported RI   |              |   |                           |                          |                          |

**Table 9.9.4.1.2-2: Minimum requirement (TDD)**

|             | Test 1   | Test 2   | Test 3   | Test 4   |
|-------------|----------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      | N/A      |
| $\gamma_2$  | 1        | N/A      | N/A      | 1.1      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 5$ |

## 9.9.4.2 Minimum requirement (CSI Reference Symbols)

### 9.9.4.2.1 FDD

The minimum performance requirement in Table 9.9.4.2.1-2 is defined as

- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.9.4.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.9.4.2.1-2.

**Table 9.9.4.2.1-1: RI Test (FDD)**

| Parameter               | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|-------------------------|------|--------|--------|--------|--------|
| Bandwidth               | MHz  |        | 10     |        |        |
| PDSCH transmission mode |      |        | 9      |        |        |



|  |   |   |                          |                          |                          |
|--|---|---|--------------------------|--------------------------|--------------------------|
| Downlink power allocation  | $\rho_A$  | dB  | 0                        |                          |                          |
|  | $\rho_B$  | dB  | 0                        |                          |                          |
|  | $P_c$   | dB  | 0                        | -3                       |                          |
|  | $\sigma$  | dB  | 0                        | -3                       |                          |
| Propagation condition and antenna configuration                          |   | 2 x 4 EPA5  |                          | 4 x 4 EPA5               |                          |
| Cell-specific reference signals  |   | Antenna ports 0   |                          |                          |                          |
| Beamforming Model  |   | As specified in Section B.4.3   |                          |                          |                          |
| CSI reference signals  |   | Antenna ports 15, 16  |                          | Antenna ports 15-18      |                          |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |   | 5/1   |                          |                          |                          |
| CSI reference signal configuration                                       |   | 6   |                          |                          |                          |
| CodeBookSubsetRestriction bitmap   |   | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          | Note 5                   |                          |
| Antenna correlation  |   | Low   | Low                      | High                     | Low                      |
| RI configuration   |   | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI | Fixed RI=2 and follow RI |
| SNR  | dB  | -4  | 16                       | 16                       | 25                       |
| $N_{oc}^{(j)}$   | dB[mW/15kHz]  | -98   | -98                      | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz]  | -102  | -82                      | -82                      | -73                      |
| Maximum number of HARQ transmissions                                     |   | 1   |                          |                          |                          |
| Reporting mode   |   | PUCCH 1-1   |                          |                          |                          |
| Physical channel for CQI/PMI reporting                                   |   | PUSCH (Note 3)  |                          |                          |                          |
| PUCCH Report Type for CQI/PMI  |   | 2   |                          |                          |                          |
| Physical channel for RI reporting  |   | PUCCH Format 2  |                          |                          |                          |
| PUCCH Report Type for RI   |   | 3   |                          |                          |                          |
| Reporting periodicity  | ms  | $N_{pd} = 5$  |                          |                          |                          |
| PMI and CQI delay  | ms  | 8   |                          |                          |                          |
| <i>cqi-pmi-ConfigurationIndex</i>  |   | 2   |                          |                          |                          |
| <i>ri-ConfigurationInd</i>   |   | 1 (Note 4)  |                          |                          |                          |
| Note 1:  | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).                        |   |                          |                          |                          |
| Note 2:  | Reference measurement channel RC.9 FDD / RC.9B FDD respectively for Test 1-3 / 4 according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.   |   |                          |                          |                          |
| Note 3:  | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5. |   |                          |                          |                          |
| Note 4:  | To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.   |   |                          |                          |                          |
| Note 5:  | The following precoders are allowed in Test 4:<br>"0x0000 0000 FFFF 0000" for RI=2<br>"0xFFFF FFFF FFFF FFFF" for UE reported RI  |   |                          |                          |                          |

Table 9.9.4.2.1-2: Minimum requirement (FDD)

|             | Test 1   | Test 2   | Test 3   | Test 4   |
|-------------|----------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      | N/A      |
| $\gamma_2$  | 1        | N/A      | N/A      | 1.1      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 5$ |

## 9.9.4.2.2 TDD

The minimum performance requirement in Table 9.9.4.2.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be  $\geq \gamma_1$ ;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be  $\geq \gamma_2$ ;

For the parameters specified in Table 9.9.4.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.9.4.2.2-2.

**Table 9.9.4.2.2-1: RI Test (TDD)**

| Parameter  | Unit         | Test 1  | Test 2                   | Test 3                   | Test 4                   |
|--|--------------|---|--------------------------|--------------------------|--------------------------|
| Bandwidth  | MHz          | 10  |                          |                          |                          |
| PDSCH transmission mode  |              | 9   |                          |                          |                          |
| Downlink power allocation  | $\rho_A$     | 0   |                          |                          |                          |
|  | $\rho_B$     | 0   |                          |                          |                          |
|  | $P_C$        | 0   |                          |                          | -3                       |
|  | $\sigma$     | 0   |                          |                          | -3                       |
| Uplink downlink configuration  |              | 1   |                          |                          |                          |
| Special subframe configuration   |              | 4   |                          |                          |                          |
| Propagation condition and antenna configuration  |              | 2 x 4 EPA5  |                          |                          | 4 x 4 EPA5               |
| Cell-specific reference signals  |              | Antenna ports 0   |                          |                          |                          |
| CSI reference signals  |              | Antenna ports 15, 16  |                          |                          | Antenna ports 15-18      |
| Beamforming Model  |              | As specified in Section B.4.3   |                          |                          |                          |
| CSI reference signal configuration   |              | 4   |                          |                          |                          |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |              | 5/4   |                          |                          |                          |
| CodeBookSubsetRestriction bitmap   |              | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |                          | Note 4                   |
| Antenna correlation  |              | Low   | Low                      | High                     | Low                      |
| RI configuration   |              | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI | Fixed RI=2 and follow RI |
| SNR  | dB           | -4  | 16                       | 16                       | 25                       |
| $N_{oc}^{(j)}$   | dB[mW/15kHz] | -98   | -98                      | -98                      | -98                      |
| $\hat{I}_{or}^{(j)}$   | dB[mW/15kHz] | -102  | -82                      | -82                      | -73                      |
| Maximum number of HARQ transmissions   |              | 1   |                          |                          |                          |
| Reporting mode   |              | PUCCH 1-1   |                          |                          |                          |
| Physical channel for CQI/ PMI reporting  |              | PUSCH (Note 3)  |                          |                          |                          |
| PUCCH report type for CQI/ PMI   |              | 2   |                          |                          |                          |
| Physical channel for RI reporting  |              | PUCCH Format 2  |                          |                          |                          |
| Reporting periodicity  | ms           | $N_{pd} = 5$  |                          |                          |                          |
| PMI and CQI delay  | ms           | 10  |                          |                          |                          |
| ACK/NACK feedback mode   |              | Bundling  |                          |                          |                          |
| <i>cqi-pmi-ConfigurationIndex</i>  |              | 4   |                          |                          |                          |
| <i>ri-ConfigurationInd</i>   |              | 1   |                          |                          |                          |

|         |   |
|---------|---|
| Note 1: | If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).                      |
| Note 2: | Reference measurement channel RC.9 TDD / RC.9B TDD respectively for Test 1-3 / 4 according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |
| Note 3: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#3 and #8. |
| Note 4: | The following precoders are allowed in Test 4:<br>“0x0000 0000 FFFF 0000” for RI=2<br>“0xFFFF FFFF FFFF FFFF” for UE reported RI  |

Table 9.9.4.2.2-2: Minimum requirement (TDD)

|             | Test 1   | Test 2   | Test 3   | Test 4   |
|-------------|----------|----------|----------|----------|
| $\gamma_1$  | N/A      | 1.05     | 0.9      | N/A      |
| $\gamma_2$  | 1        | N/A      | N/A      | 1.1      |
| UE Category | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 5$ |

## 9.10 Reporting of CSI-RS Resource Indicator (CRI)

The purpose of this test is to verify that the reported CSI-RS Resource Indicator is accurate. The accuracy of CRI reporting for Tests in Section 9.10.1 is determined by:

- a) The ratio of the throughput obtained when transmitting based on the reported CRI and fixed precoder with multiple CSI-RS resources configured compared to that obtained when transmitting based on the fixed precoder with one CSI-RS resource configured:
- $$\gamma = \frac{t_{ue, follow\_CRI, fixed\_PMI}}{t_{fixed\_CRI, fixed\_PMI}}$$

- $t_{ue, follow\_CRI, fixed\_PMI}$  is [70%] of the maximum throughput obtained at  $SNR_{ue, follow\_CRI, fixed\_PMI}$  using fixed precoder and power scaling factor according to UE reported CRI value with multiple CSI-RS resources configured
- $t_{fixed\_CRI, fixed\_PMI}$  is throughput obtained at  $SNR_{ue, follow\_CRI, fixed\_PMI}$  using fixed precoder and power scaling factor according to the one configured CSI-RS resource
- $SNR_{ue, follow\_CRI, fixed\_PMI}$  is specified based on CRS RE power

- b) Each candidate CRI value among 0, 1, ..., K-1 shall be reported at least  $\alpha\%$  of the time at  $SNR_{ue, follow\_CRI, fixed\_PMI}$  with multiple CSI-RS resources configured

- The number of configured CSI-RS resources K is specific to a test.

The accuracy of CRI reporting for Tests in Section 9.10.2 is determined by:

- a) The ratio of the throughput obtained when transmitting based on the reported CRI and fixed precoder with multiple CSI-RS resources configured compared to that obtained when transmitting based on the fixed precoder with one CSI-RS resource configured:
- $$\gamma = \frac{t_{ue, follow\_CRI}}{t_{fixed\_TP1}}$$

- $t_{ue, follow\_CRI}$  is [70%] of the maximum throughput obtained at  $SNR_{ue, follow\_CRI}$  using the CRI configured according to the CSI UE report
- $t_{fixed\_TP1}$  is throughput obtained at  $SNR_{ue, follow\_CRI}$  under assumption of single TP1 transmission

- b) CRI 2 value among 0, 1 and 2 shall be reported at least  $\alpha$  % of the time at  $SNR_{ue, follow\_CRI}$  with 2 CSI-RS resources configured
- c) CRI 0 value among 0, 1 and 2 shall be reported at least  $\beta$  % of the time at  $SNR_{fixed\_TP1}$  with 2 CSI-RS resources configured
  - $SNR_{fixed\_TP1}$  corresponds to [70%] of the maximum throughput under assumption of single TP1 transmission

### 9.10.1 Minimum requirement (PUSCH 3-1)

#### 9.10.1.1 FDD

For the parameters specified in Table 9.10.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.10.1.1-2.

**Table 9.10.1.1-1: CRI Test (FDD)**

| Parameter                                      | Unit           | Test 1-1<br>(K,N)=(2,8)                | Test 1-2<br>(K,N)=(2,16)                          | Test 1-3<br>(K,N)=(4,32)                          | Test 1-4<br>(K,N)=(8,64)                          |    |
|--|----------------|--|---|---|---|----|
| Bandwidth                                      | MHz            | 10                                     |   |   |   |    |
| Transmission mode                              |                | 9                                      |   |   |   |    |
| Propagation channel                            |                | EPA5                                   |   |   |   |    |
| Beamforming model                              |                | Annex B.4.6                            |   |   |   |    |
| Precoding granularity                          | PRB            | 50                                     |   |   |   |    |
| Correlation and antenna configuration (Note 1) |                | 4x2 XP High                            | 8x2 XP High                                       | 8x2 XP High                                       | 8x2 XP High                                       |    |
| Cell-specific reference signals eMIMO-Type     |                | Antenna ports 0,1<br>Class B           |   |   |   |    |
| Number of NZP-CSI resources (K) (Note 3)       |                | 2 for following CRI<br>1 for fixed CRI | 2 for following CRI<br>1 for fixed CRI            | 4 for following CRI<br>1 for fixed CRI            | 8 for following CRI<br>1 for fixed CRI            |    |
| NZP-CSI-RS-ID-List                             |                | {0,1}                                  | {0,1}   | {0,1,2,3}   | {0,1,2,3,4,5,6,7}                                 |    |
| legacyCSRList                                  |                | {0,0}                                  | {0,0}   | {0,0,0,0}   | {0,0,0,0,0,0,0,0}                                 |    |
| CSI reference signal configuration List        |                | {0,1}                                  | {0,1}   | {0,1,2,3}   | {0,1,2,3,0,1,2,3}                                 |    |
| Number of CSI-RS ports (N <sub>k</sub> )       |                | {4,4}                                  | {8,8}   | {8,8,8,8}   | {8,8,8,8,8,8,8,8}                                 |    |
| CSI-RS-SubframeConfig List                     |                | {1,1}                                  | {1,1}   | {1,1,1,1}   | {1,1,1,1,2,2,2,2}                                 |    |
| CodeBookSubsetRestriction with ID=0            |                | 0x<br>0000 00000000 0001               | 0x<br>0000 0000<br>0000 0020<br>0000 0000<br>0001 | 0x<br>0000 0000<br>0000 0020<br>0000 0000<br>0001 | 0x<br>0000 0000<br>0000 0020<br>0000 0000<br>0001 |    |
| alternativeCodeBookEnabledFor4TX-r12           |                | FALSE                                  | N/A   | N/A   | N/A   |    |
| Downlink power allocation                      | $\rho_A$       | dB                                     | 0   | 0   | 0   | 0  |
|  | $\rho_B$       | dB                                     | 0   | 0   | 0   | 0  |
|  | P <sub>c</sub> | dB                                     | -3  | -6  | -6  | -6 |
|  | $\sigma$       | dB                                     | -3  | -3  | -3  | -3 |
| $N_{oc}^{(j)}$                                 | dB[mW/15kHz]   | -98                                    |   |   |   |    |
| Reporting mode                                 |                | PUSCH 3-1                              |   |   |   |    |
| Reporting interval                             | ms             | 5                                      |   |   |   |    |
| CRI Delay                                      | ms             | 8                                      |   |   |   |    |
| PMI delay                                      | ms             | 8                                      |   |   |   |    |

|                                    |   |                  |                  |                  |              |
|------------------------------------|---|------------------|------------------|------------------|--------------|
| Measurement channel                |   | R.50A-1 FDD      | R.50A-2 FDD      | R.50A-2 FDD      | R.50A-3 FDD  |
| OCNG Pattern                       |   | OP.1 FDD         |                  |                  |              |
| Rank Number of PDSCH               |   | 1                |                  |                  |              |
| Scheduled PDSCH SFs                |   | SF 0,2,3,4,7,8,9 | SF 0,2,3,4,7,8,9 | SF 0,2,3,4,7,8,9 | SF 0,3,4,8,9 |
| Max number of HARQ transmissions   |   | 4                |                  |                  |              |
| Redundancy version coding sequence |   | {0,1,2,3}        |                  |                  |              |
| Note 1:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on CRI/PMI estimation at a downlink SF not later than SF#(n-4), this reported CRI/PMI cannot be applied at the eNB downlink before SF#(n+4). |                  |                  |                  |              |
| Note 2:                            | PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.   |                  |                  |                  |              |
| Note 3:                            | When one CSI-RS resource configured, the configurations according to NZP-CSI-RS-ID = 0 are configured.  |                  |                  |                  |              |

**Table 9.10.1.1-2: Minimum requirement (FDD)**

|             | Test 1-1   | Test 1-2 | Test 1-3 | Test 1-4 |
|-------------|--|----------|----------|----------|
| $\gamma$    | 1.2  | 1.2      | 1.3      | 1.35     |
| $\alpha$    | 40   | 40       | 20       | 10       |
| UE Category | $\geq 2$   | $\geq 2$ | $\geq 2$ | $\geq 2$ |
| Note1:      | According to UE capability configuration list for the maximum number of NZP CSI-RS resource Kmax and the maximum number of total NZP CSI-RS ports N in each K =2,..., Kmax: if UE supports the combination of (K,N) =(8,64), then test 1-4 is applicable ; else if UE supports the combination of (K,N) =(4,32), then test 1-3 is applicable; else if UE supports the combination of (K,N) =(2,16), then test 1-2 is applicable; otherwise test 1-1 is applicable. |          |          |          |

9.10.1.2 TDD

For the parameters specified in Table 9.10.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.10.1.2-2.

**Table 9.10.1.2-1: CRI Test (TDD)**

| Parameter                                      | Unit | Test 1-1 (K,N)=(2,8)                   | Test 1-2 (K,N)=(2,16)                  | Test 1-3 (K,N)=(4,32)                  | Test 1-4 (K,N)=(8,64)                  |
|--|------|--|--|--|--|
| Bandwidth                                      | MHz  | 10                                     |  |  |  |
| Transmission mode                              |      | 9                                      |  |  |  |
| Uplink downlink configuration                  |      | 2                                      |  |  |  |
| Special subframe configuration                 |      | 4                                      |  |  |  |
| Propagation channel                            |      | EPA5                                   |  |  |  |
| Beamforming model                              |      | Annex B.4.6                            |  |  |  |
| Precoding granularity                          | PRB  | 50                                     |  |  |  |
| Correlation and antenna configuration (Note 1) |      | 4x2 XP High                            | 8x2 XP High                            | 8x2 XP High                            | 8x2 XP High                            |
| Cell-specific reference signals eMIMO-Type     |      | Antenna ports 0,1<br>Class B           |  |  |  |
| Number of NZP-CSI resources (K) (Note 3)       |      | 2 for following CRI<br>1 for fixed CRI | 2 for following CRI<br>1 for fixed CRI | 4 for following CRI<br>1 for fixed CRI | 8 for following CRI<br>1 for fixed CRI |
| NZP-CSI-RS-ID-List legacyCSRList               |      | {0,1}                                  | {0,1}                                  | {0,1,2,3}                              | {0,1,2,3,4,5,6,7}                      |
| CSI reference signal configuration List        |      | {0,1}                                  | {0,1}                                  | {0,1,2,3}                              | {0,1,2,3,0,1,2,3}                      |
| Number of CSI-RS ports (Nk)                    |      | {4,4}                                  | {8,8}                                  | {8,8,8,8}                              | {8,8,8,8,8,8,8,8}                      |
| CSI-RS-SubframeConfig List                     |      | {9,9}                                  | {9,9}                                  | {9,9,9,9}                              | {8,8,8,8,9,9,9,9}                      |
| CodeBookSubsetRestriction with ID=0            |      | 0x<br>0000 00000000 0001               | 0x<br>0000 0000<br>0000 0020           | 0x<br>0000 0000<br>0000 0020           | 0x<br>0000 0000<br>0000 0020           |

|  |                |              |                |                   |                   |                   |
|--|----------------|--------------|----------------|-------------------|-------------------|-------------------|
|  |                |              |                | 0000 0000<br>0001 | 0000 0000<br>0001 | 0000 0000<br>0001 |
| alternativeCodeBookEnabledFor4TX-r12   |                |              | FALSE          | N/A               | N/A               | N/A               |
| Downlink power allocation  | $\rho_A$       | dB           | 0              | 0                 | 0                 | 0                 |
|  | $\rho_B$       | dB           | 0              | 0                 | 0                 | 0                 |
|  | $\alpha$ $P_c$ | dB           | -3             | -6                | -6                | -6                |
|  | $\sigma$       | dB           | -3             | -3                | -3                | -3                |
| $N_{oc}^{(j)}$   |                | dB[mW/15kHz] | -98            |                   |                   |                   |
| Reporting mode   |                |              | PUSCH 3-1      |                   |                   |                   |
| Reporting interval   |                | ms           | 10             |                   |                   |                   |
| CRI Delay  |                | ms           | 12             |                   |                   |                   |
| PMI delay  |                | ms           | 12             |                   |                   |                   |
| Measurement channel  |                |              | R.44A-1 TDD    | R.44A-2 TDD       | R.44A-2 TDD       | R.44A-3 TDD       |
| OCNG Pattern   |                |              | OP.1 TDD       |                   |                   |                   |
| Rank Number of PDSCH   |                |              | 1              |                   |                   |                   |
| Scheduled PDSCH SFs  |                |              | SF 0,1,3,6,8,9 | SF 0,1,3,6,8,9    | SF 0,1,3,6,8,9    | SF 0,1,6,8,9      |
| Max number of HARQ transmissions   |                |              | 4              |                   |                   |                   |
| Redundancy version coding sequence   |                |              | {0,1,2,3}      |                   |                   |                   |
| ACK/NACK feedback mode   |                |              | Multiplexing   |                   |                   |                   |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).</p> <p>Note 2: PDSCH_RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.</p> <p>Note 3: When one CSI-RS resource configured, the configurations according to NZP-CSI-RS-ID 0 are configured.</p> <p>Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 to allow aperiodic CRI/CQI/PMI/RI to be transmitted on uplink SF#2.</p> |                |              |                |                   |                   |                   |

**Table 9.10.1.2-2: Minimum requirement (TDD)**

|  | Test 1-1 | Test 1-2 | Test 1-3 | Test 1-4 |
|--|----------|----------|----------|----------|
| $\gamma$   | 1.2      | 1.2      | 1.3      | 1.35     |
| $\alpha$   | 40       | 40       | 20       | 10       |
| UE Category  | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ |
| <p>Note1: According to UE capability configuration list for the maximum number of NZP CSI-RS resource Kmax and the maximum number of total NZP CSI-RS ports N in each K =2,..., Kmax: if UE supports the combination of (K,N)=(8,64), then test 1-4 is applicable; else if UE supports the combination of (K,N)=(4,32), then test 1-3 is applicable; else if UE supports the combination of (K,N)=(2,16), then test 1-2 is applicable; otherwise test 1-1 is applicable.</p> |          |          |          |          |

## 9.10.2 Minimum requirement (PUSCH 3-1, QCL Type C)

### 9.10.2.1 FDD

The requirements are specified in Table 9.10.2.1-4, with the additional parameters in Table 9.10.2.1-1, Table 9.10.2.1-2 and Table 9.10.2.1-3. In Table 9.10.2.1-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and can transmit PDSCH, and transmission point 2 (TP 2) has different Cell ID and can transmit PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.2 and for TP 2 according to Table C.3.2.

**Table 9.10.2.1-1: Test Parameters**

| Parameter | Unit | Fixed TP1 case |      | Follow CRI case |      |
|-----------|------|----------------|------|-----------------|------|
|           |      | TP 1           | TP 2 | TP 1            | TP 2 |

|  |          |                  |                                  |                            |   |                            |
|--|----------|------------------|----------------------------------|----------------------------|---|----------------------------|
| Downlink power allocation  | $\rho_A$ | dB               | 0                                | 0                          | 0   | 0                          |
|  | $\rho_B$ | dB               | 0 (Note 1)                       | 0                          | 0 (Note 1)  | 0                          |
|  | $\sigma$ | dB               | -3                               | -3                         | -3  | -3                         |
| $\widehat{E}_s / N_{oc}$   |          | dB               | SNR1 (Note 2)                    | SNR2 = SNR1 - [9] dB       | SNR1 (Note 2)   | SNR2 = SNR1 - [9] dB       |
| $N_{oc}$ at antenna port   |          | dBm/15kHz        | -98                              |                            |   |                            |
| $BW_{Channel}$   |          | MHz              | 10                               |                            |   |                            |
| Cyclic Prefix  |          |                  | Normal                           |                            |   |                            |
| PDSCH transmission mode  |          |                  | 10                               |                            |   |                            |
| Number of allocated resource block   |          |                  | 50                               |                            |   |                            |
| Cell ID  |          |                  | 0                                | 126                        | 0   | 126                        |
| Number of control OFDM symbols / PDSCH start                               |          |                  | 2                                | 2                          | 2   | 2                          |
| Cell-specific reference signals  |          |                  | Antenna ports 0,1                |                            |   |                            |
| eMIMO-Type   |          |                  | Class B                          |                            |   |                            |
| CSI reference signals 0  |          |                  | Antenna ports {15,16}            | N/A                        | Antenna ports {15,16}                                 | NA                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    |          | Subframes        | 5 / 2                            |                            | 5 / 2   |                            |
| CSI reference signal 0 configuration                                       |          |                  | 0                                |                            | 0   |                            |
| CSI reference signals 1  |          |                  | N/A                              | Antenna ports {15,16}      | Antenna ports {15,16}                                 |                            |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    |          | Subframes        |                                  | 5 / 2                      | N/A   | 5 / 2                      |
| CSI reference signal 1 configuration                                       |          |                  |                                  | 8                          | 8   |                            |
| CodeBookSubsetRestriction for CSI-RS 0                                     |          |                  | 001111                           | N/A                        | 001111  | N/A                        |
| CodeBookSubsetRestriction for CSI-RS 1                                     |          |                  | N/A                              | 001111                     | N/A   | 001111                     |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ |          | Subframes/bitmap | 2/<br>001000000000<br>0000       | N/A                        | 2/<br>001000000000<br>0000                            | N/A                        |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$  |          | Subframes/bitmap | N/A                              | 2/<br>001000000000<br>0000 | N/A   | 2/<br>001000000000<br>0000 |
| Timing offset relative to TP 1   |          | us               | N/A                              | 0                          | N/A   | 0                          |
| Frequency offset relative to TP 1  |          | Hz               | N/A                              | 0                          | N/A   | 0                          |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'  |          |                  | Type B, '00'<br>Table 9.10.2.1-2 |                            | Type C, PQI based on UE reporting<br>Table 9.10.2.1-3 |                            |
| Reporting mode   |          |                  | PUSCH 3-1                        |                            |   |                            |
| Reporting interval   |          | ms               | 5                                |                            |   |                            |
| CRI Delay  |          | ms               | 8                                |                            |   |                            |
| PMI delay  |          | ms               | 8                                |                            |   |                            |
| Measurement channel  |          |                  | R.97 FDD                         |                            |   |                            |
| Correlation and antenna configuration                                      |          |                  | 2x2 Low                          |                            |   |                            |
| Propagation channel  |          |                  | EPA5                             |                            |   |                            |

Note 1:  $P_B = 1$   
 Note 2: TP1 SNR based on SNR value derived for exact test metric verification and can be equal to  $SNR_{ue, follow\_CRI}$  or  $SNR_{fixed\_TP1}$

**Table 9.10.2.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set (Fixed TP1 case)**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blank |

**Table 9.10.2.1-3: Configurations of PQI and DL transmission hypothesis for each PQI set (Follow CRI case)**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blank |
| PQI set 1     | CSI-RS 1                                 | ZP CSI-RS 1             | Blank                                       | PDSCH |
| PQI set 2     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     | ZP CSI-RS 0             | PDSCH                                       | PDSCH |

**Table 9.10.2.1-4: Minimum requirement (FDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| $\alpha$    | 40       |
| $\beta$     | 60       |
| UE Category | $\geq 2$ |

9.10.2.2 TDD

The requirements are specified in Table 9.10.2.2-4, with the additional parameters in Table 9.10.2.2-1, Table 9.10.2.2-2 and Table 9.10.2.2-3. In Table 9.10.2.2-1, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals, PBCH and can transmit PDSCH, and transmission point 2 (TP 2) has different Cell ID and can transmit PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.2 and for TP 2 according to Table C.3.2.

**Table 9.10.2.2-1: Test Parameters**

| Parameter                     | Unit      | Fixed TP1 case |                      | Follow CRI case |                      |
|-------------------------------|-----------|----------------|----------------------|-----------------|----------------------|
|                               |           | TP 1           | TP 2                 | TP 1            | TP 2                 |
| Downlink power allocation     | $\rho_A$  | 0              | 0                    | 0               | 0                    |
|                               | $\rho_B$  | 0 (Note 1)     | 0                    | 0 (Note 1)      | 0                    |
|                               | $\sigma$  | -3             | -3                   | -3              | -3                   |
| $\widehat{E}_s / N_{oc}$      | dB        | SNR1 (Note 2)  | SNR2 = SNR1 - [9] dB | SNR1 (Note 2)   | SNR2 = SNR1 - [9] dB |
| $N_{oc}$ at antenna port      | dBm/15kHz | -98            |                      |                 |                      |
| Uplink downlink configuration |           | 1              |                      |                 |                      |



|  |                  |                                  |                            |   |                            |
|--|------------------|----------------------------------|----------------------------|---|----------------------------|
| Special subframe configuration   |                  | 4                                |                            |   |                            |
| BW <sub>Channel</sub>  | MHz              | 10                               |                            |   |                            |
| Cyclic Prefix  |                  | Normal                           |                            |   |                            |
| PDSCH transmission mode  |                  | 10                               |                            |   |                            |
| Number of allocated resource block   |                  | 50                               |                            |   |                            |
| Cell ID  |                  | 0                                | 126                        | 0   | 126                        |
| Number of control OFDM symbols / PDSCH start                               |                  | 2                                | 2                          | 2   | 2                          |
| Cell-specific reference signals  |                  | Antenna ports 0,1                |                            |   |                            |
| eMIMO-Type   |                  | Class B                          |                            |   |                            |
| CSI reference signals 0  |                  | Antenna ports {15,16}            | N/A                        | Antenna ports {15,16}                                 | NA                         |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes        | 5 / 4                            |                            | 5 / 4   |                            |
| CSI reference signal 0 configuration                                       |                  | 0                                |                            | 0   |                            |
| CSI reference signals 1  |                  | N/A                              | Antenna ports {15,16}      | N/A   | Antenna ports {15,16}      |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS} / \Delta_{CSI-RS}$    | Subframes        |                                  | 5 / 4                      |   | 5 / 4                      |
| CSI reference signal 1 configuration                                       |                  |                                  | 8                          |   | 8                          |
| CodeBookSubsetRestriction for CSI-RS 0                                     |                  | 001111                           | N/A                        | 001111  | N/A                        |
| CodeBookSubsetRestriction for CSI-RS 1                                     |                  | N/A                              | 001111                     | N/A   | 001111                     |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$ | Subframes/bitmap | 4/<br>001000000000<br>0000       | N/A                        | 4/<br>001000000000<br>0000                            | N/A                        |
| Zero-power CSI-RS1 configuration $I_{CSI-RS} / ZeroPower\ CSI-RS\ bitmap$  | Subframes/bitmap | N/A                              | 4/<br>001000000000<br>0000 | N/A   | 4/<br>001000000000<br>0000 |
| Timing offset relative to TP 1   | us               | N/A                              | 0                          | N/A   | 0                          |
| Frequency offset relative to TP 1  | Hz               | N/A                              | 0                          | N/A   | 0                          |
| <i>qcl-Operation</i> , 'PDSCH RE Mapping and Quasi-Co-Location Indicator'  |                  | Type B, '00'<br>Table 9.10.2.2-2 |                            | Type C, PQI based on UE reporting<br>Table 9.10.2.2-3 |                            |
| Reporting mode   |                  | PUSCH 3-1                        |                            |   |                            |
| Reporting interval   | ms               | 5                                |                            |   |                            |
| CRI Delay  | ms               | 8                                |                            |   |                            |
| PMI delay  | ms               | 8                                |                            |   |                            |
| Measurement channel  |                  | R.97 TDD                         |                            |   |                            |
| Correlation and antenna configuration                                      |                  | 2x2 Low                          |                            |   |                            |
| Propagation channel  |                  | EPA5                             |                            |   |                            |
| Note 1:  | $P_B = 1$        |                                  |                            |   |                            |

Note 2: TP1 SNR based on SNR value derived for exact test metric verification and can be equal to

$$SNR_{ue, follow\_CRI} \text{ or } SNR_{fixed\_TP1}$$

**Table 9.10.2.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set (Fixed TP1 case)**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blank |

**Table 9.10.2.2-3: Configurations of PQI and DL transmission hypothesis for each PQI set (Follow CRI case)**

| PQI set index | Parameters in each PQI set               |                         | DL transmission hypothesis for each PQI Set |       |
|---------------|--|-------------------------|---|-------|
|               | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1  | TP 2  |
| PQI set 0     | CSI-RS 0                                 | ZP CSI-RS 0             | PDSCH                                       | Blank |
| PQI set 1     | CSI-RS 1                                 | ZP CSI-RS 1             | Blank                                       | PDSCH |
| PQI set 2     | CSI-RS 0 for CW1<br>CSI-RS 1 for CW2     | ZP CSI-RS 0             | PDSCH                                       | PDSCH |

**Table 9.10.2.2-4: Minimum requirement (FDD)**

|             | Test 1   |
|-------------|----------|
| $\gamma$    | 1.2      |
| $\alpha$    | 40       |
| $\beta$     | 60       |
| UE Category | $\geq 2$ |

## 9.11 Reporting of Hybrid Channel state information

### 9.11.1 Minimum requirement (with eMIMO-Type configured as Class B with more than one CSI-RS resource configured and eMIMO-Type2 as Class B with one CSI-RS resource configured)

The purpose of this test is to verify that the reported CRI<sup>(1)</sup> from eMIMO-Type and PMI<sup>(2)</sup> from eMIMO-Type2 are accurate.

The accuracy of CRI and PMI reporting are determined by the ratio of the throughput obtained when transmitting based on UE reported CRI<sup>(1)</sup> and PMI<sup>(2)</sup> compared to that obtained when transmitting based on the random precoding and fixed CRI:

$$\gamma = \frac{t_{ue, followCRI^{(1)}, followPMI^{(2)}}}{t_{fixedCRI^{(1)}, rndPMI^{(2)}}}$$

- $t_{ue, followCRI^{(1)}, followPMI^{(2)}}$  is [70%] of the maximum throughput obtained at  $SNR_{ue, followCRI^{(1)}, followPMI^{(2)}}$  using following precoder according to UE reported PMI<sup>(2)</sup> for eMIMO-Type2 and power scaling factor according to UE reported CRI<sup>(1)</sup> for eMIMO-Type

- $t_{fixedCRI^{(1)}, mdPMI^{(2)}}$  is throughput obtained at  $SNR_{ue, followCRI^{(1)}, followPMI^{(2)}}$  using random precoder and power scaling factor according to the one configured CSI-RS resource
- $SNR_{ue, followCRI^{(1)}, followPMI^{(2)}}$  is specified based on CRS RE power

### 9.11.1.1 FDD

For the parameters specified in Table 9.11.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.11.1.1-2.

**Table 9.11.1.1-1: CRI/PMI test for single layer (FDD)**

| Parameter  | Unit     | Test 1              |    |
|--|----------|---------------------|----|
| Bandwidth  | MHz      | 10                  |    |
| Transmission mode  |          | 9                   |    |
| Propagation channel  |          | EPA5                |    |
| Precoding granularity<br>(only for reporting and following PMI)  | PRB      | 50                  |    |
| Correlation and antenna configuration  |          | 4*2 ULA Low         |    |
| Cell-specific reference signals  |          | Antenna ports 0,1   |    |
| Beamforming model  |          | B.4.6 (Note 4)      |    |
| CSI reference signal configuration List  |          | {0,1}               |    |
| Number of CSI-RS ports (N <sub>k</sub> )   |          | {4,4}               |    |
| CSI-RS-SubframeConfig List   |          | {1,1}               |    |
| eMIMO-Type   |          | Class B             |    |
| Number of NZP-CSI resources (K)  |          | 2 for following CRI |    |
| NZP-CSI-RS-ID-List   |          | {0,1}               |    |
| eMIMO-Type2  |          | Class B             |    |
| NZP-CSI-RS-ID  |          | {0}                 |    |
| alternativeCodebookEnabledCLASSB_K1  |          | FALSE               |    |
| codebookSubsetRestriction  |          | 001111              |    |
| Reporting mode   |          | PUSCH 3-1           |    |
| Physical channel for CRI <sup>(1)</sup> reporting  |          | PUSCH               |    |
| Reporting interval for CRI <sup>(1)</sup> reporting  | ms       | 40 (Note 5)         |    |
| Physical channel for RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> reporting   |          | PUSCH               |    |
| Reporting Interval for RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> reporting   | ms       | 5                   |    |
| Downlink power allocation  | $\rho_A$ | dB                  | 0  |
|  | $\rho_B$ | dB                  | 0  |
|  | $P_c$    | dB                  | -3 |
|  | $\sigma$ | dB                  | -3 |
| Rank Number of PDSCH   |          | 1                   |    |
| Measurement channel  |          | R.50A-1 FDD         |    |
| OCNG Pattern   |          | OP.1 FDD            |    |
| Max number of HARQ transmissions   |          | 4                   |    |
| Redundancy version coding sequence   |          | {0,1,2,3}           |    |
| Scheduled PDSCH SFs  |          | SF 0,2,3,4,7,8,9    |    |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).   |          |                     |    |
| Note 2: If the UE reports in an available uplink reporting instance at subframe SF#n based on CRI,PMI estimation at a downlink SF not later than SF#(n-4), this reported CRI, PMI cannot be applied at the eNB downlink before SF#(n+4). |          |                     |    |

|         |   |
|---------|---|
| Note 3: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.  |
| Note 4: | The precoder matrix as specified in Table 6.3.4.2.3-1of [4].For following PMI, PMI equals to UE reported PMI <sup>(2)</sup> for eMIMO-Type2 "Class B".  |
| Note 5: | PDCCH DCI format 0 with a trigger for aperiodic CSI of eMIMO-Type shall be transmitted in downlink SF#1 to allow aperiodic CRI <sup>(1)</sup> to be transmitted on uplink SF#5. PDCCH DCI format 0 with a trigger for aperiodic CSI of eMIMO-Type2 shall be transmitted in downlink SF#1,6 to allow aperiodic RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> to be transmitted on uplink SF#5,0. |

**Table 9.11.1.1-2: Minimum requirement (FDD)**

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.3      |
| UE Category | $\geq 2$ |

### 9.11.1.2 TDD

For the parameters specified in Table 9.11.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.11.1.2-2.

**Table 9.11.1.2-1: CRI/PMI test for single layer (TDD)**

| Parameter  | Unit           | Test 1              |    |
|--|----------------|---------------------|----|
| Bandwidth  | MHz            | 10                  |    |
| Transmission mode  |                | 9                   |    |
| Uplink downlink configuration  |                | 2                   |    |
| Special subframe configuration   |                | 4                   |    |
| Propagation channel  |                | EPA5                |    |
| Precoding granularity (only for reporting and following PMI)                               | PRB            | 50                  |    |
| Correlation and antenna configuration  |                | 4*2 ULA Low         |    |
| Cell-specific reference signals  |                | Antenna ports 0,1   |    |
| Beamforming model  |                | B.4.6 (Note 4)      |    |
| CSI reference signal configuration List  |                | {0,1}               |    |
| Number of CSI-RS ports (N <sub>k</sub> )   |                | {4,4}               |    |
| CSI-RS-SubframeConfig List   |                | {9,9}               |    |
| eMIMO-Type   |                | Class B             |    |
| Number of NZP-CSI resources (K)  |                | 2 for following CRI |    |
| NZP-CSI-RS-ID-List   |                | {0,1}               |    |
| eMIMO-Type2  |                | Class B             |    |
| NZP-CSI-RS-ID  |                | {0}                 |    |
| alternativeCodebookEnabledCL_ASSB_K1   |                | FALSE               |    |
| codebookSubsetRestriction  |                | 001111              |    |
| Reporting mode   |                | PUSCH 3-1           |    |
| Physical channel for CRI <sup>(1)</sup> reporting  |                | PUSCH               |    |
| Reporting interval for CRI <sup>(1)</sup> reporting  | ms             | 40 (Note 5)         |    |
| Physical channel for RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> reporting   |                | PUSCH               |    |
| Reporting Interval for RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> reporting | ms             | 10                  |    |
| Downlink power allocation  | $\rho_A$       | dB                  | 0  |
|  | $\rho_B$       | dB                  | 0  |
|  | P <sub>c</sub> | dB                  | -3 |

|                                    |   |    |                |
|------------------------------------|---|----|----------------|
|                                    | $\sigma$  | dB | -3             |
| Rank Number of PDSCH               |   |    | 1              |
| Measurement channel                |   |    | R.44A-1 TDD    |
| OCNG Pattern                       |   |    | OP.1 TDD       |
| Max number of HARQ transmissions   |   |    | 4              |
| Redundancy version coding sequence |   |    | {0,1,2,3}      |
| Scheduled PDSCH SFs                |   |    | SF 0,1,3,6,8,9 |
| Note 1:                            | For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).  |    |                |
| Note 2:                            | If the UE reports in an available uplink reporting instance at subframe SF#n based on CRI, PMI estimation at a downlink SF not later than SF#(n-4), this reported CRI, PMI cannot be applied at the eNB downlink before SF#(n+4).   |    |                |
| Note 3:                            | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.  |    |                |
| Note 4:                            | The precoder matrix as specified in Table 6.3.4.2.3-1 of [4]. For following PMI, PMI equals to UE reported PMI <sup>(2)</sup> for eMIMO-Type2 "Class B".  |    |                |
| Note 5:                            | PDCCH DCI format 0 with a trigger for aperiodic CSI of eMIMO-Type shall be transmitted in downlink SF#4 to allow aperiodic CRI <sup>(1)</sup> to be transmitted on uplink SF#4. PDCCH DCI format 0 with a trigger for aperiodic CSI of eMIMO-Type2 shall be transmitted in downlink SF#4 to allow aperiodic RI <sup>(2)</sup> /CQI <sup>(2)</sup> /PMI <sup>(2)</sup> to be transmitted on uplink SF#2. |    |                |

Table 9.11.2.2-2: Minimum requirement (TDD)

| Parameter   | Test 1   |
|-------------|----------|
| $\gamma$    | 1.3      |
| UE Category | $\geq 2$ |

## 9.12 CSI reporting (UE supporting Short TTI)

The requirements in this sub-clause are valid for UEs capable of short TTI.

### 9.12.1 CQI reporting under fading conditions (Cell-Specific Reference Symbol)

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective fading conditions is determined by the reporting variance, and the relative increase of the throughput obtained when the transport format transmitted is that indicated by the reported CQI compared to the case for which a fixed transport format configured according to the reported median CQI is transmitted. In addition, the reporting accuracy is determined by a minimum BLER using the transport formats indicated by the reported CQI. The purpose is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for frequently non-selective scheduling. To account for sensitivity of the input SNR the CQI reporting under frequency non-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

#### 9.12.1.1 FDD

For the parameters specified in Table 9.12.1.1-1, Table 9.12.1.1-2 and Table 9.12.1.1-3 using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.12.1.1-4 by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$ % of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;

- c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

**Table 9.12.1.1-1: Fading test for slot-PDSCH (FDD)**

| Parameter   |          | Unit         | Test 1            |     | Test 2 |     |
|---|----------|--------------|-------------------|-----|--------|-----|
| Bandwidth   |          | MHz          | 10 MHz            |     |        |     |
| Transmission mode   |          |              | 4 (ports 0 and 1) |     |        |     |
| Downlink power allocation   | $\rho_A$ | dB           | -3                |     |        |     |
|   | $\rho_B$ | dB           | -3                |     |        |     |
|   | $\sigma$ | dB           | 0                 |     |        |     |
| SNR (Note 3)  |          | dB           | 1                 | 2   | 9      | 10  |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -97               | -96 | -89    | -88 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98               |     | -98    |     |
| Propagation channel   |          |              | EPA5              |     |        |     |
| Correlation and antenna configuration   |          |              | High (2 x 2)      |     |        |     |
| Reporting mode  |          |              | PUSCH 1-1         |     |        |     |
| Reporting interval  |          | ms           | 5                 |     |        |     |
| CQI delay   |          | slots        | 8                 |     |        |     |
| Max number of HARQ transmissions  |          |              | 1                 |     |        |     |
| CodeBookSubsetRestriction bitmap  |          |              | 00 0001           |     |        |     |
| DL TTI length   |          |              | Slot              |     |        |     |
| Configured SPDCCH-PRB sets  |          |              | {Set 1}           |     |        |     |
| SPDCCH-PRB set used for DCI transmission  |          |              | Set 1             |     |        |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at slot #n based on CQI estimation at a downlink slot not later than slot #(n-4), this reported wideband CQI cannot be applied at the eNB downlink before slot #(n+4).</p> <p>Note 2: Reference measurement channel RC.26 FDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |          |              |                   |     |        |     |

**Table 9.12.1.1-2: Fading test for subslot-PDSCH (FDD)**

| Parameter                             |          | Unit         | Test 3            |     | Test 4 |     |
|---------------------------------------|----------|--------------|-------------------|-----|--------|-----|
| Bandwidth                             |          | MHz          | 10 MHz            |     |        |     |
| Transmission mode                     |          |              | 4 (ports 0 and 1) |     |        |     |
| Downlink power allocation             | $\rho_A$ | dB           | -3                |     |        |     |
|                                       | $\rho_B$ | dB           | -3                |     |        |     |
|                                       | $\sigma$ | dB           | 0                 |     |        |     |
| SNR (Note 3)                          |          | dB           | 1                 | 2   | 9      | 10  |
| $\hat{I}_{or}^{(j)}$                  |          | dB[mW/15kHz] | -97               | -96 | -89    | -88 |
| $N_{oc}^{(j)}$                        |          | dB[mW/15kHz] | -98               |     | -98    |     |
| Propagation channel                   |          |              | EPA5              |     |        |     |
| Correlation and antenna configuration |          |              | High (2 x 2)      |     |        |     |
| Reporting mode                        |          |              | PUSCH 1-1         |     |        |     |
| Reporting interval                    |          | ms           | 5                 |     |        |     |
| CQI delay                             |          | subslots     | 8 or 12 (Note 1)  |     |        |     |

|   |  |         |
|---|--|---------|
| Max number of HARQ transmissions  |  | 1       |
| CodeBookSubsetRestriction bitmap  |  | 00 0001 |
| DL TTI length   |  | Subslot |
| Configured SPDCCH-PRB sets  |  | {Set 1} |
| SPDCCH-PRB set used for DCI transmission  |  | Set 1   |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subslot #n based on CQI estimation at a downlink slot not later than subslot #(n-k), this reported wideband CQI cannot be applied at the eNB downlink before subslot #(n+k), where k = 4 for UE capability <i>ProcessingTimelineSet=set1</i> and k=6 for UE capability <i>ProcessingTimelineSet=set2</i>.</p> <p>Note 2: Reference measurement channel RC.28 FDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |  |         |

**Table 9.12.1.1-3: SPDCCH parameters (FDD)**

| Parameter                                  | Unit | Set 1          |
|--|------|----------------|
| Reference symbol                           |      | CRS            |
| Number of PRB per SPDCCH-PRB set           |      | 16             |
| Transmission type                          |      | Localized      |
| Number of OFDM symbols                     |      | 1              |
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 16             |
| Rate Matching mode                         |      | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | Not configured |
| Aggregatoin level                          | SCCE | 4              |
| Note 1: PRB = {0, 1, ..., 15}.             |      |                |

**Table 9.12.1.1-4: Minimum requirement for slot/subslot-PDSCH (FDD)**

|              | Test 1   | Test 2   | Test 3   | Test 4   |
|--------------|----------|----------|----------|----------|
| $\alpha$ [%] | 20       | 20       | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ |

### 9.12.1.2 TDD

For the parameters specified in Table 9.12.1.2-1 and Table 9.12.1.2-2 using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.12.1.2-3 by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$ % of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

**Table 9.12.1.2-1: Fading test for slot-PDSCH (TDD)**

| Parameter | Unit | Test 1 | Test 2 |
|-----------|------|--------|--------|
|-----------|------|--------|--------|

|   |          |              |                   |     |     |     |
|---|----------|--------------|-------------------|-----|-----|-----|
| Bandwidth   |          | MHz          | 10 MHz            |     |     |     |
| Transmission mode   |          |              | 4 (ports 0 and 1) |     |     |     |
| Uplink downlink configuration   |          |              | 2                 |     |     |     |
| Special subframe configuration  |          |              | 4                 |     |     |     |
| Downlink power allocation   | $\rho_A$ | dB           | -3                |     |     |     |
|   | $\rho_B$ | dB           | -3                |     |     |     |
|   | $\sigma$ | dB           | 0                 |     |     |     |
| SNR (Note 3)  |          | dB           | 1                 | 2   | 9   | 10  |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -97               | -96 | -89 | -88 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98               |     | -98 |     |
| Propagation channel   |          |              | EPA5              |     |     |     |
| Correlation and antenna configuration   |          |              | High (2 x 2)      |     |     |     |
| Reporting mode  |          |              | PUSCH 1-1         |     |     |     |
| Reporting interval  |          | ms           | 5                 |     |     |     |
| CQI delay   |          | slots        | 8                 |     |     |     |
| Max number of HARQ transmissions  |          |              | 1                 |     |     |     |
| CodeBookSubsetRestriction bitmap  |          |              | 00 0001           |     |     |     |
| DL TTI length   |          |              | Slot              |     |     |     |
| Configured SPDCCH-PRB sets  |          |              | {Set 1}           |     |     |     |
| SPDCCH-PRB set used for DCI transmission  |          |              | Set 1             |     |     |     |
| ACK/NACK feedback mode  |          |              | Multiplexing      |     |     |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at slot #n based on CQI estimation at a downlink slot not later than slot #(n-4), this reported wideband CQI cannot be applied at the eNB downlink before slot #(n+4).</p> <p>Note 2: Reference measurement channel RC.26 TDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.1.1.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |          |              |                   |     |     |     |

**Table 9.12.1.2-2: SPDCCH parameters (FDD)**

| Parameter                                  | Unit | Set 1          |
|--|------|----------------|
| Reference symbol                           |      | CRS            |
| Number of PRB per SPDCCH-PRB set           |      | 16             |
| Transmission type                          |      | Localized      |
| Number of OFDM symbols                     |      | 1              |
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 16             |
| Rate Matching mode                         |      | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | Not configured |
| Aggregatoin level                          | SCCE | 4              |
| Note 1: PRB = {0, 1, ..., 15}.             |      |                |

**Table 9.12.1.2-3: Minimum requirement for slot-PDSCH (FDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ |



## 9.12.2 CQI reporting under fading conditions (CSI Reference Symbol)

### 9.12.2.1 FDD

For the parameters specified in Table 9.12.2.1-1, Table 9.12.2.1-2, and Table 9.12.2.1-3 using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.12.2.1-4 by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha\%$  of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to [0.02].

**Table 9.12.2.1-1: Fading test for slot-PDSCH (FDD)**

| Parameter  |          | Unit         | Test 1                        |     | Test 2 |     |
|--|----------|--------------|-------------------------------|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz                        |     |        |     |
| Transmission mode  |          |              | 9                             |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0                             |     |        |     |
|  | $\rho_B$ | dB           | 0                             |     |        |     |
|  | $\sigma$ | dB           | -3                            |     |        |     |
| SNR (Note 3)   |          | dB           | 3                             | 4   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -95                           | -94 | -86    | -85 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98                           |     | -98    |     |
| Propagation channel  |          |              | EPA5                          |     |        |     |
| Correlation and antenna configuration  |          |              | High (2 x 2)                  |     |        |     |
| Beamforming Model  |          |              | As specified in Section B.4.3 |     |        |     |
| Cell-specific reference signals  |          |              | Antenna ports 0,1             |     |        |     |
| CSI reference signals  |          |              | Antenna ports 15,16           |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$   |          |              | 5/1                           |     |        |     |
| CSI-RS reference signal configuration  |          |              | 0                             |     |        |     |
| Reporting mode   |          |              | PUSCH 1-1                     |     |        |     |
| Reporting interval   |          | ms           | 5                             |     |        |     |
| CQI delay  |          | slots        | 8                             |     |        |     |
| Max number of HARQ transmissions   |          |              | 1                             |     |        |     |
| CodeBookSubsetRestriction bitmap   |          |              | 00 0001                       |     |        |     |
| DL TTI length  |          |              | Slot                          |     |        |     |
| Configured SPDCCH-PRB sets   |          |              | {Set 1}                       |     |        |     |
| SPDCCH-PRB set used for DCI transmission   |          |              | Set 1                         |     |        |     |
| <p>Note 1: For slot-PDSCH, if the UE reports in an available uplink reporting instance at slot #n based on CQI estimation at a downlink slot not later than slot #(n-4), this reported wideband CQI cannot be applied at the eNB downlink before slot #(n+4).</p> <p>Note 2: Reference measurement channel RC.27 FDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> |          |              |                               |     |        |     |

Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.

**Table 9.12.2.1-2: Fading test for subslot-PDSCH (FDD)**

| Parameter   |          | Unit         | Test 3                        |     | Test 4 |     |
|---|----------|--------------|-------------------------------|-----|--------|-----|
| Bandwidth   |          | MHz          | 10 MHz                        |     |        |     |
| Transmission mode   |          |              | 9                             |     |        |     |
| Downlink power allocation   | $\rho_A$ | dB           | 0                             |     |        |     |
|   | $\rho_B$ | dB           | 0                             |     |        |     |
|   | $\sigma$ | dB           | -3                            |     |        |     |
| SNR (Note 3)  |          | dB           | 4                             | 5   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$  |          | dB[mW/15kHz] | -94                           | -93 | -86    | -85 |
| $N_{oc}^{(j)}$  |          | dB[mW/15kHz] | -98                           |     | -98    |     |
| Propagation channel   |          |              | EPA5                          |     |        |     |
| Correlation and antenna configuration   |          |              | High (2 x 2)                  |     |        |     |
| Beamforming Model   |          |              | As specified in Section B.4.3 |     |        |     |
| Cell-specific reference signals   |          |              | Antenna ports 0,1             |     |        |     |
| CSI reference signals   |          |              | Antenna ports 15,16           |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$  |          |              | 5/1                           |     |        |     |
| CSI-RS reference signal configuration   |          |              | 0                             |     |        |     |
| Reporting mode  |          |              | PUSCH 1-1                     |     |        |     |
| Reporting interval  |          | ms           | 5                             |     |        |     |
| CQI delay   |          | subslots     | 8 or 12 (Note 1)              |     |        |     |
| Max number of HARQ transmissions  |          |              | 1                             |     |        |     |
| CodeBookSubsetRestriction bitmap  |          |              | 00 0001                       |     |        |     |
| DL TTI length   |          |              | Subslot                       |     |        |     |
| Configured SPDCCH-PRB sets  |          |              | {Set 1}                       |     |        |     |
| SPDCCH-PRB set used for DCI transmission  |          |              | Set 1                         |     |        |     |
| <p>Note 1: If the UE reports in an available uplink reporting instance at subslot #n based on CQI estimation at a downlink slot not later than subslot #(n-k), this reported wideband CQI cannot be applied at the eNB downlink before subslot #(n+k), where k = 4 for UE capability <i>ProcessingTimelineSet=set1</i> and k=6 for UE capability <i>ProcessingTimelineSet=set2</i>.</p> <p>Note 2: Reference measurement channel RC.29 FDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.</p> <p>Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</p> |          |              |                               |     |        |     |

**Table 9.12.2.1-3: SPDCCH parameters (FDD)**

| Parameter                        | Unit | Set 1     |
|----------------------------------|------|-----------|
| Reference symbol                 |      | CRS       |
| Number of PRB per SPDCCH-PRB set |      | 16        |
| Transmission type                |      | Localized |
| Number of OFDM symbols           |      | 2         |

|  |      |                |
|--|------|----------------|
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 16             |
| Rate Matching mode                         |      | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | Not configured |
| Aggregatoin level                          | SCCE | 8              |
| Note 1: PRB = {0, 1, ..., 15}.             |      |                |

**Table 9.12.2.1-4: Minimum requirement for slot/subslot-PDSCH (FDD)**

|              | Test 1   | Test 2   | Test 3   | Test 4   |
|--------------|----------|----------|----------|----------|
| $\alpha$ [%] | 20       | 20       | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ |

### 9.12.2.2 TDD

For the parameters specified in Table 9.12.2.2-1 and Table 9.12.2.2-2 using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.12.2.2-3 by the following

- a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$ % of the time;
- the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be  $\geq \gamma$ ;
- when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to [0.02].

**Table 9.12.2.2-1: Fading test for slot-PDSCH (TDD)**

| Parameter  |          | Unit         | Test 1                        |     | Test 2 |     |
|--|----------|--------------|-------------------------------|-----|--------|-----|
| Bandwidth  |          | MHz          | 10 MHz                        |     |        |     |
| Transmission mode  |          |              | 9                             |     |        |     |
| Uplink downlink configuration  |          |              | 2                             |     |        |     |
| Special subframe configuration   |          |              | 4                             |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0                             |     |        |     |
|  | $\rho_B$ | dB           | 0                             |     |        |     |
|  | $\sigma$ | dB           | -3                            |     |        |     |
| SNR (Note 3)   |          | dB           | 3                             | 4   | 12     | 13  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -95                           | -94 | -86    | -85 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98                           |     | -98    |     |
| Propagation channel  |          |              | EPA5                          |     |        |     |
| Correlation and antenna configuration                                    |          |              | High (2 x 2)                  |     |        |     |
| Beamforming Model  |          |              | As specified in Section B.4.3 |     |        |     |
| Cell-specific reference signals  |          |              | Antenna ports 0,1             |     |        |     |
| CSI reference signals  |          |              | Antenna ports 15,16           |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{CSI-RS} / \Delta_{CSI-RS}$ |          |              | 5/1                           |     |        |     |
| CSI-RS reference signal configuration                                    |          |              | 0                             |     |        |     |
| Reporting mode   |          |              | PUSCH 1-1                     |     |        |     |
| Reporting interval   |          | ms           | 5                             |     |        |     |
| CQI delay  |          | Slots        | 8                             |     |        |     |

|  |  |              |
|--|--|--------------|
| Max number of HARQ transmissions         |  | 1            |
| CodeBookSubsetRestriction bitmap         |  | 00 0001      |
| DL TTI length                            |  | Slot         |
| Configured SPDCCH-PRB sets               |  | {Set 1}      |
| SPDCCH-PRB set used for DCI transmission |  | Set 1        |
| ACK/NACK feedback mode                   |  | Multiplexing |
| Note 1:                                  | If the UE reports in an available uplink reporting instance at slot #n based on CQI estimation at a downlink slot not later than slot #(n-4), this reported wideband CQI cannot be applied at the eNB downlink before slot #(n+4). |              |
| Note 2:                                  | Reference measurement channel RC.27 TDD according to Table A.4-1 for Categories 2 or higher with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.1.1.  |              |
| Note 3:                                  | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |              |

**Table 9.12.2.2-2: SPDCCH parameters (TDD)**

| Parameter                                  | Unit | Set 1          |
|--|------|----------------|
| Reference symbol                           |      | CRS            |
| Number of PRB per SPDCCH-PRB set           |      | 16             |
| Transmission type                          |      | Localized      |
| Number of OFDM symbols                     |      | 2              |
| Number of PRBs per SPDCCH-PRB set (Note 1) |      | 16             |
| Rate Matching mode                         |      | Mode 1         |
| SPDCCH L1 Reuse Indication                 |      | Not configured |
| Aggregation level                          | SCCE | 8              |
| Note 1: PRB = {0, 1, ..., 15}.             |      |                |

**Table 9.12.2.2-3: Minimum requirement for slot-PDSCH (TDD)**

|              | Test 1   | Test 2   |
|--------------|----------|----------|
| $\alpha$ [%] | 20       | 20       |
| $\gamma$     | 1.05     | 1.05     |
| UE Category  | $\geq 2$ | $\geq 2$ |

## 9.13 CSI reporting for 8Rx UE

### 9.13.1 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 36.213 [6]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

#### 9.13.1.1 Minimum requirement PUCCH 1-1 with Rank 4 (CSI Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by

the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

9.13.1.2.1 Void

9.13.1.2.2 TDD

The following requirements apply to UE Category 8 and DL Category 14, 17~20, ≥22. For the parameters specified in table 9.13.1.2.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband CQI}_1 = \text{wideband CQI}_0 - \text{Codeword 1 offset level}$$

The wideband CQI<sub>1</sub> shall be within the set {median CQI<sub>1</sub> -1, median CQI<sub>1</sub>, median CQI<sub>1</sub> +1} for more than 90% of the time, where the resulting wideband values CQI<sub>1</sub> shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> - 1 and median CQI<sub>1</sub> - 1 shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median CQI<sub>0</sub> + 1 and median CQI<sub>1</sub> + 1 shall be greater than or equal to 0.1.

**Table 9.13.1.2.2-1: PUCCH 1-1 static test 4x8 (TDD)**

| Parameter  |          | Unit         | Test 1                        |     | Test 2 |     |
|--|----------|--------------|-------------------------------|-----|--------|-----|
| Bandwidth  |          | MHz          | 10                            |     |        |     |
| PDSCH transmission mode  |          |              | 9                             |     |        |     |
| Uplink downlink configuration  |          |              | 2                             |     |        |     |
| Special subframe configuration   |          |              | 4                             |     |        |     |
| Downlink power allocation  | $\rho_A$ | dB           | 0                             |     |        |     |
|  | $\rho_B$ | dB           | 0                             |     |        |     |
|  | $P_C$    | dB           | -6                            |     |        |     |
|  | $\sigma$ | dB           | -3                            |     |        |     |
| CRS reference signals  |          |              | Antenna ports 0, 1            |     |        |     |
| CSI reference signals  |          |              | Antenna ports 15,..., 18      |     |        |     |
| CSI-RS periodicity and subframe offset<br>$T_{\text{CSI-RS}} / \Delta_{\text{CSI-RS}}$ |          |              | 5/ 3                          |     |        |     |
| CSI reference signal configuration   |          |              | 0                             |     |        |     |
| Propagation condition and antenna configuration  |          |              | Clause B.1 (4x8 for Rank4)    |     |        |     |
| Beamforming Model  |          |              | As specified in Section B.4.3 |     |        |     |
| CodeBookSubsetRestriction bitmap   |          |              | 0x0001 0000 0000 0000         |     |        |     |
| SNR (Note 2)   |          | dB           | 4                             | 5   | 11     | 12  |
| $\hat{I}_{or}^{(j)}$   |          | dB[mW/15kHz] | -94                           | -93 | -87    | -86 |
| $N_{oc}^{(j)}$   |          | dB[mW/15kHz] | -98                           |     | -98    |     |
| Max number of HARQ transmissions   |          |              | 1                             |     |        |     |
| Physical channel for CQI/PMI reporting   |          |              | PUSCH (Note 3)                |     |        |     |
| PUCCH Report Type for CQI/PMI  |          |              | 2                             |     |        |     |
| Physical channel for RI reporting  |          |              | PUSCH                         |     |        |     |
| PUCCH Report Type for RI   |          |              | 3                             |     |        |     |
| Reporting periodicity  |          | ms           | $N_{pd} = 5$                  |     |        |     |
| CQI delay  |          | ms           | 10 or 11                      |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 3                             |     |        |     |
| <i>ri-ConfigIndex</i>  |          |              | 805 (Note 4)                  |     |        |     |
| ACK/NACK feedback mode   |          |              | Multiplexing                  |     |        |     |

|         |  |
|---------|--|
| Note 1: | Reference measurement channel RC.23 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.   |
| Note 2: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.  |
| Note 3: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.  |
| Note 4: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |

## 10 Performance requirement (MBMS)

### 10.1 FDD (Fixed Reference Channel)

The parameters specified in Table 10.1-1 are valid for all FDD tests unless otherwise stated. For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 0 dB as the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

**Table 10.1-1: Common Test Parameters (FDD)**

| Parameter                                    | Unit   | Value       |
|--|--|-------------|
| Number of HARQ processes                     | Processes  | None        |
| Subcarrier spacing                           | kHz  | 15 kHz      |
| Allocated subframes per Radio Frame (Note 1) |  | 6 subframes |
| Number of OFDM symbols for PDCCH             |  | 2           |
| Cyclic Prefix                                |  | Extended    |
| Note1:                                       | For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. |             |

All tests specified in 10.1 and 10.3 the applicability rules are defined as the following. The requirements in clause 10.3 are applicable to UEs that support FeMBMS. The test case applicability is in according to Table 10.1-2 depending on set of supported UE capabilities.

**Table 10.1-2: FeMBMS PMCH tests applicability**

| Tests / clause | Applicable if UE indicates at least the following capability   |
|----------------|--|
| 10.3.1         | FeMBMS support of <i>fembmsMixedCell</i> and <i>unicast-fembmsMixedSCell</i> with corresponding subcarrier spacing |
| 10.3.2         | FeMBMS support of <i>fembmsMixedCell</i> with corresponding subcarrier spacing                                     |
| 10.3.3         | FeMBMS support of <i>fembmsDedicatedCell</i> with corresponding subcarrier spacing                                 |

For FeMBMS capable UEs, if corresponding tests listed in clause 10.1 or 10.3.1 or 10.3.2 are tested, the test coverage can be considered fulfilled without executing the corresponding tests listed in clause 10.3.3.

#### 10.1.1 Minimum requirement

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS.

For the parameters specified in Table 10.1-1 and Table 10.1.1-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.1.1-2.

**Table 10.1.1-1: Test Parameters for Testing**

| Parameter                 |          | Unit      | Test 1-4   |
|---------------------------|----------|-----------|------------|
| Downlink power allocation | $\rho_A$ | dB        | 0          |
|                           | $\rho_B$ | dB        | 0 (Note 1) |
|                           | $\sigma$ | dB        | 0          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98        |
| Note 1: $P_B = 0$ .       |          |           |            |

**Table 10.1.1-2: Minimum performance**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation condition               | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|-----------|-------------------|--------------|-------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |           |                   |              |                                     |                                | BLER (%)        | SNR(dB) |                  |
| 1           | 10 MHz    | R.37 FDD          | OP.4 FDD     | MBSFN channel model (Table B.2.6-1) | 1x2 low                        | 1               | 4.1     | $\geq 1$         |
| 2           | 10 MHz    | R.38 FDD          | OP.4 FDD     |                                     |                                |                 | 11.0    | $\geq 1$         |
| 3           | 10 MHz    | R.39 FDD          | OP.4 FDD     |                                     |                                |                 | 20.1    | $\geq 2$         |
|             | 5.0MHz    | R.39-1 FDD        | OP.4 FDD     |                                     |                                |                 | 20.5    | 1                |
| 4           | 1.4 MHz   | R.40 FDD          | OP.4 FDD     |                                     |                                |                 | 6.6     | $\geq 1$         |

## 10.2 TDD (Fixed Reference Channel)

The parameters specified in Table 10.2-1 are valid for all TDD tests unless otherwise stated. For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 0 dB as the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

**Table 10.2-1: Common Test Parameters (TDD)**

| Parameter  | Unit      | Value       |
|--|-----------|-------------|
| Number of HARQ processes   | Processes | None        |
| Subcarrier spacing   | kHz       | 15 kHz      |
| Allocated subframes per Radio Frame (Note 1)   |           | 5 subframes |
| Number of OFDM symbols for PDCCH   |           | 2           |
| Cyclic Prefix  |           | Extended    |
| Note1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. |           |             |

### 10.2.1 Minimum requirement

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS.

For the parameters specified in Table 10.2-1 and Table 10.2.1-1 and Annex A.3.8.2, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.2.1-2.

**Table 10.2.1-1: Test Parameters for Testing**

| Parameter                 |          | Unit      | Test 1-4   |
|---------------------------|----------|-----------|------------|
| Downlink power allocation | $\rho_A$ | dB        | 0          |
|                           | $\rho_B$ | dB        | 0 (Note 1) |
|                           | $\sigma$ | dB        | 0          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98        |
| Note 1: $P_B = 0$ .       |          |           |            |

**Table 10.2.1-2: Minimum performance**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation condition               | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|-----------|-------------------|--------------|-------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |           |                   |              |                                     |                                | BLER (%)        | SNR(dB) |                  |
| 1           | 10 MHz    | R.37 TDD          | OP.4 TDD     | MBSFN channel model (Table B.2.6-1) | 1x2 low                        | 1               | 3.4     | $\geq 1$         |
| 2           | 10 MHz    | R.38 TDD          | OP.4 TDD     |                                     |                                |                 | 11.1    | $\geq 1$         |
| 3a          | 10 MHz    | R.39 TDD          | OP.4 TDD     |                                     |                                |                 | 20.1    | $\geq 2$         |
| 3b          | 5MHz      | R.39-1 TDD        | OP.4 TDD     |                                     |                                |                 | 20.5    | 1                |
| 4           | 1.4 MHz   | R.40 TDD          | OP.4 TDD     |                                     |                                |                 | 5.8     | $\geq 1$         |

## 10.3 FDD (Fixed Reference Channel) with FeMBMS

For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 0 dB for subcarrier spacing as 15kHz, 3dB for for subcarrier spacing as 7.5kHz and 10.8dB for for subcarrier spacing as 1.25kHz because the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

### 10.3.1 Minimum requirement for FeMBMS Unicast-mixed Cell under CA

#### 10.3.1.1 Minimum requirement with 1.25kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for FeMBMS Unicast-mixed Cell under CA.

For the parameters specified in Table 10.3.1.1-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.1.1-2.

**Table 10.3.1.1-1: Test Parameters for Testing**

| Parameter                 |          | Unit      | Test 1-2   |
|---------------------------|----------|-----------|------------|
| Downlink power allocation | $\rho_A$ | dB        | 0          |
|                           | $\rho_B$ | dB        | 0 (Note 1) |
|                           | $\sigma$ | dB        | 0          |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98        |



|   |     |  |
|---|-----|--|
| PDSCH transmission mode in PCell and SCell  |     | 1  |
| Subcarrier spacing for SCell  | kHz | 1.25 kHz                                       |
| Allocated subframes per Radio Frame for SCell (Note 2)  |     | 8 subframes                                    |
| Number of OFDM symbols for PDCCH for SCell  |     | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix for SCell in non-MBSFN subframes  |     | Extended                                       |
| Note 1: $P_B = 0$ .   |     |  |
| Note 2: For SCell with FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331. |     |  |

Table 10.3.1.1-2: Minimum performance

| Test number | Cell  | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|-------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |       |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | SCell | 10              | R.81-1 FDD        | OP.4A FDD    | MBSFN channel model (Table B.2.6.2-1) | 1x2 low                        | 1               | 14.1    | $\geq 2$         |
| 2           | PCell | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | SCell | 10              | R.81-2 FDD        | OP.4A FDD    | MBSFN channel model (Table B.2.6.2-1) | 1x2 low                        | 1               | 26.0    | $\geq 2$         |

### 10.3.1.2 Minimum requirement with 7.5kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for FeMBMS Unicast-mixed Cell under CA.

For the parameters specified in Table 10.3.1.2-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.1.2-2.

Table 10.3.1.2-1: Test Parameters for Testing

| Parameter  |          | Unit      | Test 1      |
|--|----------|-----------|-------------|
| Downlink power allocation                              | $\rho_A$ | dB        | 0           |
|  | $\rho_B$ | dB        | 0 (Note 1)  |
|  | $\sigma$ | dB        | 0           |
| $N_{oc}$ at antenna port                               |          | dBm/15kHz | -98         |
| PDSCH transmission mode in PCell and SCell             |          |           | 1           |
| Subcarrier spacing for SCell                           |          | kHz       | 7.5 kHz     |
| Allocated subframes per Radio Frame for SCell (Note 2) |          |           | 8 subframes |

|   |  |  |
|---|--|--|
| Number of OFDM symbols for PDCCH for SCell  |  | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix for SCell in non-MBSFN subframes  |  | Extended                                       |
| Note 1: $P_B = 0$ .   |  |  |
| Note 2: For SCell with FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331. |  |  |

Table 10.3.1.2-2: Minimum performance

| Test number | Cell  | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|-------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |       |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | SCell | 10              | R.82-1 FDD        | OP.4A FDD    | MBSFN channel model (Table B.2.6.1-1) | 1x2 low                        | 1               | 13.9    | $\geq 2$         |

## 10.3.2 Minimum requirement for FeMBMS Unicast-mixed Cell as Non-Serving Cell

### 10.3.2.1 Minimum requirement with 1.25kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for FeMBMS Unicast-mixed Cell as non-serving cell.

For the parameters specified in Table 10.3.2.1-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.2.1-2.

Table 10.3.2.1-1: Test Parameters for Testing

| Parameter  |          | Unit      | Test 1-4                                       |
|--|----------|-----------|--|
| Downlink power allocation  | $\rho_A$ | dB        | 0  |
|  | $\rho_B$ | dB        | 0 (Note 1)                                     |
|  | $\sigma$ | dB        | 0  |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98  |
| Subcarrier spacing   |          | kHz       | 1.25 kHz                                       |
| Allocated subframes per Radio Frame (Note 2)   |          |           | 8 subframes                                    |
| Number of OFDM symbols for PDCCH   |          |           | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix in non-MBSFN subframes   |          |           | Extended                                       |
| Note 1: $P_B = 0$ .  |          |           |  |
| Note 2: For FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331. |          |           |  |

Table 10.3.2.1-2: Minimum performance

| Test number | Cell  | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |   |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell   | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | FeMBMS Unicast-mixed Cell as non-serving cell | 10              | R.81-1 FDD        | OP.4A FDD    | MBSFN channel model (Table B.2.6.2-1) | 1x2 low                        | 1               | 14.1    | ≥2               |
| 2           | PCell   | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | FeMBMS Unicast-mixed Cell as non-serving cell | 10              | R.81-2 FDD        | OP.4A FDD    | MBSFN channel model (Table B.2.6.2-1) | 1x2 low                        | 1               | 26.0    | ≥2               |

### 10.3.2.2 Minimum requirement with 7.5kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for enhanced FeMBMS Unicast-mixed Cell as non-serving cell.

For the parameters specified in Table 10.3.2.2-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.2.2-2.

Table 10.3.2.2-1: Test Parameters for Testing

| Parameter  |          | Unit      | Test 1-4                                       |
|--|----------|-----------|--|
| Downlink power allocation  | $\rho_A$ | dB        | 0  |
|  | $\rho_B$ | dB        | 0 (Note 1)                                     |
|  | $\sigma$ | dB        | 0  |
| $N_{ac}$ at antenna port   |          | dBm/15kHz | -98  |
| Subcarrier spacing   |          | kHz       | 7.5 kHz  |
| Allocated subframes per Radio Frame (Note 2)   |          |           | 8 subframes                                    |
| Number of OFDM symbols for PDCCH   |          |           | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix in non-MBSFN subframes   |          |           | Extended                                       |
| Note 1: $P_B = 0$ .  |          |           |  |
| Note 2: For FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331. |          |           |  |

Table 10.3.2.2-2: Minimum performance

| Test number | Cell | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|------|-----------------|-------------------|--------------|-----------------------|--------------------------------|-----------------|---------|------------------|
|             |      |                 |                   |              |                       |                                | BLER (%)        | SNR(dB) |                  |

|   |   |    |            |           |                                       |         |    |      |          |
|---|---|----|------------|-----------|---------------------------------------|---------|----|------|----------|
| 1 | PCell   | 10 | NA         | OP.1 FDD  | AWGN                                  | 1x2 low | NA | NA   | NA       |
|   | FeMBMS Unicast-mixed Cell as non-serving cell | 10 | R.82-1 FDD | OP.4A FDD | MBSFN channel model (Table B.2.6.1-1) | 1x2 low | 1  | 13.9 | $\geq 2$ |

### 10.3.3 Minimum requirement for MBMS Dedicated cell

#### 10.3.3.1 Minimum requirement with 1.25kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS Dedicated Cell.

For the parameters specified in Table 10.3.3.1-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.3.1-2.

**Table 10.3.3.1-1: Test Parameters for Testing MBMS Dedicated Cell**

| Parameter  |          | Unit        | Test 1-2                                       |
|--|----------|-------------|--|
| Downlink power allocation  | $\rho_A$ | dB          | 0  |
|  | $\rho_B$ | dB          | 0 (Note 1)                                     |
|  | $\sigma$ | dB          | 0  |
| $N_{oc}$ at antenna port   |          | dBm/1.25kHz | -98  |
| PDSCH transmission mode in PCell                                     |          |             | 1  |
| Subcarrier spacing for MBMS Dedicated Cell                           |          | kHz         | 1.25 kHz                                       |
| Allocated subframes per Radio Frame for MBMS Dedicated Cell (Note 2) |          |             | 10 subframes                                   |
| Number of OFDM symbols for PDCCH for MBMS Dedicated Cell             |          |             | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix for CAS in MBMS Dedicated Cell                         |          |             | Extended                                       |
| Note 1: $P_B = 0$ .  |          |             |  |
| Note 2: All subframes are MBSFN subframes except CAS                 |          |             |  |

**Table 10.3.3.1-2: Minimum performance for MBMS dedicated Cell**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | MBMS Dedicated Cell | 10              | R.83-1 FDD        | NA           | MBSFN channel model (Table B.2.6.2-1) | 1x2 low                        | 1               | 14.1    | $\geq 2$         |
| 2           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |

|  |                     |    |            |    |                                       |         |   |      |          |
|--|---------------------|----|------------|----|---------------------------------------|---------|---|------|----------|
|  | MBMS Dedicated Cell | 10 | R.83-2 FDD | NA | MBSFN channel model (Table B.2.6.2-1) | 1x2 low | 1 | 26.0 | $\geq 2$ |
|--|---------------------|----|------------|----|---------------------------------------|---------|---|------|----------|

### 10.3.3.2 Minimum requirement with 7.5kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS Dedicated Cell.

For the parameters specified in Table 10.3.3.2-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.3.2-2.

**Table 10.3.3.2-1: Test Parameters for Testing MBMS Dedicated Cell**

| Parameter  |          | Unit        | Test 1   |
|--|----------|-------------|--|
| Downlink power allocation  | $\rho_A$ | dB          | 0  |
|  | $\rho_B$ | dB          | 0 (Note 1)                                     |
|  | $\sigma$ | dB          | 0  |
| $N_{oc}$ at antenna port   |          | dBm/1.25kHz | -98  |
| PDSCH transmission mode in PCell                                     |          |             | 1  |
| Subcarrier spacing for MBMS Dedicated Cell                           |          | kHz         | 7.5 kHz  |
| Allocated subframes per Radio Frame for MBMS Dedicated Cell (Note 2) |          |             | 10 subframes                                   |
| Number of OFDM symbols for PDCCH for MBMS Dedicated Cell             |          |             | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix for CAS in MBMS Dedicated Cell                         |          |             | Extended                                       |
| Note 1: $P_B = 0$ .  |          |             |  |
| Note 2: All subframes are MBSFN subframes except CAS                 |          |             |  |

**Table 10.3.3.2-2: Minimum performance for MBMS dedicated Cell**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | MBMS Dedicated Cell | 10              | R.84-1 FDD        | NA           | MBSFN channel model (Table B.2.6.1-1) | 1x2 low                        | 1               | 13.9    | $\geq 2$         |

### 10.3.3.3 Minimum requirement with 15kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS Dedicated Cell.

For the parameters specified in Table 10.3.3.3-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.3.3.3-2.

**Table 10.3.3.3-1: Test Parameters for Testing MBMS Dedicated Cell**

| Parameter  |          | Unit        | Test 1-3                                       |
|--|----------|-------------|--|
| Downlink power allocation  | $\rho_A$ | dB          | 0  |
|  | $\rho_B$ | dB          | 0 (Note 1)                                     |
|  | $\sigma$ | dB          | 0  |
| $N_{oc}$ at antenna port   |          | dBm/1.25kHz | -98  |
| PDSCH transmission mode in PCell                                     |          |             | 1  |
| Subcarrier spacing for MBMS Dedicated Cell                           |          | kHz         | 15 kHz   |
| Allocated subframes per Radio Frame for MBMS Dedicated Cell (Note 2) |          |             | 10 subframes                                   |
| Number of OFDM symbols for PDCCH for MBMS Dedicated Cell             |          |             | 0 (MBSFN subframes)<br>2 (non-MBSFN subframes) |
| Cyclic Prefix for MBMS Dedicated Cell                                |          |             | Extended                                       |
| Note 1: $P_B = 0$ .  |          |             |  |
| Note 2: All subframes are MBSFN subframes                            |          |             |  |

**Table 10.3.3.3-2: Minimum performance for MBMS dedicated Cell**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | MBMS Dedicated Cell | 3               | R.85-1 FDD        | NA           | MBSFN channel model (Table B.2.6.1-1) | 1x2 low                        | 1               | 7.0     | $\geq 2$         |
| 2           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | MBMS Dedicated Cell | 5               | R.85-2 FDD        | NA           | MBSFN channel model (Table B.2.6.1-1) | 1x2 low                        | 1               | 13.5    | $\geq 2$         |
| 3           | PCell               | 10              | NA                | OP.1 FDD     | AWGN                                  | 1x2 low                        | NA              | NA      | NA               |
|             | MBMS Dedicated Cell | 10              | R.85-3 FDD        | NA           | MBSFN channel model (Table B.2.6.1-1) | 1x2 low                        | 1               | 22.3    | $\geq 2$         |

## 10.4 FDD with 5G terrestrial broadcast

For all tests in section 10.4 the applicability rules are defined in Table 10.4-1 depending on the capabilities of the UE. The requirements in clause 10.4 are applicable to UEs that support 5G terrestrial broadcast.

**Table 10.4-1: 5G terrestrial broadcast tests applicability**

| Tests                   | Applicable if UE supports at least the following capability  |
|-------------------------|--|
| Table 10.4.1.1-2 test 1 | 5G terrestrial broadcast support of <i>mbms-ScalingFactor0dot37-r16</i> and <i>timeSeparationSlot4-r16</i> |

|                         |  |
|-------------------------|--|
| Table 10.4.1.1-2 test 2 | 5G terrestrial broadcast support of <i>mbms-ScalingFactor0dot37-r16</i> and <i>timeSeparationSlot2-r16</i>                             |
| Table 10.4.1.2-2 test 1 | 5G terrestrial broadcast support of <i>mbms-ScalingFactor2dot5-r16</i>   |
| Table 10.4.2.1-1 test 1 | 5G terrestrial broadcast support of <i>mbms-ScalingFactor0dot37-r16</i> and 5G terrestrial broadcast support of PBCH repetition in CAS |
| Table 10.4.2.1-1 test 2 | 5G terrestrial broadcast support of <i>mbms-ScalingFactor2dot5-r16</i> and 5G terrestrial broadcast support of PBCH repetition in CAS  |

For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 16dB for subcarrier spacing as 0.37kHz, 7.8 dB for subcarrier spacing as 2.5kHz because the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

## 10.4.1 Minimum requirement for PMCH decoding

### 10.4.1.1 Minimum requirement with 0.37kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER.

For the parameters specified in Table 10.4.1.1-1 and Table A.3.8.1-9, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.4.1.1-2.

**Table 10.4.1.1-1: Test Parameters for Testing**

| Parameter                         |          | Unit      |            |
|-----------------------------------|----------|-----------|------------|
| Downlink power allocation         | $\rho_A$ | dB        | 0          |
|                                   | $\rho_B$ | dB        | 0 (Note 1) |
|                                   | $\sigma$ | dB        | 0          |
| $N_{oc}$ at antenna port          |          | dBm/15kHz | -98        |
| PDSCH transmission mode in PCell  |          |           | 1          |
| Subcarrier spacing for MBSFN cell |          | kHz       | 0.37 kHz   |
| Bandwidth                         |          | MHz       | 10(Note 2) |
| Note 1: $P_B = 0$ .               |          |           |            |
| Note 2: For both Pcell and Scell. |          |           |            |

**Table 10.4.1.1-2: Minimum performance**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | MBSFN RS type | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|---------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |               |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell               | 10              | N/A               | N/A           | OP.1 FDD     | AWGN                                  | 1x1                            | N/A             | N/A     | N/A              |
|             | MBMS Dedicated Cell | 10              | R.106-1 FDD       | Type 1        | N/A          | MBSFN channel model (Table B.2.6.3-1) | 1x1                            | 1               | 18.5    | $\geq 2$         |
| 2           | PCell               | 10              | N/A               | N/A           | OP.1 FDD     | AWGN                                  | 1x1                            | N/A             | N/A     | N/A              |
|             | MBMS Dedicated Cell | 10              | R.106-2 FDD       | Type 2        | N/A          | MBSFN channel model (Table B.2.6.3-1) | 1x1                            | 1               | 20.2    | $\geq 2$         |

### 10.4.1.2 Minimum requirement with 2.5kHz subcarrier spacing

The receive characteristic of MBMS is determined by the BLER.

For the parameters specified in Table 10.4.1.2-1 and Table A.3.8.1-10, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.4.1.2-2.

**Table 10.4.1.2-1: Test Parameters for Testing**

| Parameter                         |          | Unit      |                          |
|-----------------------------------|----------|-----------|--------------------------|
| Downlink power allocation         | $\rho_A$ | dB        | 0                        |
|                                   | $\rho_B$ | dB        | 0 (Note 1)               |
|                                   | $\sigma$ | dB        | 0                        |
| $N_{oc}$ at antenna port          |          | dBm/15kHz | $N_{oc}$ at antenna port |
| PDSCH transmission mode in PCell  |          |           | 1                        |
| Subcarrier spacing for MBSFN cell |          | kHz       | 2.5 kHz                  |
| Bandwidth                         |          | MHz       | 10(Note 2)               |
| Note 1: $P_B = 0$ .               |          |           |                          |
| Note 2: For both Pcell and Scell. |          |           |                          |

**Table 10.4.1.2-2: Minimum performance**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition                 | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|--------------|---------------------------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |              |                                       |                                | BLER (%)        | SNR(dB) |                  |
| 1           | PCell               | 10              | N/A               | OP.1 FDD     | AWGN                                  | 1x2 low                        | N/A             | N/A     | N/A              |
|             | MBMS Dedicated Cell | 10              | R.107 FDD         | N/A          | MBSFN channel model (Table B.2.6.4-1) | 1x2 low                        | 1               | 12.9    | $\geq 2$         |

## 10.4.2 Minimum requirement for CAS detection

### 10.4.2.1 Minimum requirement for PBCH detection

For the parameters specified in Table 8.6.1-1, the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 10.4.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 10.4.2.1-1: Minimum performance**

| Test number | Cell                | Bandwidth (MHz) | Reference Channel | OCNG Pattern | Propagation condition | Correlation Matrix and antenna | Reference value |         | MBMS UE Category |
|-------------|---------------------|-----------------|-------------------|--------------|-----------------------|--------------------------------|-----------------|---------|------------------|
|             |                     |                 |                   |              |                       |                                | Pm-bch (%)      | SNR(dB) |                  |
| 1           | PCell               | 10              | N/A               | OP.1 FDD     | AWGN                  | 1x1 low                        | N/A             | N/A     | N/A              |
|             | MBMS Dedicated Cell | 10              | R.23-1            | N/A          | AWGN                  | 1x1 low                        | 1               | -7.2    | $\geq 2$         |



|   |                     |    |        |          |           |         |     |      |     |
|---|---------------------|----|--------|----------|-----------|---------|-----|------|-----|
| 2 | PCell               | 10 | N/A    | OP.1 FDD | AWGN      | 1x2 low | N/A | N/A  | N/A |
|   | MBMS Dedicated Cell | 10 | R.23-1 | N/A      | EVA 162Hz | 1x2 low | 1   | -6.7 | ≥ 2 |

## 11 Performance requirement (ProSe Direct Discovery)

This clause contains the performance requirements for the Sidelink physical channels specified for ProSe Direct Discovery.

### 11.1 General

#### 11.1.1 Applicability of requirements

The requirements in this clause are applicable to UEs that support ProSe Direct Discovery. The test case applicability is in according to table 11.1.1-1 depending on set of supported UE capabilities.

**Table 11.1.1-1: ProSe Direct Discovery test applicability**

| FDD/TDD | Tests / clause | Applicable if UE indicates at least the following capability                                      |
|---------|----------------|---|
| FDD     | 11.2.1         | ProSe Direct Discovery without support of <i>disc-SLSS-r12</i>                                    |
|         | 11.2.3         | ProSe Direct Discovery with support of <i>discPeriodicSLSS-r13</i> and ProSe Direct Communication |
|         | 11.3.1         | ProSe Direct Discovery  |
|         | 11.4.1         | ProSe Direct Discovery with support of <i>disc-SLSS-r12</i>                                       |
|         | 11.5.1         | ProSe Direct Discovery  |
| TDD     | 11.2.2         | ProSe Direct Discovery  |
|         | 11.3.2         | ProSe Direct Discovery  |
|         | 11.5.2         | ProSe Direct Discovery  |

For maximum Sidelink Processes test specified in clause 11.5, the UE is required to only meet the test for the maximum channel bandwidth over the ProSe operating bands supported by the UE. Test case 11.2.3 for 5MHz channel bandwidth is applicable to UEs that support ProSe Direct Communication on Band 31 only.

#### 11.1.2 Reference DRX configuration

**Table 11.1.2-1: Reference DRX configuration**

| Parameter  | Value     | Comments |
|--|-----------|----------|
| onDurationTimer  | psf1      |          |
| drx-InactivityTimer  | psf1      |          |
| drx-RetransmissionTimer  | psf1      |          |
| longDRX-CycleStartOffset                                       | sf2560, 0 |          |
| shortDRX   | disabled  |          |
| NOTE 1: For further information see clause 6.3.2 in TS 36.331. |           |          |

## 11.2 Demodulation of PSDCH (single link performance)

The purpose of the requirements in this subclause is to verify the PSDCH demodulation performance with a single active PSDCH link under different operating scenarios and channel conditions.

The active cell(s), when present, are specified in the test parameters specific to the test.

## 11.2.1 FDD (in-coverage)

The minimum requirements are specified in Table 11.2.1-2 with the test parameters specified in Table 11.2.1-1. The receiver UE under test is associated with Cell 1.

**Table 11.2.1-1: Test Parameters**

| Parameter  |                           | Unit      | Test 1  |            |
|--|---------------------------|-----------|---|------------|
| Discovery resource pool configuration  |                           |           | As specified in Table A.7.1.1-1 (Configuration #1-FDD)  |            |
| DRX configuration  |                           |           | As specified in Table 11.1.2-1  |            |
| $N_{oc}$ at antenna port (NOTE 3)  |                           | dBm/15kHz | -98   |            |
| Active cell(s)   |                           |           | Cell 1 (Serving cell)   |            |
| Cell 1   | Cyclic prefix             |           | Normal  |            |
|  | Cell ID                   |           | 0   |            |
|  | Downlink power allocation | $\rho_A$  | dB  | 0          |
|  |                           | $\rho_B$  | dB  | 0 (NOTE 1) |
|  |                           | $\sigma$  | dB  | 0          |
|  | OCNG Pattern (NOTE 2)     |           |   | OP.1 FDD   |
|  | Propagation channel       |           |   | AWGN       |
|  | Antenna configuration     |           |   | 1x2        |
| RSRP   |                           | dBm/15kHz | -92   |            |
| Active Sidelink UE(s)  |                           |           | Sidelink UE 1   |            |
| Sidelink UE 1  | Sidelink Transmissions    |           | PSDCH   |            |
|  | PSDCH RB allocation       |           | PRB pairs $\{2i..2i+1\}$ , where $i$ is chosen randomly uniformly from $[0,11]$ in each discovery period. |            |
|  | Time offset (NOTE 4)      |           | $\mu$ s   | +1         |
|  | Frequency offset (NOTE 5) |           | Hz  | +200       |
|  | Propagation Channel       |           |   | EPA5       |
|  | Antenna configuration     |           |   | 1x2 Low    |
| NOTE 1: $P_B = 0$ .  |                           |           |   |            |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.                       |                           |           |   |            |
| NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.                          |                           |           |   |            |
| NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE. |                           |           |   |            |
| NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.                           |                           |           |   |            |

**Table 11.2.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | Reference channel | Reference value   |          |
|-----------|-------------|------------|-------------------|-------------------|----------|
|           |             |            |                   | BLER of PSDCH (%) | SNR (dB) |
| 1         | 1           | 5 MHz      | D.1 FDD           | 30                | 4.6      |

## 11.2.2 TDD (in-coverage)

The minimum requirements are specified in Table 11.2.2-2 with the test parameters specified in Table 11.2.2-1. The receiver UE under test is associated with Cell 1.

**Table 11.2.2-1: Test Parameters**

| Parameter                             |  | Unit      | Test 1   |
|---------------------------------------|--|-----------|--|
| Discovery resource pool configuration |  |           | As specified in Table A.7.1.2-1 (Configuration #1-TDD) |
| DRX configuration                     |  |           | As specified in Table 11.1.2-1                         |
| $N_{oc}$ at antenna port (NOTE 5)     |  | dBm/15kHz | -98  |
| Active cell(s)                        |  |           | Cell 1 (Serving cell)                                  |
| Cell 1                                | Cyclic prefix                          |           | Normal   |
|                                       | Uplink downlink configuration (NOTE 3) |           | 0  |

|  |   |               |   |            |
|--|---|---------------|---|------------|
|  | Special subframe configuration (NOTE 4) |               | 4   |            |
|  | Cell ID                                 |               | 0   |            |
|  | Downlink power allocation               | $\rho_A$      | dB  | 0          |
|  |   | $\rho_B$      | dB  | 0 (NOTE 1) |
|  |   | $\sigma$      | dB  | 0          |
|  | OCNG Pattern <sup>NOTE 2</sup>          |               | OP.1 TDD  |            |
|  | Propagation channel                     |               | AWGN  |            |
|  | Antenna configuration                   |               | 1x2   |            |
| RSRP   | dBm/15kHz                               | -92           |   |            |
| Active Sidelink UE(s)  |   | Sidelink UE 1 |   |            |
| Sidelink UE 1  | Sidelink Transmissions                  |               | PSDCH   |            |
|  | RB allocation                           |               | PRB pairs $\{2i..2i+1\}$ , where $i$ is chosen randomly uniformly from $[0,11]$ in each discovery period. |            |
|  | Time offset (NOTE 6)                    | $\mu$ s       | +1  |            |
|  | Frequency offset (NOTE 7)               | Hz            | +200  |            |
|  | Propagation Channel                     |               | EPA5  |            |
|  | Antenna configuration                   |               | 1x2 Low   |            |
| NOTE 1: $P_B = 0$ .  |   |               |   |            |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.                       |   |               |   |            |
| NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].  |   |               |   |            |
| NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].  |   |               |   |            |
| NOTE 5: Applicable to both DL subframes and UL subframes configured for ProSe Direct Discovery.            |   |               |   |            |
| NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE. |   |               |   |            |
| NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.                           |   |               |   |            |

**Table 11.2.2-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | Reference channel | Reference value   |          |
|-----------|-------------|------------|-------------------|-------------------|----------|
|           |             |            |                   | BLER of PSDCH (%) | SNR (dB) |
| 1         | 1           | 5 MHz      | D.1 TDD           | 30                | 4.6      |

### 11.2.3 FDD (out-of-coverage)

The minimum requirements are specified in Table 11.2.3-2 with the test parameters specified in Table 11.2.3-1. The receiver UE under test is out of network coverage.

**Table 11.2.3-1: Test Parameters**

| Parameter                   | Unit                            | Test 1   |
|-----------------------------|---------------------------------|--|
| Resource pool configuration |                                 | As specified in Table A.7.1.1-4 (Configuration #4-FDD)   |
| DRX configuration           |                                 | As specified in Table 11.1.2-1                           |
| $N_{oc}$ at antenna port    | dBm/15kHz                       | -98  |
| Active cell(s)              |                                 | None   |
| Active Sidelink UE(s)       |                                 | Sidelink UEs 1, 2  |
| Sidelink UE 1               | Sidelink Transmissions          | SLSS + PSBCH   |
|                             | networkControlledSyncTx         | ON   |
|                             | slssid                          | 30   |
|                             | inCoverage (in MIB-SL)          | TRUE   |
|                             | syncOffsetIndicator             | Set same as syncOffsetIndicator1 in Configuration #4-FDD |
|                             | Propagation channel             | EPA5   |
|                             | Antenna configuration           | 1x2 Low  |
|                             | $\widehat{E}_s$ at antenna port | dBm/15kHz  |
| Sidelink UE 2               | Sidelink Transmissions          | PSDCH  |

|  |                           |               |  |
|--|---------------------------|---------------|--|
|  | PSDCH RB allocation       |               | PRB pairs $\{2i..2i+1\}$ , where $i$ is chosen randomly uniformly from $[0,11]$ (for 5MHz) or $[0,24]$ (for 10MHz) in each discovery period. |
|  | Time offset (Note 1)      | $\mu\text{s}$ | +1   |
|  | Frequency offset (Note 2) | Hz            | +200   |
|  | Propagation Channel       |               | EPA5   |
|  | Antenna configuration     |               | 1x2 Low  |
| NOTE 1: Time offset of Sidelink UE 2 receive signal timing with respect to Sidelink UE 1 receive signal timing at the tested UE. |                           |               |  |
| NOTE 2: Frequency offset of Sidelink UE 2 with respect to Sidelink UE 1 transmit frequency.                                      |                           |               |  |

Table 11.2.3-2: Minimum performance

| Test number | Sidelink UE | Band-width | Reference channel | Reference value   |          |
|-------------|-------------|------------|-------------------|-------------------|----------|
|             |             |            |                   | BLER of PSDCH (%) | SNR (dB) |
| 1           | 1           | 5 MHz      | D.1 FDD           | 30                | 4.6      |
|             |             | 10 MHz     |                   |                   |          |

## 11.3 Power imbalance performance with two links

The purpose of this test is to check the demodulation performance when receiving PSDCH transmissions from two Sidelink UEs with power imbalance in one subframe.

### 11.3.1 FDD

The minimum requirements are specified in Table 11.3.1-2 with the test parameters specified in Table 11.3.1-1. The receiver UE under test is associated with Cell 1. The Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSDCH on adjacent RBs.

Table 11.3.1-1: Test Parameters

| Parameter                             |                                     | Unit          | Test 1   |            |
|---------------------------------------|-------------------------------------|---------------|--|------------|
| Discovery resource pool configuration |                                     |               | As specified in Table A.7.1.1-1 (Configuration #1-FDD) |            |
| DRX configuration                     |                                     |               | As specified in Table 11.1.2-1                         |            |
| $N_{oc}$ at antenna port (NOTE 3)     |                                     | dBm/15kHz     | -98  |            |
| Active cell(s)                        |                                     |               | Cell 1 (Serving cell)                                  |            |
| Cell 1                                | Cyclic prefix                       |               | Normal   |            |
|                                       | Cell ID                             |               | 0  |            |
|                                       | Downlink power allocation           | $\rho_A$      | dB   | 0          |
|                                       |                                     | $\rho_B$      | dB   | 0 (NOTE 1) |
|                                       |                                     | $\sigma$      | dB   | 0          |
|                                       | OCNG Pattern (NOTE 2)               |               |  | OP.1 FDD   |
|                                       | Propagation channel                 |               |  | AWGN       |
| Antenna configuration                 |                                     |               | 1x2  |            |
| RSRP                                  |                                     | dBm/15kHz     | -92  |            |
| Active Sidelink UE(s)                 |                                     |               | Sidelink UE 1, Sidelink UE 2                           |            |
| Sidelink UE 1                         | Sidelink Transmissions              |               | PSDCH  |            |
|                                       | PSDCH RB allocation                 |               | PRB pairs {4..5}                                       |            |
|                                       | Time offset (NOTE 3)                | $\mu\text{s}$ | 0  |            |
|                                       | Frequency offset (NOTE 4)           | Hz            | 0  |            |
|                                       | Propagation Channel                 |               | AWGN   |            |
| Antenna configuration                 |                                     |               | 1x2 Low  |            |
| Sidelink UE 2                         | Sidelink Transmissions              |               | PSDCH  |            |
|                                       | PSDCH RB allocation                 |               | PRB pairs {6..7}                                       |            |
|                                       | Time offset (w.r.t. Cell 1 DL)      | $\mu\text{s}$ | 0  |            |
|                                       | Frequency offset (w.r.t. Cell 1 UL) | Hz            | 0  |            |
|                                       | Propagation Channel                 |               | AWGN   |            |

|  |         |
|--|---------|
| Antenna configuration  | 1x2 Low |
| NOTE 1: $P_B = 0$ .  |         |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.                       |         |
| NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.                          |         |
| NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE. |         |
| NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.                           |         |

**Table 11.3.1-2: Minimum performance**

| Test num.   | Bandwidth | Sidelink UE | Reference channel | Reference value   |          |
|---|-----------|-------------|-------------------|-------------------|----------|
|   |           |             |                   | BLER of PSDCH (%) | SNR (dB) |
| 1   | 5 MHz     | 1           | D.1 FDD           | (NOTE 1)          | 24.3     |
|   |           | 2           | D.1 FDD           | 30                | 6.9      |
| NOTE 1: There is no BLER requirement for Sidelink UE 1. |           |             |                   |                   |          |

### 11.3.2 TDD

The minimum requirements are specified in Table 11.3.2-2 with the test parameters specified in Table 11.3.2-1. The receiver UE under test is associated with Cell 1. The Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSDCH on adjacent RBs.

**Table 11.3.2-1: Test Parameters**

| Parameter                             |   | Unit      | Test 1   |            |
|---------------------------------------|---|-----------|--|------------|
| Discovery resource pool configuration |   |           | As specified in Table A.7.1.2-1 (Configuration #1-TDD) |            |
| DRX configuration                     |   |           | As specified in Table 11.1.2-1                         |            |
| $N_{oc}$ at antenna port (NOTE 5)     |   | dBm/15kHz | -98  |            |
| Active cell(s)                        |   |           | Cell 1 (Serving cell)                                  |            |
| Cell 1                                | Cyclic prefix                           |           | Normal   |            |
|                                       | Uplink downlink configuration (NOTE 3)  |           | 0  |            |
|                                       | Special subframe configuration (NOTE 4) |           | 4  |            |
|                                       | Cell ID                                 |           | 0  |            |
|                                       | Downlink power allocation               | $\rho_A$  | dB   | 0          |
|                                       |   | $\rho_B$  | dB   | 0 (NOTE 1) |
|                                       |   | $\sigma$  | dB   | 0          |
|                                       | OCNG Pattern <sup>NOTE 2</sup>          |           | OP.1 TDD   |            |
|                                       | Propagation channel                     |           | AWGN   |            |
|                                       | Antenna configuration                   |           | 1x2  |            |
| RSRP                                  | dBm/15kHz                               | -92       |  |            |
| Active Sidelink UE(s)                 |   |           | Sidelink UE 1, Sidelink UE 2                           |            |
| Sidelink UE 1                         | Sidelink Transmissions                  |           | PSDCH  |            |
|                                       | PSDCH RB allocation                     |           | PRB pairs {4..5}                                       |            |
|                                       | Time offset (NOTE 6)                    | $\mu$ s   | 0  |            |
|                                       | Frequency offset (NOTE 7)               | Hz        | 0  |            |
|                                       | Propagation Channel                     |           | AWGN   |            |
|                                       | Antenna configuration                   |           | 1x2 Low  |            |
| Sidelink UE 2                         | Sidelink Transmissions                  |           | PSDCH  |            |
|                                       | RB allocation                           |           | PRB pairs {6..7}                                       |            |
|                                       | Time offset (NOTE 6)                    | $\mu$ s   | 0  |            |
|                                       | Frequency offset (NOTE 7)               | Hz        | 0  |            |
|                                       | Propagation Channel                     |           | AWGN   |            |
|                                       | Antenna configuration                   |           | 1x2 Low  |            |

NOTE 1:  $P_B = 0$ .

NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.

NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].

NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].

NOTE 5: Applicable to both DL subframes and UL subframes configured for ProSe Direct Discovery.

NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.

NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

Table 11.3.2-2: Minimum performance

| Test num.   | Bandwidth | Sidelink UE | Reference channel | Reference value   |          |
|---|-----------|-------------|-------------------|-------------------|----------|
|   |           |             |                   | BLER of PSDCH (%) | SNR (dB) |
| 1   | 5 MHz     | 1           | D.1 TDD           | (NOTE 1)          | 24.3     |
|   |           | 2           | D.1 TDD           | 30                | 6.9      |
| NOTE 1: There is no BLER requirement for Sidelink UE 1. |           |             |                   |                   |          |

## 11.4 Multiple timing reference test

The purpose of this test is to check the demodulation performance when receiving from two Sidelink UEs that follow different timing references and transmitting on different resources (non-overlapping in time).

### 11.4.1 FDD

The test parameters are specified in Table 11.4.1-1. Sidelink UE 2 and the receiver UE under test are associated with Cell 1. Sidelink UE 1 and 3 are associated with another cell and use a different timing, and UE 1 acts as a synchronization reference. The minimum requirements are specified in Table 11.4.1-2.

Table 11.4.1-1: Test Parameters

| Parameter                             |   | Unit      | Test 1   |            |
|---------------------------------------|---|-----------|--|------------|
| Discovery resource pool configuration |   |           | As specified in Table A.7.1.1-2 (Configuration #2-FDD) |            |
| DRX configuration                     |   |           | As specified in Table 11.1.2-1                         |            |
| $N_{oc}$ at antenna port (NOTE 3)     |   | dBm/15kHz | -98  |            |
| Active cell(s)                        |   |           | Cell 1 (Serving cell)                                  |            |
| Cell 1                                | Cyclic prefix                           |           | Normal   |            |
|                                       | Cell ID                                 |           | 0  |            |
|                                       | Downlink power allocation               | $\rho_A$  | dB   | 0          |
|                                       |   | $\rho_B$  | dB   | 0 (NOTE 1) |
|                                       |   | $\sigma$  | dB   | 0          |
|                                       | OCNG Pattern <sup>NOTE 2</sup>          |           | OP.1 FDD   |            |
|                                       | Propagation channel                     |           | AWGN   |            |
|                                       | Antenna configuration                   |           | 1x2  |            |
| RSRP                                  | dBm/15kHz                               | -92       |  |            |
| Active Sidelink UE(s)                 |   |           | Sidelink UEs 1, 2, 3                                   |            |
| Sidelink UE 1                         | Sidelink Transmissions                  |           | SLSS   |            |
|                                       | networkControlledSyncTx                 |           | ON   |            |
|                                       | slssid                                  |           | 30   |            |
|                                       | Time offset (NOTE 4)                    | $\mu$ s   | 3511   |            |
|                                       | Frequency offset (NOTE 5)               | Hz        | -100   |            |
|                                       | Propagation channel                     |           | EPA5   |            |
|                                       | Antenna configuration                   |           | 1x2 Low  |            |
|                                       | $\widehat{E}_s$ of SLSS at antenna port | dBm/15kHz | -82  |            |
| Sidelink UE 2                         | Sidelink Transmissions                  |           | PSDCH  |            |

|  |                                      |         |   |
|--|--------------------------------------|---------|---|
|  | Resource pool used for transmissions |         | $discRxPool(0)$   |
|  | RB allocation                        |         | PRB pairs $\{2i..2i+1\}$ , where $i$ is chosen randomly uniformly from $[0,11]$ in each discovery period. |
|  | Time offset (NOTE 4)                 | $\mu s$ | +1  |
|  | Frequency offset (NOTE 5)            | Hz      | +200  |
|  | Propagation Channel                  |         | EPA5  |
|  | Antenna configuration                |         | 1x2 Low   |
| Sidelink UE 3  | Sidelink Transmissions               |         | PSDCH   |
|  | Resource pool used for transmissions |         | $discRxPool(1)$   |
|  | RB allocation                        |         | PRB pairs $\{2i..2i+1\}$ , where $i$ is chosen randomly uniformly from $[0,11]$ in each discovery period. |
|  | Time offset (NOTE 4)                 | $\mu s$ | 3511  |
|  | Frequency offset (NOTE 5)            | Hz      | +300  |
|  | Antenna configuration                |         | 1x2 Low   |
| NOTE 1: $P_B = 0$ .  |                                      |         |   |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.                       |                                      |         |   |
| NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.                          |                                      |         |   |
| NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE. |                                      |         |   |
| NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.                           |                                      |         |   |

Table 11.4.1-2: Minimum performance

| Test num.  | Band-width | Sidelink UE | Reference channel | Reference value                     |          |
|--|------------|-------------|-------------------|-------------------------------------|----------|
|  |            |             |                   | BLER of PSDCH (%) <sup>NOTE 1</sup> | SNR (dB) |
| 1  | 5 MHz      | 2           | D.1 FDD           | 30                                  | 4.6      |
|  |            | 3           | D.1 FDD           | 30                                  | 4.6      |
| NOTE 1: The BLER is measured after 5 D2D Discovery periods (1600 frames) of lead time during which the test UE detects and synchronizes to Sidelink UE 1 SLSS. |            |             |                   |                                     |          |

## 11.5 Maximum Sidelink processes test

The purpose of this test is to verify the maximum number of Sidelink processes supported by the UE as reported using UE capability signalling ( $discSupportedProc$ ).

The UE is required to meet only the test for the maximum channel bandwidth over the ProSe operating bands supported by the UE.

### 11.5.1 FDD

The test parameters are specified in Table 11.5.1-1. Multiple discovery resource pools are interleaved. Each Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 11.5.1-2.

Table 11.5.1-1: Test Parameters

| Parameter                             |               | Unit | Test 1-7  |
|---------------------------------------|---------------|------|---|
| Discovery resource pool configuration |               |      | As specified in Table A.7.1.1-3 (Configuration #3-FDD) with parameters $BW_{Channel}$ , $N_{Pools}$ = Number of configured resource pools (as specified in Table 11.5.1-2), and $N = discSupportedProc$ |
| DRX configuration                     |               |      | As specified in Table 11.1.2-1  |
| Active cell(s)                        |               |      | Cell 1 (Serving cell)   |
| Cell 1                                | Cyclic prefix |      | Normal  |
|                                       | Cell ID       |      | 0   |

|   |                              |   |    |            |
|---|------------------------------|---|----|------------|
|   | Downlink power allocation    | $\rho_A$  | dB | 0          |
|   |                              | $\rho_B$  | dB | 0 (NOTE 1) |
|   |                              | $\sigma$  | dB | 0          |
|   | OCNG Pattern                 | NOTE 2  |    | OP.1 FDD   |
|   | Propagation channel          | Static propagation condition<br>No external noise sources are applied |    |            |
|   | Antenna configuration        | 1x2   |    |            |
|   | RSRP                         | dBm/15kHz   |    | -85        |
| Active Sidelink UE(s)   |                              | Sidelink UE $i, i = 0, \dots, \text{discSupportedProc}-1$             |    |            |
| Sidelink UE $i$   | Sidelink Transmissions       | PSDCH (D.1 FDD)   |    |            |
|   | Resource pool index (NOTE 3) | $\lfloor \frac{i}{N_{MAX\_SF}} \rfloor$                               |    |            |
|   | PSDCH RB allocation (NOTE 3) | PRB pairs $\{2*(i \% N_{MAX\_SF}), 2*(i \% N_{MAX\_SF})+1\}$          |    |            |
|   | Time offset (NOTE 4)         | $\mu\text{s}$   | 0  |            |
|   | Frequency offset (NOTE 4)    | Hz  | 0  |            |
|   | Propagation Channel          | Static propagation condition<br>No external noise sources are applied |    |            |
|   | Antenna configuration        | 1x2 Low   |    |            |
| NOTE 1: $P_B = 0$ .   |                              |   |    |            |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs..   |                              |   |    |            |
| NOTE 3: $N_{MAX\_SF}$ represents the maximum number of Sidelink UEs transmitting in one subframe. $N_{MAX\_SF} = 12$ (5 MHz), 25 (10MHz), 37 (15MHz), 50 (10MHz). |                              |   |    |            |
| NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.  |                              |   |    |            |
| NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.  |                              |   |    |            |

Table 11.5.1-2: Minimum performance

| Test num. | Bandwidth | discSupportedProc | Number of configured resource pools | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value for Sidelink UE $i=0\dots\text{discSupportedProc}-1$ |
|-----------|-----------|-------------------|-------------------------------------|---|--|
|           |           |                   |                                     |   | Fraction of maximum throughput (%)                                   |
| 1         | 5 MHz     | 50                | 5                                   | -85                                     | 95   |
| 2         | 10 MHz    | 50                | 2                                   | -85                                     | 95   |
| 3         | 15 MHz    | 50                | 2                                   | -85                                     | 95   |
| 4         | 20 MHz    | 50                | 1                                   | -85                                     | 95   |
| 5         | 10 MHz    | 400               | 16                                  | -85                                     | 95   |
| 6         | 15 MHz    | 400               | 11                                  | -85                                     | 95   |
| 7         | 20 MHz    | 400               | 8                                   | -85                                     | 95   |

### 11.5.2 TDD

The test parameters are specified in Table 11.5.2-1. Multiple discovery resource pools are interleaved. Each Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 11.5.2-2.

Table 11.5.2-1: Test Parameters

| Parameter                             | Unit | Test 1-7   |
|---------------------------------------|------|--|
| Discovery resource pool configuration |      | As specified in Table A.7.1.2-2 (Configuration #2-TDD) with parameters $BW_{\text{Channel}}$ , $N_{\text{Pools}}$ = Number of configured resource pools (as specified in Table 11.5.2-2), and $N = \text{discSupportedProc}$ |
| DRX configuration                     |      | As specified in Table 11.1.2-1   |
| Active cell(s)                        |      | Cell 1 (Serving cell)  |



|   |   |           |   |   |
|---|---|-----------|---|---|
| Cell 1  | Cyclic prefix                           |           |   | Normal  |
|   | Uplink downlink configuration (NOTE 3)  |           |   | 0   |
|   | Special subframe configuration (NOTE 4) |           |   | 4   |
|   | Cell ID                                 |           |   | 0   |
|   | Downlink power allocation               | $\rho_A$  | dB  | 0   |
|   |   | $\rho_B$  | dB  | 0 (NOTE 1)  |
|   |   | $\sigma$  | dB  | 0   |
|   | OCNG Pattern <sup>NOTE 2</sup>          |           |   | OP.1 TDD  |
|   | Propagation channel                     |           |   | Static propagation condition<br>No external noise sources are applied |
|   | Antenna configuration                   |           |   | 1x2   |
| RSRP  |   | dBm/15kHz | -85   |   |
| Active Sidelink UE(s)   |   |           | Sidelink UE $i, i = 0, \dots, \text{discSupportedProc}-1$ |   |
| Sidelink UE $i$   | Sidelink Transmissions                  |           |   | PSDCH (D.1 TDD)   |
|   | PSDCH Resource pool (NOTE 5)            |           |   | $\left\lfloor \frac{i}{N_{MAX\_SF}} \right\rfloor$                    |
|   | PSDCH RB allocation (NOTE 5)            |           |   | PRB pairs $\{2*(i \% N_{MAX\_SF}), 2*(i \% N_{MAX\_SF})+1\}$          |
|   | Time offset (NOTE 6)                    |           | $\mu\text{s}$   | 0   |
|   | Frequency offset (NOTE 7)               |           | Hz  | 0   |
|   | Propagation Channel                     |           |   | Static propagation condition<br>No external noise sources are applied |
|   | Antenna configuration                   |           |   | 1x2 Low   |
| <p>NOTE 1: <math>P_B = 0</math>.</p> <p>NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.</p> <p>NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].</p> <p>NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].</p> <p>NOTE 5: <math>N_{MAX\_SF}</math> represents the maximum number of Sidelink UEs transmitting in one subframe. <math>N_{MAX\_SF} = 12</math> (5 MHz), 25 (10MHz), 37 (15MHz), 50 (10MHz).</p> <p>NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.</p> <p>NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.</p> |   |           |   |   |

Table 11.5.2-2: Minimum performance

| Test num. | Bandwidth | discSupportedProc | Number of configured resource pools | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value   |
|-----------|-----------|-------------------|-------------------------------------|---|---|
|           |           |                   |                                     |   | Fraction of maximum throughput (%) for Sidelink UE $i=0\dots\text{discSupportedProc}-1$ |
| 1         | 5 MHz     | 50                | 5                                   | -85                                     | 95  |
| 2         | 10 MHz    | 50                | 2                                   | -85                                     | 95  |
| 3         | 15 MHz    | 50                | 2                                   | -85                                     | 95  |
| 4         | 20 MHz    | 50                | 1                                   | -85                                     | 95  |
| 5         | 10 MHz    | 400               | 16                                  | -85                                     | 95  |
| 6         | 15 MHz    | 400               | 11                                  | -85                                     | 95  |
| 7         | 20 MHz    | 400               | 8                                   | -85                                     | 95  |

## 12 Performance requirement (ProSe Direct Communication)

This clause contains the performance requirements for the Sidelink physical channels specified for ProSe Direct Communication in TS 36.211 [4].

### 12.1 General

#### 12.1.1 Applicability of requirements

##### 12.1.1.1 Applicability of requirements for different channel bandwidths

The requirements in this clause are applicable to UEs that support ProSe Direct Communication. Test cases defined for 5MHz channel bandwidth are applicable to UEs that support ProSe Direct Communication on only Band 31.

##### 12.1.1.2 Test coverage for different number of component carriers

For FDD tests specified in 12.8, if corresponding CA tests are tested, the test coverage can be considered fulfilled without executing single carrier tests.

##### 12.1.1.3 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA UE demodulation tests with active Sidelink in Clause 12 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 12.1.1.3-1. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 12.1.1.3-1: Applicability and test rules for CA UE demodulation tests with active Sidelink**

| Tests                             | CA capability where the tests apply   | CA configuration from the selected CA capability where the tests apply                          | CA Bandwidth combination to be tested in priority order |
|-----------------------------------|---|---|---|
| CA tests with 2CCs in Clause 12.8 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination             |

#### 12.1.2 Reference DRX configuration

**Table 12.1.2-1: Reference DRX configuration**

| Parameter  | Value     | Comments |
|--|-----------|----------|
| onDurationTimer  | psf1      |          |
| drx-InactivityTimer  | psf1      |          |
| drx-RetransmissionTimer  | psf1      |          |
| longDRX-CycleStartOffset                                       | sf2560, 0 |          |
| shortDRX   | disabled  |          |
| NOTE 1: For further information see clause 6.3.2 in TS 36.331. |           |          |

## 12.2 Demodulation of PSSCH

The purpose of the requirements in this subclause is to verify the PSSCH demodulation performance with a single active PSSCH link.

### 12.2.1 FDD

The minimum requirements are specified in Table 12.2.1-2 with the test parameters specified in Table 12.2.1-1. This test specifies an out-of-coverage scenario where Sidelink UE 1 is the synchronization reference only and Sidelink UE 2 transmits PSCCH and PSSCH.

**Table 12.2.1-1: Test Parameters**

| Parameter  |  | Unit       | Test 1  |
|--|--|------------|---|
| Communication resource pool configuration  |  |            | As specified in Table A.7.2.1-1 (Configuration #1-FDD)  |
| $N_{oc}$ at antenna port (NOTE 1)  |  | dBm/15 kHz | -98   |
| Active cell(s)   |  |            | None  |
| Sidelink UE 1  | Sidelink Transmissions                   |            | SLSS + PSBCH  |
|  | networkControlledSyncTx                  |            | ON  |
|  | slssid                                   |            | 30  |
|  | inCoverage (in MIB-SL)                   |            | FALSE   |
|  | syncOffsetIndicator                      |            | Set same as syncOffsetIndicator1 in Configuration #1-FDD  |
|  | Propagation channel                      |            | EPA5  |
|  | Antenna configuration                    |            | 1x2 Low   |
|  | $\widehat{E}_s$ at antenna port          | dBm/15 kHz | -85   |
| Sidelink UE 2  | Sidelink Transmissions                   |            | PSCCH + PSSCH   |
|  | PSCCH RMC                                |            | 5MHz: CC.3 FDD<br>10 MHz: CC.4 FDD  |
|  | PSCCH subframe allocation                |            | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH} \cdot RP / 2 \rfloor L_{PSCCH} - 1]$ every sc-period                            |
|  | PSCCH RB allocation                      |            |   |
|  | $\widehat{E}_s$ of PSCCH at antenna port | dBm/15 kHz | -85   |
|  | PSSCH RMC                                |            | As specified in Table 12.2.1-2  |
|  | PSSCH subframe allocation                |            | As per time repetition pattern specified in PSCCH   |
|  | PSSCH RB allocation                      |            | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
|  | Time offset (NOTE 2)                     | $\mu$ s    | +1  |
|  | Frequency offset (NOTE 3)                | Hz         | +200  |
|  | Propagation Channel                      |            | EVA70   |
| Antenna configuration  |  | 1x2 Low    |   |
| NOTE 1: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.  |  |            |   |
| NOTE 2: Time offset of Sidelink UE 2 receive signal timing with respect to Sidelink UE 1 receive signal timing at the tested UE. |  |            |   |
| NOTE 3: Frequency offset of Sidelink UE 2 with respect to Sidelink UE 1 transmit frequency.                                      |  |            |   |

**Table 12.2.1-2: Minimum performance**

| Test num. | Sidelink UE | Bandwidth | PSSCH Reference channel | Reference value                             |                   |
|-----------|-------------|-----------|-------------------------|---|-------------------|
|           |             |           |                         | Fraction of maximum throughput (%) (NOTE 1) | SNR (dB) of PSSCH |

|   |   |        |          |    |      |
|---|---|--------|----------|----|------|
| 1   | 2 | 10 MHz | CD.1 FDD | 70 | -3.4 |
|   |   | 5 MHz  |          | 70 | -3.3 |
| NOTE 1: The throughput is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1. |   |        |          |    |      |

## 12.3 Demodulation of PSCCH

The purpose of the requirements in this subclause is to verify the PSCCH demodulation performance with a single active PSSCH link.

### 12.3.1 FDD

The minimum requirements are specified in Table 12.3.1-2 with the test parameters specified in Table 12.3.1-1. This test specifies an out-of-coverage scenario where Sidelink UE 1 is the synchronization reference only and Sidelink UE 2 transmits PSCCH and PSSCH.

**Table 12.3.1-1: Test Parameters**

| Parameter  |                           | Unit       | Test 1  |
|--|---------------------------|------------|---|
| Communication resource pool configuration  |                           |            | As specified in Table A.7.2.1-1 (Configuration #1-FDD)  |
| $N_{oc}$ at antenna port (NOTE 1)  |                           | dBm/15 kHz | -98   |
| Active cell(s)   |                           |            | None  |
| Sidelink UE 1  | Sidelink Transmissions    |            | SLSS + PSBCH  |
|  | networkControlledSyncTx   |            | ON  |
|  | slssid                    |            | 30  |
|  | inCoverage (in MIB-SL)    |            | FALSE   |
|  | syncOffsetIndicator       |            | Set same as syncOffsetIndicator1 in Configuration #1-FDD  |
|  | Propagation channel       |            | EPA5  |
|  | Antenna configuration     |            | 1x2 Low   |
| $\hat{E}_s$ at antenna port  | dBm/15 kHz                | -85        |   |
| Sidelink UE 2  | Sidelink Transmissions    |            | PSCCH + PSSCH   |
|  | PSCCH RMC                 |            | As specified in Table 12.3.1-2  |
|  | PSCCH subframe allocation |            | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH} \cdot RP / 2 \rfloor L_{PSCCH} - 1]$ every sc-period                            |
|  | PSCCH RB allocation       |            |   |
|  | PSSCH RMC                 |            | CD.1 FDD  |
|  | PSSCH subframe allocation |            | As per time repetition pattern specified in PSCCH   |
|  | PSSCH RB allocation       |            | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
|  | Time offset (NOTE 2)      | $\mu$ s    | +1  |
|  | Frequency offset (NOTE 3) | Hz         | +200  |
|  | Propagation Channel       |            | EVA70   |
|  | Antenna configuration     |            | 1x2 Low   |
| NOTE 1: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.  |                           |            |   |
| NOTE 2: Time offset of Sidelink UE 2 receive signal timing with respect to Sidelink UE 1 receive signal timing at the tested UE. |                           |            |   |
| NOTE 3: Frequency offset of Sidelink UE 2 with respect to Sidelink UE 1 transmit frequency.                                      |                           |            |   |

**Table 12.3.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | PSCCH Reference channel | Reference value                          |                   |
|-----------|-------------|------------|-------------------------|--|-------------------|
|           |             |            |                         | Probability of missed PSCCH (%) (NOTE 1) | SNR (dB) of PSCCH |
| 1         | 2           | 10 MHz     | CC.4 FDD                | 1  | 4.7               |
|           |             | 5 MHz      | CC.3 FDD                | 1  | 4.8               |

NOTE 1: The probability is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1.

## 12.4 Demodulation of PSBCH

The purpose of the requirements in this subclause is to verify the PSBCH demodulation performance with a single active link.

### 12.4.1 FDD

The minimum requirements are specified in Table 12.4.1-2 with the test parameters specified in Table 12.4.1-1.

**Table 12.4.1-1: Test Parameters**

| Parameter                                 |                         | Unit      | Test 1   |
|---|-------------------------|-----------|--|
| Communication resource pool configuration |                         |           | As specified in Table A.7.2.1-1 (Configuration #1-FDD)   |
| $N_{oc}$ at antenna port                  |                         | dBm/15kHz | -98  |
| Active cell(s)                            |                         |           | None   |
| Sidelink UE 1                             | Sidelink Transmissions  |           | SLSS + PSBCH (CP.1 FDD)                                  |
|   | networkControlledSyncTx |           | ON   |
|   | slssid                  |           | 30   |
|   | inCoverage (in MIB-SL)  |           | FALSE  |
|   | syncOffsetIndicator     |           | Set same as syncOffsetIndicator1 in Configuration #1-FDD |
|   | Propagation channel     |           | EPA5   |
|   | Antenna configuration   |           | 1x2 Low  |

**Table 12.4.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | Reference channel | Reference value                          |          |
|-----------|-------------|------------|-------------------|--|----------|
|           |             |            |                   | Probability of missed PSBCH (%) (NOTE 1) | SNR (dB) |
| 1         | 1           | 10 MHz     | PSBCH (CP.1 FDD)  | 1  | 4.4      |
|           |             | 5 MHz      |                   |  |          |

NOTE 1: The probability is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1.

## 12.5 Power imbalance performance with two links

The purpose of this test is to check the demodulation performance when receiving PSSCH transmissions from two Sidelink UEs with power imbalance in one subframe.

### 12.5.1 FDD

The test parameters in Table 12.5.1-1 specifies an in-coverage scenario where Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSSCH on adjacent RBs. The minimum requirements are specified in Table 12.5.1-2.

**Table 12.5.1-1: Test Parameters**

| Parameter                                 |  | Unit      | Test 1   |            |
|---|--|-----------|--|------------|
| Communication resource pool configuration |  |           | As specified in Table A.7.2.1-2 (Configuration #2-FDD) |            |
| DRX configuration                         |  |           | As specified in Table 12.1.2-1                         |            |
| $N_{oc}$ at antenna port (Note 3)         |  | dBm/15kHz | -98  |            |
| Active cell(s)                            |  |           | Cell 1 (Serving cell)                                  |            |
| Cell 1                                    | Cyclic prefix                            |           | Normal   |            |
|   | Cell ID                                  |           | 0  |            |
|   | Downlink power allocation                | $\rho_A$  | dB   | 0          |
|   |  | $\rho_B$  | dB   | 0 (NOTE 1) |
|   |  | $\sigma$  | dB   | 0          |
|   | OCNG Pattern (Note 2)                    |           |  | OP.1 FDD   |
|   | Propagation channel                      |           |  | AWGN       |
|   | Antenna configuration                    |           |  | 1x2        |
| RSRP                                      |  | dBm/15kHz | -92  |            |
| Active Sidelink UE(s)                     |  |           | Sidelink UE 1, Sidelink UE 2                           |            |
| Sidelink UE 1                             | Sidelink Transmissions                   |           | PSCCH + PSSCH  |            |
|   | PSCCH RMC                                |           | 5 MHz: CC.1 FDD<br>10 MHz: CC.2 FDD                    |            |
|   | PSCCH subframe allocation                |           | $n_{PSCCH} = 0$ (as defined in TS 36.213)              |            |
|   | PSCCH RB allocation                      |           |  |            |
|   | $\widehat{E}_s$ of PSCCH at antenna port |           | dBm/15kHz  | -85        |
|   | PSSCH RMC                                |           | As specified in Table 12.5.1-2                         |            |
|   | PSSCH subframe allocation                |           | As per time repetition pattern specified in PSCCH      |            |
|   | PSSCH RB allocation                      |           | PRB pairs {4, 5}                                       |            |
|   | Time offset (NOTE 4)                     |           | $\mu$ s  | 0          |
|   | Frequency offset (NOTE 5)                |           | Hz   | 0          |
|   | Propagation Channel                      |           |  | AWGN       |
|   | Antenna configuration                    |           |  | 1x2        |
| Sidelink UE 2                             | Sidelink Transmissions                   |           | PSCCH + PSSCH  |            |
|   | PSCCH RMC                                |           | 5 MHz: CC.1 FDD<br>10 MHz: CC.2 FDD                    |            |
|   | PSCCH subframe allocation                |           | $n_{PSCCH} = 2$ (as defined in TS 36.213)              |            |
|   | PSCCH RB allocation                      |           |  |            |
|   | $\widehat{E}_s$ of PSCCH at antenna port |           | dBm/15kHz  | -85        |
|   | PSSCH RMC                                |           | As specified in Table 12.5.1-2                         |            |
|   | PSSCH subframe allocation                |           | As per time repetition pattern specified in PSCCH      |            |
|   | PSSCH RB allocation                      |           | PRB pairs {6, 7}                                       |            |
|   | Time offset (NOTE 4)                     |           | $\mu$ s  | 0          |
|   | Frequency offset (NOTE 5)                |           | Hz   | 0          |
|   | Propagation Channel                      |           |  | AWGN       |
|   | Antenna configuration                    |           |  | 1x2        |

NOTE 1:  $P_B = 0$ .

NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.

NOTE 3: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.

NOTE 4: The power of PSCCH is set high to ensure reliable reception of PSCCH.

NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.

NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 12.5.1-2: Minimum performance**

| Test num. | Bandwidth  | Sidelink UE | PSSCH Reference channel | Reference value                    |                   |
|-----------|------------|-------------|-------------------------|------------------------------------|-------------------|
|           |            |             |                         | Fraction of maximum throughput (%) | SNR (dB) of PSSCH |
| 1         | 5 / 10 MHz | 1           | CD.5 FDD                | (NOTE 1)                           | 24.35             |
|           |            | 2           | CD.5 FDD                | 70                                 | 2.4               |

NOTE 1: There is no throughput requirement for Sidelink UE 1.

## 12.6 Multiple timing reference test

The purpose of this test is to check the PSSCH demodulation performance when receiving from two Sidelink UEs that follow different timing references and transmitting on different resources (non-overlapping in time).

### 12.6.1 FDD

The test parameters are specified in Table 12.6.1-1. Sidelink UE 2 and the receiver UE under test are associated with Cell 1. Sidelink UE 1 and Sidelink UE 3 are associated with another cell and use a different timing, and Sidelink UE 1 acts as a synchronization reference only. The minimum requirements are specified in Table 12.6.1-2.

**Table 12.6.1-1: Test Parameters**

| Parameter                                 |  | Unit      | Test 1  |            |
|---|--|-----------|---|------------|
| Communication resource pool configuration |  |           | As specified in Table A.7.2.1-3 (Configuration #3-FDD)  |            |
| DRX configuration                         |  |           | As specified in Table 12.1.2-1  |            |
| $N_{oc}$ at antenna port (Note 3)         |  | dBm/15kHz | -98   |            |
| Active cell(s)                            |  |           | Cell 1 (Serving cell)   |            |
| Cell 1                                    | Cyclic prefix                            |           | Normal  |            |
|   | Cell ID                                  |           | 0   |            |
|   | Downlink power allocation                | $\rho_A$  | dB  | 0          |
|   |  | $\rho_B$  | dB  | 0 (NOTE 1) |
|   |  | $\sigma$  | dB  | 0          |
|   | OCNG Pattern <sup>NOTE 2</sup>           |           | OP.1 FDD  |            |
|   | Propagation channel                      |           | AWGN  |            |
|   | Antenna configuration                    |           | 1x2   |            |
| RSRP                                      | dBm/15kHz                                | -92       |   |            |
| Active Sidelink UE(s)                     |  |           | Sidelink UE 1, Sidelink UE 2, Sidelink UE 3   |            |
| Sidelink UE 1                             | Sidelink Transmissions                   |           | SLSS + PSBCH  |            |
|   | networkControlledSyncTx                  |           | ON  |            |
|   | sllssid                                  |           | 30  |            |
|   | inCoverage (in MIB-SL)                   |           | TRUE  |            |
|   | syncOffsetIndicator                      |           | Set same as syncOffsetIndicator in Configuration #3-FDD   |            |
|   | Time offset (NOTE 5)                     | ms        | +12.51 ms   |            |
|   | Frequency offset (NOTE 6)                | Hz        | -100 Hz   |            |
|   | Propagation channel                      |           | EPA5  |            |
|   | Antenna configuration                    |           | 1x2 Low   |            |
|   | $\widehat{E}_s$ at antenna port          | dBm/15kHz | -85   |            |
| Sidelink UE 2                             | Sidelink Transmissions                   |           | PSCCH + PSSCH   |            |
|   | Resource pool                            |           | $commRxPool(0)$   |            |
|   | PSCCH RMC                                |           | 5MHz: CC.1 FDD<br>10 MHz: CC.2 FDD<br>(NOTE 5)  |            |
|   | PSCCH subframe allocation                |           | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in   |            |
|   | PSCCH RB allocation                      |           | $[0, \lfloor M_{RB}^{PSCCH} - RP / 2 \rfloor, \lfloor M_{PSCCH} - 1 \rfloor]$ every sc-period   |            |
|   | $\widehat{E}_s$ of PSCCH at antenna port | dBm/15kHz | -85   |            |
|   | PSSCH RMC                                |           | As specified in Table 12.6.1-2  |            |
|   | PSSCH subframe allocation                |           | As per time repetition pattern specified in PSCCH   |            |
|   | PSSCH RB allocation                      |           | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |            |
|   | Time offset (NOTE 4, 5)                  |           | PSCCH: +1 $\mu$ s PSSCH: +1 $\mu$ s – 288T <sub>s</sub>   |            |

|                       |  |           |   |
|-----------------------|--|-----------|---|
| Sidelink UE 3         | Frequency offset (NOTE 6)                | Hz        | +200  |
|                       | Propagation Channel                      |           | EVA70   |
|                       | Antenna configuration                    |           | 1x2 Low   |
|                       | Sidelink Transmissions                   |           | PSCCH + PSSCH   |
|                       | Resource pool                            |           | <i>commRxPool(1)</i>  |
|                       | PSCCH RMC                                |           | 5MHz: CC.5 FDD<br>10 MHz: CC.6 FDD  |
|                       | PSCCH subframe allocation                |           | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH} - RP / 2 \rfloor - 1]$ every sc-period  |
|                       | PSCCH RB allocation                      |           |   |
|                       | $\widehat{E}_s$ of PSCCH at antenna port | dBm/15kHz | -85   |
|                       | PSSCH RMC                                |           | As specified in Table 12.6.1-2  |
|                       | PSSCH subframe allocation                |           | As per time repetition pattern specified in PSCCH   |
|                       | PSSCH RB allocation                      |           | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
|                       | Time offset (NOTE 5)                     | ms        | +12.509   |
|                       | Frequency offset (NOTE 6)                | Hz        | +300  |
| Propagation Channel   |  | EVA70     |   |
| Antenna configuration |  | 1x2 Low   |   |

NOTE 1:  $P_b = 0$ .  
 NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.  
 NOTE 3: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.  
 NOTE 4: Timing advance indication in PSSCH is set as 18 ( $=288T_s$ ) in this test. PSSCH timing is advanced with respect to PSCCH timing by the quantity (i.e., PSSCH timing shall be  $+1\mu s - 288T_s$  in this test).  
 NOTE 5: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.  
 NOTE 6: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

Table 12.6.1-2: Minimum performance

| Test num. | Band-width | Sidelink UE | PSSCH Reference channel | Reference value                             |          |
|-----------|------------|-------------|-------------------------|---|----------|
|           |            |             |                         | Fraction of maximum throughput (%) (NOTE 1) | SNR (dB) |
| 1         | 10 MHz     | 2           | CD.4 FDD                | 70  | 3.0      |
|           |            | 3           | CD.2 FDD                | 70  | 2.8      |
|           | 5 MHz      | 2           | CD.3 FDD                | 70  | 2.9      |
|           |            | 3           | CD.2 FDD                | 70  | 2.8      |

NOTE 1: The throughput is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1.

## 12.7 Maximum Sidelink processes test

The purpose of this test is to verify the maximum number of Sidelink processes and the maximum number of bits per TTI supported by the UE.

### 12.7.1 FDD

The test parameters are specified in Table 12.7.1-1. Multiple communication resource pools are interleaved. Each active Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 12.7.1-2.

Table 12.7.1-1: Test Parameters

| Parameter                                 | Unit | Test 1   |
|---|------|--|
| Communication resource pool configuration |      | As specified in Table A.7.2.1-4 (Configuration #4-FDD) |
| DRX configuration                         |      | As specified in Table 12.1.2-1                         |



|  |                           |           |  |            |  |
|--|---------------------------|-----------|--|------------|--|
| Active cell(s)   |                           |           | Cell 1 (Serving cell)  |            |  |
| Cell 1   | Cyclic prefix             |           | Normal   |            |  |
|  | Cell ID                   |           | 0  |            |  |
|  | Downlink power allocation | $\rho_A$  | dB   | 0          |  |
|  |                           | $\rho_B$  | dB   | 0 (NOTE 1) |  |
|  |                           | $\sigma$  | dB   | 0          |  |
|  | OCNG Pattern (Note 2)     |           | OP.1 FDD   |            |  |
|  | Propagation channel       |           | Static propagation condition<br>No external noise sources are applied                        |            |  |
|  | Antenna configuration     |           | 1x2  |            |  |
| RSRP   |                           | dBm/15kHz | -85  |            |  |
| Active Sidelink UE(s)  |                           |           | Sidelink UE $i$ , $0 \leq i \leq 15$   |            |  |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 15$  | Sidelink Transmissions    |           | PSCCH + PSSCH  |            |  |
|  | Resource pool             |           | $commRxPool(\lfloor \frac{i}{8} \rfloor)$  |            |  |
|  | PSCCH RMC                 |           | 5MHz: CC.1 FDD with $I_{TRP}=i\%8$ (NOTE 3)<br>10 MHz: CC.2 FDD with $I_{TRP}=i\%8$ (NOTE 3) |            |  |
|  | PSCCH subframe allocation |           | As defined by TS 36.213 with $n_{PSCCH} = i$   |            |  |
|  | PSCCH RB allocation       |           |  |            |  |
|  | PSSCH RMC                 |           | As specified in Table 12.7.1-2   |            |  |
|  | PSSCH subframe allocation |           | As per time repetition pattern specified in PSCCH  |            |  |
|  | PSSCH RB allocation       |           | Fully allocated  |            |  |
|  | Time offset (NOTE 4)      |           | $\mu s$  | 0          |  |
|  | Frequency offset (NOTE 5) |           | Hz   | 0          |  |
|  | Propagation Channel       |           | Static propagation condition<br>No external noise sources are applied                        |            |  |
|  | Antenna configuration     |           | 1x2 Low  |            |  |
| NOTE 1: $P_B = 0$ .  |                           |           |  |            |  |
| NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.   |                           |           |  |            |  |
| NOTE 3: For $N_{TRP} = 8$ (FDD) and $trpt-Subset = 001$ , $I_{TRP} = 0$ corresponds to a time repetition pattern of (1,0,0,0,0,0,0,0), $I_{TRP} = 1$ corresponds to a time repetition pattern of (0,1,0,0,0,0,0,0), etc. |                           |           |  |            |  |
| NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.   |                           |           |  |            |  |
| NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.   |                           |           |  |            |  |

**Table 12.7.1-2: Minimum performance**

| Test num. | Bandwidth | PSCCH Reference channel | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value for Sidelink UE $i=0\dots15$ |
|-----------|-----------|-------------------------|---|--|
|           |           |                         |   | Fraction of maximum throughput (%)           |
| 1         | 10 MHz    | CD.7 FDD                | -85                                     | 95   |
|           | 5 MHz     | CD.6 FDD                | -85                                     | 95   |

## 12.8 Sustained downlink data rate with active Sidelink

The purpose of this test is to verify the downlink data rate is not impacted when Sidelink resource are also configured. The test parameters are in Table 12.8.1-1. Cell 1 is the serving cell and UE 1 and UE 2 are transmitters of Prose Direct Communication. The test UE is expected to receive all PDSCH transmissions, and prioritize the transmission of ACK/NACK over the reception of UE 2's PSSCH.

The test cases apply to UE categories and bandwidth combinations with maximum aggregated bandwidth as specified in Table 12.8.1-2. The minimum requirements are specified in Table 12.8.1-3. The TB success rate in the cellular link shall be sustained during at least 300 frames.

**Table 12.8.1-1: Test parameters for sustained downlink data rate (FDD 64QAM) with active Sidelink**

| Parameter   | Unit | Test 1, 2, 3A, 3B, 4A, 6C       |
|---|------|---------------------------------|
| Communication resource pool configuration <sup>Note 5</sup> |      | As specified in Table A.7.2.1-5 |

|  |   | (Configuration #5-FDD)   |     |  |
|--|---|--|-----|--|
| Active cell(s)   |   | Cell 1 (PCell)<br>Cell 2 (SCell) for Test 3B, 4A, 6C                                       |     |  |
| Cell 1   | Test parameters   | As specified in clause 8.7.1: Table 8.7.1-1 and Test 1, 2, 3A, 3B, 4A, 6C in Table 8.7.1-2 |     |  |
| Active Sidelink UE(s)  |   | Sidelink UE 1, Sidelink UE 2   |     |  |
| Sidelink UE 1  | Sidelink Transmissions  | PSCCH + PSSCH  |     |  |
|  | PSCCH RMC   | 10 MHz: CC.2 FDD with $I_{TRP}=0$ (NOTE 1)   |     |  |
|  | PSCCH subframe allocation   | As defined by TS 36.213 with $n_{PSCCH} = 0$   |     |  |
|  | PSCCH RB allocation   |  |     |  |
|  | PSSCH RMC   | 10 MHz: CD.7 FDD   |     |  |
|  | PSSCH subframe allocation   | As per time repetition pattern specified in PSCCH  |     |  |
|  | PSSCH RB allocation   | Fully allocated  |     |  |
|  | Time offset (NOTE 3)  | $\mu$ s  | 0   |  |
|  | Frequency offset (NOTE 4)   | Hz   | 0   |  |
|  | Propagation Channel   | Static propagation condition<br>No external noise sources are applied                      |     |  |
| Antenna configuration  | 1x2 Low   |  |     |  |
| $\widehat{E}_s$ at antenna port  | dBm/15kHz   | -85  |     |  |
| Sidelink UE 2  | Sidelink Transmissions  | PSCCH (NOTE 2)   |     |  |
|  | PSCCH RMC   | 10 MHz: CC.2 FDD with $I_{TRP}=1$ (NOTE 1)   |     |  |
|  | PSCCH subframe allocation   | As defined by TS 36.213 with $n_{PSCCH} = 1$   |     |  |
|  | PSCCH RB allocation   |  |     |  |
|  | Time offset (NOTE 3)  | $\mu$ s  | 0   |  |
|  | Frequency offset (NOTE 4)   | Hz   | 0   |  |
|  | Propagation Channel   | Static propagation condition<br>No external noise sources are applied                      |     |  |
|  | Antenna configuration   | 1x2 Low  |     |  |
|  | $\widehat{E}_s$ at antenna port   | dBm/15kHz  | -85 |  |
|  | NOTE 1: For $N_{TRP} = 8$ (FDD) and $trpt-Subset = 001$ , $I_{TRP} = 0$ corresponds to a time repetition pattern of (1,0,0,0,0,0,0,0), $I_{TRP} = 1$ corresponds to a time repetition pattern of (0,1,0,0,0,0,0,0). |  |     |  |
| NOTE 2: Sidelink UE 2 transmits PSCCH but not PSSCH.   |   |  |     |  |
| NOTE 3: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE. |   |  |     |  |
| NOTE 4: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.                           |   |  |     |  |
| NOTE 5: Sidelink Communication resources are configured on the primary serving cell.                       |   |  |     |  |

Table 12.8.1-2: Test cases for sustained data rate

| CA config                                       | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9,10 | Cat 11, 12    | DL Cat. 15 |
|---|--|--------|--------|--------|--------|----------|-----------|---------------|------------|
|   |  |        |        |        |        |          |           | DL Cat. 11,12 |            |
| Single carrier                                  | 10   | 1      | 2      | 3A     | 3A     | 3A       | 3A        | 3A            | 3A         |
| CA with 2CCs (Note1)                            | 10+10  | -      | -      | 3B     | 4A     | 4A       | 4A        | 4A            | 4A         |
|   | 10+20  | -      | -      | 3B     | 4A     | 6C       | 6C        | 6C            | 6C         |
| NOTE 1: Sidelink operation is configured on PCC |  |        |        |        |        |          |           |               |            |

Table 12.8.1-3: Minimum requirements (FDD 64QAM) with active Sidelink

| Test | Bandwidth (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value           |
|------|-----------------|--|---------------------|---------------------------|
|      |                 |  |                     | PDSCH TB success rate (%) |
| 1    | 10              | 10296  | R.31-1 FDD (NOTE 2) | 95                        |

|  |       |  |   |    |
|--|-------|--|---|----|
| 2  | 10    | 25456  | R.31-2 FDD (NOTE 2)                                 | 95 |
| 3A   | 10    | 36696 (NOTE 1)   | R.31-3A FDD (NOTE 2)                                | 85 |
| 3B   | 10+10 | 25456  | R.31-2 FDD (NOTE 2)                                 | 95 |
| 4A   | 10+10 | 75376 (NOTE 3)   | R.31-4 FDD (NOTE 2)                                 | 85 |
| 6C   | 10+20 | 36696 (NOTE 1) for 10MHz CC<br>75376 (NOTE 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| <p>NOTE 1: 35160 bits for sub-frame 5.<br/> NOTE 2: PDSCH scheduling pattern is changed as per the following bitmap that repeats every 40ms, and applies to all the serving cells..<br/> PDSCH scheduling subframe bitmap = {01110111 11110111 11110111 11110111 11111110}.</p> <p>NOTE 3: 71112 bits for sub-frame 5.</p> |       |  |   |    |

## 13 Void

## 14 Performance requirement (V2X Sidelink Communication)

This clause contains the performance requirements for the sidelink physical channels specified for V2X Sidelink Communication.

### 14.1 General

#### 14.1.1 Applicability of requirements

The requirements in this clause are applicable to UEs that support V2X sidelink communication using Band 47.

When GNSS or GNSS-equivalent synchronization source is used, the reference GNSS signal power is as specified in Table B.6.1-1 in TS 36.133.

The test case applicability is in according to Table 14.1.1-1.

**Table 14.1.1-1: V2X test applicability**

| Tests / clause                      | Applicable if UE supports the following capability   |
|-------------------------------------|--|
| 14.2<br>14.3<br>14.4<br>14.8 Test 1 | UE supporting V2X sidelink<br>If the SL-C-RX Category 4 UE passes 14.11 Test 1 or 2, then the test coverage can be considered fulfilled without executing 14.8 Test 1.                           |
| 14.5                                | UE with support of <i>slss-TxRx-r14</i> [7]  |
| 14.6<br>14.9                        | UE supporting concurrent operation band for V2X and E-UTRA   |
| 14.7                                | UE not supporting concurrent operation band for V2X and E-UTRA   |
| 14.8 Test 2                         | UE with support of <i>v2x-HighReception-r14</i> [7].<br>If the SL-C-RX Category 4 UE passes 14.11 Test 3 or 4, then the test coverage can be considered fulfilled without executing 14.8 Test 2. |
| 14.10 Test 1<br>14.11 Test 1        | UE with support of CA with 2 SL CCs and without support of CA with 3 SL CCs  |
| 14.10 Test 2<br>14.11 Test 2        | UE with support of CA with 3 SL CCs  |
| 14.11 Test 3                        | UE with support of <i>v2x-EnhancedHighReception-r15</i> [7] and CA with 2 SL CCs and without support of CA with 3 SL CCs   |
| 14.11 Test 4                        | UE with support of <i>v2x-EnhancedHighReception-r15</i> [7] and CA with 3 SL CCs   |

## 14.2 Demodulation of PSSCH

The purpose of the requirements in this subclause is to verify the PSSCH for V2X demodulation performance with a single active PSSCH link.

The minimum requirements are specified in Table 14.2-2 with the test parameters specified in Table 14.2-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and Sidelink UE 1 transmits PSCCH and PSSCH.

**Table 14.2-1: Test Parameters**

| Parameter  |                           | Unit       | Test 1, 2  | Test 3, 4                    |
|--|---------------------------|------------|--|------------------------------|
| Communication resource pool configuration  |                           |            | As specified in Table A.9-1 (Configuration #1-V2X) |                              |
| $N_{oc}$ at antenna port   |                           | dBm/15 kHz | -98  |                              |
| Active cell(s)   |                           |            | None   |                              |
| V2X Tx format (SL-V2X-TxProfileList-r15)   |                           |            | N/A  | SL-V2X-TxProfile-r15 = rel15 |
| Sidelink UE 1  | Sidelink Transmissions    |            | PSCCH+PSSCH  |                              |
|  | Timing offset (Note 1)    |            | CP/2-12Ts  |                              |
|  | Frequency offset (Note 2) | Hz         | +600   |                              |
|  | Synchronization           |            | GNSS or GNSS-equivalent                            |                              |
|  | Antenna configuration     |            | 1x2 Low  |                              |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing. |                           |            |  |                              |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.        |                           |            |  |                              |

**Table 14.2-2: Minimum performance**

| Test num. | Bandwidth | PSSCH Reference channel | Propagation condition | Reference value |                   |
|-----------|-----------|-------------------------|-----------------------|-----------------|-------------------|
|           |           |                         |                       | PSSCH BLER (%)  | SNR (dB) of PSSCH |
| 1         | 20 MHz    | CD.8                    | EVA180                | 10              | 14.2              |
| 2         | 10 MHz    | CD.9                    | EVA2700               |                 | 5.4               |
| 3         | 20 MHz    | CD.13                   | EVA180                |                 | 12.5              |
| 4         | 10 MHz    | CD.14                   | EVA2700               |                 | 2.8               |

## 14.3 Demodulation of PSCCH

The purpose of the requirements in this subclause is to verify the PSCCH for V2X demodulation performance with a single active PSSCH link.

The minimum requirements are specified in Table 14.3-2 with the test parameters specified in Table 14.3-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and Sidelink UE 1 transmits PSCCH and PSSCH.

**Table 14.3-1: Test Parameters**

| Parameter                                 |                        | Unit       | Test 1   |
|---|------------------------|------------|--|
| Communication resource pool configuration |                        |            | As specified in Table A.9-1 (Configuration #1-V2X) |
| $N_{oc}$ at antenna port                  |                        | dBm/15 kHz | -98  |
| Active cell(s)                            |                        |            | None   |
| Sidelink UE 1                             | Sidelink Transmissions |            | PSCCH+PSSCH  |

|   |                           |    |                         |
|---|---------------------------|----|-------------------------|
|   | Timing offset (Note 1)    |    | CP/2-12Ts               |
|   | Frequency offset (Note 2) | Hz | +600                    |
|   | Synchronization           |    | GNSS or GNSS-equivalent |
|   | Antenna configuration     |    | 1x2 Low                 |
|   | PSSCH RMC                 |    | CD.9                    |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.<br>Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.<br>Note 3: Cyclic shift for PSSCH DMRS is randomly selected between {0, 3, 6, 9} for each PSSCH transmission. |                           |    |                         |

**Table 14.3-2: Minimum performance**

| Test number | Bandwidth | PSSCH Reference channel | Propagation condition | Reference value                 |                   |
|-------------|-----------|-------------------------|-----------------------|---------------------------------|-------------------|
|             |           |                         |                       | Probability of missed PSSCH (%) | SNR (dB) of PSSCH |
| 1           | 10 MHz    | CC.8                    | EVA1500               | 1                               | 2.6               |

## 14.4 Power imbalance performance with two links

The purpose of this test is to check the demodulation performance when receiving PSSCH transmissions from two Sidelink UEs with power imbalance in one subframe.

The minimum requirements are specified in Table 14.4-2 with the test parameters specified in Table 14.4-1. The Sidelink UE 1 and 2 are synchronized to GNSS or GNSS-equivalent synchronization reference.

**Table 14.4-1: Test Parameters**

| Parameter   |                           | Unit      | Test 1   |
|---|---------------------------|-----------|--|
| Communication resource pool configuration   |                           |           | As specified in Table A.9-2 (Configuration #2-V2X) |
| $N_{oc}$ at antenna port  |                           | dBm/15kHz | -98  |
| Active cell(s)  |                           |           | None   |
| Active Sidelink UE(s)   |                           |           | Sidelink UE 1, Sidelink UE 2                       |
| Sidelink UE 1   | Sidelink Transmissions    |           | PSSCH + PSSCH                                      |
|   | PSSCH RB allocation       |           | PRB pairs {5, 6}                                   |
|   | PSSCH RMC                 |           | As specified in Table 14.4-2                       |
|   | PSSCH RB allocation       |           | PRB pairs {7, 8, 9}                                |
|   | Time offset (Note 1)      | μs        | 0  |
|   | Frequency offset (Note 2) | Hz        | 0  |
|   | Propagation Channel       |           | AWGN   |
|   | Antenna configuration     |           | 1x2  |
| Sidelink UE 2   | Sidelink Transmissions    |           | PSSCH + PSSCH                                      |
|   | PSSCH RB allocation       |           | PRB pairs {20, 21}                                 |
|   | PSSCH RMC                 |           | As specified in Table 14.4-2                       |
|   | PSSCH RB allocation       |           | PRB pairs {22, 23, 24}                             |
|   | Time offset (Note 1)      | μs        | 0  |
|   | Frequency offset (Note 2) | Hz        | 0  |
|   | Propagation Channel       |           | AWGN   |
|   | Antenna configuration     |           | 1x2  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.<br>Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency. |                           |           |  |

**Table 14.4-2: Minimum performance**

| Test number | Bandwidth | Sidelink UE | PSSCH Reference channel | Reference value |                   |
|-------------|-----------|-------------|-------------------------|-----------------|-------------------|
|             |           |             |                         | PSSCH BLER (%)  | SNR (dB) of PSSCH |
| 1           | 20MHz     | 1           | CD.10                   | (Note 1)        | 30.35             |
|             |           | 2           | CD.10                   | 10              | 13.3              |

Note 1: There is no throughput requirement for Sidelink UE 1.

## 14.5 Demodulation of PSBCH

The purpose of the requirements in this subclause is to verify the PSBCH demodulation performance with a single active link.

The minimum requirements are specified in Table 14.5-2 with the test parameters specified in Table 14.5-1. The Sidelink UE 1 transmit PSBCH to tested UE and tested UE is synchronized to SLSS of Sidelink UE 1

**Table 14.5-1: Test Parameters**

| Parameter  |                           | Unit      | Test 1   |
|--|---------------------------|-----------|--|
| Communication resource pool configuration  |                           |           | As specified in Table A.9-1 (Configuration #1-V2X) |
| $N_{oc}$ at antenna port   |                           | dBm/15kHz | -98  |
| Active cell(s)   |                           |           | None   |
| Sidelink UE 1  | Sidelink Transmissions    |           | SLSS+PSBCH (Note 3)                                |
|  | sllsid                    |           | 169  |
|  | Time offset (Note 1)      | $\mu$ s   | 0  |
|  | Frequency offset (Note 2) | Hz        | 0  |
|  | Synchronization source    |           | GNSS   |
| Antenna configuration  |                           |           | 1x2 Low  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing. |                           |           |  |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.        |                           |           |  |
| Note 3: PSBCH transmits together with corresponding SLSS in the same subframe.           |                           |           |  |

**Table 14.5-2: Minimum performance**

| Test number | Bandwidth | PSBCH Reference channel | Propagation condition | Reference value                 |                   |
|-------------|-----------|-------------------------|-----------------------|---------------------------------|-------------------|
|             |           |                         |                       | Probability of missed PSBCH (%) | SNR (dB) of PSBCH |
| 1           | 20 MHz    | CP.2                    | EVA180                | 1                               | 2.5               |

## 14.6 Demodulation of PSSCH with eNB based synchronization

The purpose of the requirements in this subclause is to verify the PSSCH for V2X demodulation performance with a single active PSSCH link under eNB based synchronization.

The minimum requirement is specified in Table 14.6-2 with the test parameters specified in Table 14.6-1. In this test scenario, eNB based synchronization source is used and Sidelink UE 1 transmits PSCCH and PSSCH.

**Table 14.6-1: Test Parameters**

| Parameter                                 |                           | Unit       | Test 1   |            |
|---|---------------------------|------------|--|------------|
| Communication resource pool configuration |                           |            | As specified in Table A.9-3 (Configuration #3-V2X) |            |
| $N_{oc}$ at antenna port                  |                           | dBm/15 kHz | -98  |            |
| Active cell(s)                            |                           |            | Cell 1 (Serving cell)                              |            |
| Cell 1                                    | Cyclic prefix             |            | Normal   |            |
|   | Cell ID                   |            | 0  |            |
|   | Downlink power allocation | $\rho_A$   | dB   | 0          |
|   |                           | $\rho_B$   | dB   | 0 (Note 1) |
|   |                           | $\sigma$   | dB   | 0          |
|   | OCNG Pattern (Note 2)     |            |  | OP.1 FDD   |
| Propagation channel                       |                           |            | AWGN   |            |

|   |                           |            |             |
|---|---------------------------|------------|-------------|
|   | Antenna configuration     |            | 1x2 Low     |
|   | RSRP                      | dBm/15 kHz | -92         |
| Sidelink UE 1   | Sidelink Transmissions    |            | PSCCH+PSSCH |
|   | Timing offset (Note 3)    |            | CP/2-24Ts   |
|   | Frequency offset (Note 4) | Hz         | +1300       |
|   | Synchronization source    |            | Cell 1      |
|   | Antenna configuration     |            | 1x2 Low     |
| Note 1: $P_B = 0$<br>Note 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.<br>Note 3: Time offset of Sidelink UE receive signal with respect to Cell1 reference timing.<br>Note 4: Frequency offset of Sidelink UE with respect to Cell 1 reference frequency. |                           |            |             |

**Table 14.6-2: Minimum performance**

| Test num. | Bandwidth | PSSCH Reference channel | Propagation condition | Reference value |                   |
|-----------|-----------|-------------------------|-----------------------|-----------------|-------------------|
|           |           |                         |                       | PSSCH BLER (%)  | SNR (dB) of PSSCH |
| 1         | 20 MHz    | CD.12                   | EVA180                | 10              | 4.9               |

## 14.7 Soft buffer test

The purpose of this test is to verify the maximum number of bits per TTI supported by the V2X UE.

The minimum requirement is specified in Table 14.7-2 with the test parameters specified in Table 14.7-1.

**Table 14.7-1: Test Parameters**

| Parameter  |  | Unit      | Test 1   | Test 2                       |
|--|--|-----------|--|------------------------------|
| Communication resource pool configuration  |  |           | As specified in Table A.9-4 (Configuration #4-V2X) |                              |
| $N_{oc}$ at antenna port   |  | dBm/15kHz | -98  |                              |
| Active cell(s)   |  |           | None   |                              |
| V2X Tx format (SL-V2X-TxProfileList-r15)   |  |           | N/A  | SL-V2X-TxProfile-r15 = rel15 |
| Active Sidelink UE(s)  |  |           | Sidelink UE $i, 0 \leq i \leq 14$                  |                              |
| Sidelink UE $i, 0 \leq i \leq 14$  | Sidelink Transmissions                                   |           | PSCCH + PSSCH                                      |                              |
|  | Time gap between initial transmission and retransmission | Subframe  | 15   |                              |
|  | Timing offset (Note 1)                                   | $\mu$ s   | 0  |                              |
|  | Frequency offset (Note 2)                                | Hz        | 0  |                              |
|  | Synchronization source                                   |           | GNSS or GNSS-equivalent                            |                              |
|  | Antenna configuration                                    |           | 1x2  |                              |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.<br>Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.<br>Note 3: 15 sidelink UEs should transmit one by one circularly for every subframe. |  |           |  |                              |

**Table 14.7-2: Minimum performance**

| Test num. | Bandwidth | PSSCH Reference channel | Propagation condition | Reference value |                   | ue-CategorySL-C-RX |
|-----------|-----------|-------------------------|-----------------------|-----------------|-------------------|--------------------|
|           |           |                         |                       | PSSCH BLER (%)  | SNR (dB) of PSSCH |                    |
| 1         | 20 MHz    | CD.11                   | AWGN                  | 5               | 8.0               | SL-C-RX Category 2 |

|   |        |       |      |   |      |                       |
|---|--------|-------|------|---|------|-----------------------|
| 2 | 20 MHz | CD.15 | AWGN | 5 | 12.0 | SL-C-RX<br>Category 3 |
|---|--------|-------|------|---|------|-----------------------|

## 14.8 PSCCH decoding capability test

The purpose of this test is to verify the maximum number of received PSCCHs per subframe supported by the V2X UE.

The minimum requirements are specified in Table 14.8-3 with the test parameters specified in Table 14.8-1 and Table 14.8-2 according to UE capability.

**Table 14.8-1: Test Parameters**

| Parameter  |                           | Unit          | Test 1  |
|--|---------------------------|---------------|---|
| Communication resource pool configuration  |                           |               | As specified in Table A.9-5<br>(Configuration #5-V2X)                 |
| Active cell(s)   |                           |               | None  |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 9$   | Sidelink Transmissions    |               | PSCCH + PSSCH   |
|  | Timing offset (Note 1)    | $\mu\text{s}$ | 0   |
|  | Frequency offset (Note 2) | Hz            | 0   |
|  | Synchronization source    |               | GNSS or GNSS-equivalent   |
|  | Propagation Channel       |               | Static propagation condition<br>No external noise sources are applied |
|  | Antenna configuration     |               | 1x2   |
|  | PSSCH RMC                 |               | CD.12   |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.                   |                           |               |   |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.                          |                           |               |   |
| Note 3: Cyclic shift for PSCCH DMRS is randomly selected between {0, 3, 6, 9} for each PSCCH transmission. |                           |               |   |

**Table 14.8-2: Test Parameters**

| Parameter  |                           | Unit          | Test 2  |
|--|---------------------------|---------------|---|
| Communication resource pool configuration  |                           |               | As specified in Table A.9-5<br>(Configuration #5-V2X)                 |
| Active cell(s)   |                           |               | None  |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 19$  | Sidelink Transmissions    |               | PSCCH + PSSCH   |
|  | Timing offset (Note 1)    | $\mu\text{s}$ | 0   |
|  | Frequency offset (Note 2) | Hz            | 0   |
|  | Synchronization source    |               | GNSS or GNSS-equivalent   |
|  | Propagation Channel       |               | Static propagation condition<br>No external noise sources are applied |
|  | Antenna configuration     |               | 1x2   |
|  | PSSCH RMC                 |               | CD.10   |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.                   |                           |               |   |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.                          |                           |               |   |
| Note 3: Cyclic shift for PSCCH DMRS is randomly selected between {0, 3, 6, 9} for each PSCCH transmission. |                           |               |   |

**Table 14.8-3: Minimum performance**

| Test number | Bandwidth | PSCCH Reference channel | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value                 |
|-------------|-----------|-------------------------|---|---------------------------------|
|             |           |                         |   | Probability of missed PSCCH (%) |
| 1           | 20 MHz    | CC.8                    | -85                                     | 1                               |
| 2           | 20 MHz    | CC.8                    | -85                                     | 1                               |



## 14.9 Sustained downlink data rate with active sidelink

The purpose of this test is to verify the WAN and V2X operation is not impacted with each other when UE is under concurrent operation. This test case applies to UEs support concurrent operation of V2X communication with E-UTRA uplink/downlink on the operating bands combinations listed in Table 5.5G-2.

The test parameters are in Table 14.9-1, and the test UE is expected to receive all PSSCH and PDSCH transmissions simultaneously.

For PDSCH, the test cases apply to UE categories and bandwidth as specified in Table 14.9-2. The minimum requirements for PSSCH are specified in Table 14.7-2, Table 14.10-3 and Table 14.10-4 with corresponding test applicability and the minimum requirements for PDSCH downlink data rate are specified in Table 14.9-3. Both PDSCH and PSSCH performance will be verified simultaneously. The TB success rate in the cellular link shall be sustained during at least 300 frames.

**Table 14.9-1: Test parameters for sustained downlink data rate (FDD 64QAM) and maximum PSSCH processing capability**

| Parameter  |  | Unit      | Test 1   |
|--|--|-----------|--|
| Communication resource pool configuration  |  |           | As specified in Table A.9-4 (Configuration #4-V2X) |
| $N_{oc}$ at antenna port   |  | dBm/15kHz | -98  |
| Active cell(s)   |  |           | Cell 1 (PCell)                                     |
| Cell 1   | Test parameters  |           | As specified in Table 8.7.1-1 and Table 14.9-2     |
| Active Sidelink UE(s)  |  |           | Sidelink UE $i$ , $0 \leq i \leq 14$               |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 14$  | Sidelink Transmissions                                   |           | PSSCH + PSSCH                                      |
|  | Time gap between initial transmission and retransmission | Subframe  | 15   |
|  | Timing offset (Note 1)                                   | $\mu$ s   | 0  |
|  | Frequency offset (Note 2)                                | Hz        | 0  |
|  | Synchronization  |           | GNSS or GNSS-equivalent                            |
| Antenna configuration  |  |           | 1x2  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing. |  |           |  |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.        |  |           |  |
| Note 3: 15 sidelink UEs should transmit one by one circularly for every subframe.        |  |           |  |

**Table 14.9-2: Test cases for sustained data rate**

| CA config      | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9,10 | Cat 11, 12    | DL Cat. 15 |
|----------------|--|--------|--------|--------|--------|----------|-----------|---------------|------------|
|                |  |        |        |        |        |          |           | DL Cat. 11,12 |            |
| Single carrier | 10   | 1      | 2      | 3A     | 3A     | 3A       | 3A        | 3A            | 3A         |
|                | 20   | -      | -      | 3      | 4      | 6        | 6         | 6             | 6          |

**Table 14.9-3: Minimum requirements (FDD 64QAM) for PDSCH**

| Test | Bandwidth (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel  | Reference value           |
|------|-----------------|--|----------------------|---------------------------|
|      |                 |  |                      | PDSCH TB success rate (%) |
| 1    | 10              | 10296  | R.31-1 FDD (NOTE 2)  | 95                        |
| 2    | 10              | 25456  | R.31-2 FDD (NOTE 2)  | 95                        |
| 3    | 20              | 51024  | R.31-3 FDD           | 95                        |
| 3A   | 10              | 36696 (NOTE 1)   | R.31-3A FDD (NOTE 2) | 85                        |
| 4    | 20              | 75376 (Note 2)   | R.31-4 FDD           | 85                        |

|                                     |    |                |            |    |
|-------------------------------------|----|----------------|------------|----|
| 6                                   | 20 | 75376 (Note 2) | R.31-4 FDD | 85 |
| NOTE 1: 35160 bits for sub-frame 5. |    |                |            |    |
| NOTE 2: 71112 bits for sub-frame 5. |    |                |            |    |

## 14.10 Soft buffer test (CA)

The purpose of this test is to verify the maximum number of bits per TTI supported by the V2X UE with UE SL-C-RX Category 4 for UEs supporting V2X CA.

For CA with 2 SL CCs, the requirements are specified in Table 14.10-3, based on single carrier requirement specified in Table 14.10-2, with the test parameters specified in Table 14.10-1.

For CA with 3 SL CCs, the requirements are specified in Table 14.10-4, based on single carrier requirement specified in Table 14.10-2, with the test parameters specified in Table 14.10-1.

**Table 14.10-1: Test Parameters**

| Parameter  |  | Unit      | Test 1, 2  |
|--|--|-----------|--|
| Communication resource pool configuration  |  |           | As specified in Table A.9-4 (Configuration #4-V2X) |
| $N_{oc}$ at antenna port   |  | dBm/15kHz | -98  |
| Active cell(s)   |  |           | None   |
| V2X Tx format (SL-V2X-TxProfileList-r15)   |  |           | SL-V2X-TxProfile-r15 = rel15                       |
| Active Sidelink UE(s)  |  |           | Sidelink UE $i$ , $0 \leq i \leq 14$               |
| Sidelink UE $i$ , $0 \leq i \leq 14$   | Sidelink Transmissions                                   |           | PSSCH + PSSCH                                      |
|  | Time gap between initial transmission and retransmission | Subframe  | 15   |
|  | Timing offset (Note 1)                                   | $\mu$ s   | 0  |
|  | Frequency offset (Note 2)                                | Hz        | 0  |
|  | Synchronization source                                   |           | GNSS or GNSS-equivalent                            |
| Antenna configuration  |  |           | 1x2  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing. |  |           |  |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.        |  |           |  |
| Note 3: 15 sidelink UEs should transmit one by one circularly for every subframe.        |  |           |  |

**Table 14.10-2: Single carrier performance with different bandwidths for multiple CA configurations**

| Bandwidth | PSSCH Reference channel | Propagation condition | Reference value |                   |
|-----------|-------------------------|-----------------------|-----------------|-------------------|
|           |                         |                       | PSSCH BLER (%)  | SNR (dB) of PSSCH |
| 10 MHz    | CD.16                   | AWGN                  | 5               | 12.0              |
| 20 MHz    | CD.15                   | AWGN                  | 5               | 12.0              |

**Table 14.10-3: Minimum performance for CA with 2 SL CCs**

| Test num. | CA Bandwidth combination | Requirement                    | ue-CategorySL-C-RX |
|-----------|--------------------------|--------------------------------|--------------------|
| 1         | 10+20 MHz                | As specified in 14.10-2 per CC | SL-C-RX Category 4 |

**Table 14.10-4: Minimum performance for CA with 3 SL CCs**

| Test num. | CA Bandwidth combination | Requirement                    | ue-CategorySL-C-RX |
|-----------|--------------------------|--------------------------------|--------------------|
| 2         | 3x10 MHz                 | As specified in 14.10-2 per CC | SL-C-RX Category 4 |

## 14.11 PSCCH/PSSCH decoding capability test (CA)

The purpose of this test is to verify the maximum number of Sidelink processes and the maximum number of bits per TTI supported by the UE with UE SL-C-RX Category 4 for UEs supporting V2X CA.

For CA with 2 SL CCs, the requirements are specified in Table 14.11-4 based on single carrier requirement specified in Table 14.11-3, with the test parameters specified in Table 14.11-1 and Table 14.11-2 according to UE capability.

For CA with 3 SL CCs, the requirements are specified in Table 14.11-5 based on single carrier requirement specified in Table 14.11-3, with test parameters specified in Table 14.11-1 and Table 14.11-2 according to UE capability.

**Table 14.11-1: Test Parameters**

| Parameter  |                           | Unit          | Test 1  | Test 2   |
|--|---------------------------|---------------|---|--|
| Communication resource pool configuration  |                           |               | As specified in Table A.9-5 and A.9-6 (Configuration #5-V2X and #6-V2X) | As specified in Table A.9-6 (Configuration #6-V2X) |
| V2X Tx format (SL-V2X-TxProfileList-r15)   |                           |               | SL-V2X-TxProfile-r15 = rel15  |  |
| Active cell(s)   |                           |               | None  |  |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 14$  | Sidelink Transmissions    |               | PSCCH + PSSCH   |  |
|  | Timing offset (Note 1)    | $\mu\text{s}$ | 0   |  |
|  | Frequency offset (Note 2) | Hz            | 0   |  |
|  | Synchronization source    |               | GNSS or GNSS-equivalent   |  |
|  | Propagation Channel       |               | Static propagation condition<br>No external noise sources are applied   |  |
|  | Antenna configuration     |               | 1x2   |  |
|  | PSSCH RMC                 |               | CD.17 and CD.18   | CD.18  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.                   |                           |               |   |  |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.                          |                           |               |   |  |
| Note 3: Cyclic shift for PSCCH DMRS is randomly selected between {0, 3, 6, 9} for each PSCCH transmission. |                           |               |   |  |

**Table 14.11-2: Test Parameters**

| Parameter  |                           | Unit          | Test 3  | Test 4   |
|--|---------------------------|---------------|---|--|
| Communication resource pool configuration  |                           |               | As specified in Table A.9-5 and A.9-6 (Configuration #5-V2X and #6-V2X) | As specified in Table A.9-6 (Configuration #6-V2X) |
| V2X Tx format (SL-V2X-TxProfileList-r15)   |                           |               | SL-V2X-TxProfile-r15 = rel15  |  |
| Active cell(s)   |                           |               | None  |  |
| Sidelink UE $i$ ,<br>$0 \leq i \leq 29$  | Sidelink Transmissions    |               | PSCCH + PSSCH   |  |
|  | Timing offset (Note 1)    | $\mu\text{s}$ | 0   |  |
|  | Frequency offset (Note 2) | Hz            | 0   |  |
|  | Synchronization source    |               | GNSS or GNSS-equivalent   |  |
|  | Propagation Channel       |               | Static propagation condition<br>No external noise sources are applied   |  |
|  | Antenna configuration     |               | 1x2   |  |
|  | PSSCH RMC                 |               | CD.19 and CD.20   | CD.20  |
| Note 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.                   |                           |               |   |  |
| Note 2: Frequency offset of Sidelink UE with respect to GNSS reference frequency.                          |                           |               |   |  |
| Note 3: Cyclic shift for PSCCH DMRS is randomly selected between {0, 3, 6, 9} for each PSCCH transmission. |                           |               |   |  |

**Table 14.11-3: Single carrier performance with different bandwidths for multiple CA configurations**

| Bandwidth | PSCCH Reference channel | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value                 |
|-----------|-------------------------|---|---------------------------------|
|           |                         |   | Probability of missed PSCCH (%) |
| 10 MHz    | CC.8                    | -85                                     | 1                               |

|        |      |     |   |
|--------|------|-----|---|
| 20 MHz | CC.8 | -85 | 1 |
|--------|------|-----|---|

**Table 14.11-4: Minimum performance for CA configuration with 2 SL CCs**

| Test number | CA Bandwidth combination (MHz) | Minimum performance requirement    |
|-------------|--------------------------------|------------------------------------|
| 1           | 10+20                          | As defined in Table 14.11-3 per CC |
| 3           | 10+20                          | As defined in Table 14.11-3 per CC |

**Table 14.11-5: Minimum performance for CA configuration with 3 SL CCs**

| Test number | CA Bandwidth combination (MHz) | Minimum performance requirement    |
|-------------|--------------------------------|------------------------------------|
| 2           | 3x10                           | As defined in Table 14.11-3 per CC |
| 4           | 3x10                           | As defined in Table 14.11-3 per CC |

---

# Annex A (normative): Measurement channels

## A.1 General

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per datastream (codeword). For multi-stream (more than one codeword) transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all datastreams (codewords).

The UE category entry in the definition of the reference measurement channel in Annex A is only informative and reveals the UE categories, which can support the corresponding measurement channel. Whether the measurement channel is used for testing a certain UE category or not is specified in the individual minimum requirements.

---

## A.2 UL reference measurement channels

### A.2.1 General

The measurement channels in the following subclauses are defined to derive the requirements in clause 6 (Transmitter Characteristics) and clause 7 (Receiver Characteristics). The measurement channels represent example configurations of physical channels for different data rates.

#### A.2.1.1 Applicability and common parameters

The UL reference measurement channels comprise transmission of PUSCH and Demodulation Reference signals only. The following conditions apply:

- 1 HARQ transmission
- Cyclic Prefix normal
- PUSCH hopping off
- Link adaptation off
- Demodulation Reference signal as per TS 36.211 [4] subclause 5.5.2.1.2.

Where ACK/NACK is transmitted, it is assumed to be multiplexed on PUSCH as per TS 36.212 [5] subclause 5.2.2.6.

- ACK/NACK 1 bit
- ACK/NACK mapping adjacent to Demodulation Reference symbol
- ACK/NACK resources punctured into data
- Max number of resources for ACK/NACK: 4 SC-FDMA symbols per subframe
- No CQI transmitted, no RI transmitted

#### A.2.1.2 Determination of payload size

The algorithm for determining the payload size  $A$  is as follows; given a desired coding rate  $R$  and radio block allocation  $N_{RB}$

1. Calculate the number of channel bits  $N_{ch}$  that can be transmitted during the first transmission of a given sub-frame.
2. Find  $A$  such that the resulting coding rate is as close to  $R$  as possible, that is,

$$\min \left| R - (A + 24 * (N_{CB} + 1)) / N_{ch} \right|, \text{ where } N_{CB} = \begin{cases} 0, & \text{if } C = 1 \\ C, & \text{if } C > 1 \end{cases}$$

subject to

- A is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of  $N_{RB}$  resource blocks.
- C is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].
- For RMC-s, which at the nominal target coding rate do not cover all the possible UE categories for the given modulation, reduce the target coding rate gradually (within the same modulation), until the maximal possible number of UE categories is covered.

3. If there is more than one A that minimises the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

### A.2.1.3 Overview of UL reference measurement channels

In Table A.2.1.3-1 to A.2.1.3-1K are listed the UL reference measurement channels specified in annexes A.2.2 and A.2.3 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.2.2 and A.2.3 as appropriate.

**Table A.2.1.3-1: Overview of UL reference measurement channels (FDD, Full RB allocation, QPSK)**

| Duplex       | Table              | Name | BW  | Mod  | TCR  | RB  | RB Off set | UE Cat eg | Notes             |
|--------------|--------------------|------|-----|------|------|-----|------------|-----------|-------------------|
| FDD          | Table A.2.2.1.1-1  |      | 1.4 | QPSK | 1/3  | 6   |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.1-1  |      | 3   | QPSK | 1/3  | 15  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.1-1  |      | 5   | QPSK | 1/3  | 25  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.1-1  |      | 10  | QPSK | 1/3  | 50  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.1-1  |      | 15  | QPSK | 1/5  | 75  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.1-1  |      | 20  | QPSK | 1/6  | 100 |            | ≥ 1       |                   |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 1.4 | QPSK | 1/3  | 6   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 3   | QPSK | 1/5  | 15  |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 5   | QPSK | 1/8  | 25  |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 10  | QPSK | 1/10 | 36  |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 15  | QPSK | 1/10 | 36  |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1a |      | 20  | QPSK | 1/10 | 36  |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 1.4 | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 3   | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 5   | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 10  | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 15  | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1b |      | 20  | QPSK | 1/3  | 6   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 1.4 | QPSK | 1/3  | 6   |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 3   | QPSK | 1/3  | 12  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 5   | QPSK | 1/3  | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 10  | QPSK | 1/3  | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 15  | QPSK | 1/3  | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.1-1c |      | 20  | QPSK | 1/3  | 24  |            | -         | UE UL category M2 |

**Table A.2.1.3-1A: Overview of UL reference measurement channels (FDD, Full RB allocation, 16-QAM)**

| Duplex       | Table              | Name | BW  | Mod   | TCR | RB  | RB Off set | UE Cat eg | Notes             |
|--------------|--------------------|------|-----|-------|-----|-----|------------|-----------|-------------------|
| FDD          | Table A.2.2.1.2-1  |      | 1.4 | 16QAM | 3/4 | 6   |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.2-1  |      | 3   | 16QAM | 1/2 | 15  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.2-1  |      | 5   | 16QAM | 1/3 | 25  |            | ≥ 1       |                   |
| FDD          | Table A.2.2.1.2-1  |      | 10  | 16QAM | 3/4 | 50  |            | ≥ 2       |                   |
| FDD          | Table A.2.2.1.2-1  |      | 15  | 16QAM | 1/2 | 75  |            | ≥ 2       |                   |
| FDD          | Table A.2.2.1.2-1  |      | 20  | 16QAM | 1/3 | 100 |            | ≥ 2       |                   |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 1.4 | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 3   | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 5   | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 10  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 15  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1a |      | 20  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 1.4 | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 3   | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 5   | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 10  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 15  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1b |      | 20  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 1.4 | 16QAM | 1/3 | 6   |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 3   | 16QAM | 1/3 | 12  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 5   | 16QAM | 1/3 | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 10  | 16QAM | 1/3 | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 15  | 16QAM | 1/3 | 24  |            | -         | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.1.2-1c |      | 20  | 16QAM | 1/3 | 24  |            | -         | UE UL category M2 |

**Table A.2.1.3-1B: Overview of UL reference measurement channels (FDD, Full RB allocation, 64-QAM)**

| Duplex | Table             | Name | BW  | Mod   | TCR | RB  | RB Off set | UE Cat eg | Notes                    |
|--------|-------------------|------|-----|-------|-----|-----|------------|-----------|--------------------------|
| FDD    | Table A.2.2.1.3-1 |      | 1.4 | 64QAM | 3/4 | 6   |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.1.3-1 |      | 3   | 64QAM | 3/4 | 15  |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.1.3-1 |      | 5   | 64QAM | 3/4 | 25  |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.1.3-1 |      | 10  | 64QAM | 3/4 | 50  |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.1.3-1 |      | 15  | 64QAM | 3/4 | 75  |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.1.3-1 |      | 20  | 64QAM | 3/4 | 100 |            | 5,8       | UL category 5, 8, 13, 14 |

**Table A.2.1.3-1Ba: Overview of UL reference measurement channels (FDD, Full RB allocation, 256-QAM)**

| Duplex | Table             | Name | BW  | Mod    | TCR | RB | RB Off set | UE Cat eg | Notes            |
|--------|-------------------|------|-----|--------|-----|----|------------|-----------|------------------|
| FDD    | Table A.2.2.1.4-1 |      | 1.4 | 256QAM | 4/5 | 6  |            |           | UL category ≥ 15 |
| FDD    | Table A.2.2.1.4-1 |      | 3   | 256QAM | 4/5 | 15 |            |           | UL category ≥ 15 |

|     |                   |  |    |        |     |     |  |  |                       |
|-----|-------------------|--|----|--------|-----|-----|--|--|-----------------------|
| FDD | Table A.2.2.1.4-1 |  | 5  | 256QAM | 4/5 | 25  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.1.4-1 |  | 10 | 256QAM | 4/5 | 50  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.1.4-1 |  | 15 | 256QAM | 4/5 | 75  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.1.4-1 |  | 20 | 256QAM | 4/5 | 100 |  |  | UL category $\geq 15$ |

**Table A.2.1.3-1C: Overview of UL reference measurement channels (FDD, Partial RB allocation, QPSK)**

| Duplex       | Table              | Name | BW       | Mod  | TCR | RB | RB Off set | UE Cat eg | Notes            |
|--------------|--------------------|------|----------|------|-----|----|------------|-----------|------------------|
| FDD          | Table A.2.2.2.1-1  |      | 1.4 - 20 | QPSK | 1/3 | 1  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 1.4 - 20 | QPSK | 1/3 | 2  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 1.4 - 20 | QPSK | 1/3 | 3  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 1.4 - 20 | QPSK | 1/3 | 4  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 1.4 - 20 | QPSK | 1/3 | 5  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 3 - 20   | QPSK | 1/3 | 6  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 3 - 20   | QPSK | 1/3 | 8  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 3 - 20   | QPSK | 1/3 | 9  |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 3 - 20   | QPSK | 1/3 | 10 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 3 - 20   | QPSK | 1/3 | 12 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 5 - 20   | QPSK | 1/3 | 15 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 5 - 20   | QPSK | 1/3 | 16 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 5 - 20   | QPSK | 1/3 | 18 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 5 - 20   | QPSK | 1/3 | 20 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 5 - 20   | QPSK | 1/3 | 24 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 25 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 27 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 30 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 32 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 36 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 40 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 45 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 10 - 20  | QPSK | 1/3 | 48 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 15 - 20  | QPSK | 1/3 | 50 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 15 - 20  | QPSK | 1/3 | 54 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 15 - 20  | QPSK | 1/4 | 60 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 15 - 20  | QPSK | 1/4 | 64 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 15 - 20  | QPSK | 1/4 | 72 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 20       | QPSK | 1/5 | 75 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 20       | QPSK | 1/5 | 80 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 20       | QPSK | 1/5 | 81 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 20       | QPSK | 1/6 | 90 |            | $\geq 1$  |                  |
| FDD          | Table A.2.2.2.1-1  |      | 20       | QPSK | 1/6 | 96 |            | $\geq 1$  |                  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |      | 1.4 - 20 | QPSK | 1/3 | 1  |            | -         | UE UL category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a |      | 1.4 - 20 | QPSK | 1/3 | 2  |            | -         | UE UL category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a |      | 1.4 - 20 | QPSK | 1/3 | 3  |            | -         | UE UL category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a |      | 1.4 - 20 | QPSK | 1/3 | 4  |            | -         | UE UL category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a |      | 1.4 - 20 | QPSK | 1/3 | 5  |            | -         | UE UL category 0 |



|              |                    |  |        |      |      |    |  |   |                   |
|--------------|--------------------|--|--------|------|------|----|--|---|-------------------|
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 3-20   | QPSK | 1/3  | 6  |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 3-20   | QPSK | 1/3  | 8  |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 3-20   | QPSK | 1/3  | 9  |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 3-20   | QPSK | 1/3  | 10 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 3-20   | QPSK | 1/4  | 12 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 5-20   | QPSK | 1/5  | 15 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 5-20   | QPSK | 1/5  | 16 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 5-20   | QPSK | 1/6  | 18 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 5-20   | QPSK | 1/6  | 20 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 5-20   | QPSK | 1/8  | 24 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 10-20  | QPSK | 1/8  | 25 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 10-20  | QPSK | 1/8  | 27 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1a |  | 10-20  | QPSK | 1/10 | 30 |  | - | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 1.4-20 | QPSK | 1/3  | 1  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 1.4-20 | QPSK | 1/3  | 2  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 1.4-20 | QPSK | 1/3  | 3  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 1.4-20 | QPSK | 1/3  | 4  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 1.4-20 | QPSK | 1/3  | 5  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1b |  | 3-20   | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 1.4-20 | QPSK | 1/3  | 1  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 1.4-20 | QPSK | 1/3  | 2  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 1.4-20 | QPSK | 1/3  | 3  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 1.4-20 | QPSK | 1/3  | 4  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 1.4-20 | QPSK | 1/3  | 5  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 3-20   | QPSK | 1/3  | 6  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 3-20   | QPSK | 1/3  | 9  |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 3-20   | QPSK | 1/3  | 12 |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 5-20   | QPSK | 1/3  | 15 |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 5-20   | QPSK | 1/3  | 18 |  | - | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.1-1c |  | 5-20   | QPSK | 1/3  | 21 |  | - | UE UL category M2 |

**Table A.2.1.3-1D: Overview of UL reference measurement channels (FDD, Partial RB allocation, 16-QAM)**

| Duplex | Table             | Name | BW       | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------|-------------------|------|----------|-------|-----|----|------------|-----------|-------|
| FDD    | Table A.2.2.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 1  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 2  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 3  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 4  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 5  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 3 - 20   | 16QAM | 3/4 | 6  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 3 - 20   | 16QAM | 3/4 | 8  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 3 - 20   | 16QAM | 3/4 | 9  |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 3 - 20   | 16QAM | 3/4 | 10 |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 3 - 20   | 16QAM | 3/4 | 12 |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 5 - 20   | 16QAM | 1/2 | 15 |            | ≥ 1       |       |
| FDD    | Table A.2.2.2.2-1 |      | 5 - 20   | 16QAM | 1/2 | 16 |            | ≥ 1       |       |

|              |                    |  |          |       |     |    |  |     |                   |
|--------------|--------------------|--|----------|-------|-----|----|--|-----|-------------------|
| FDD          | Table A.2.2.2.2-1  |  | 5 - 20   | 16QAM | 1/2 | 18 |  | ≥ 1 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 5 - 20   | 16QAM | 1/3 | 20 |  | ≥ 1 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 5 - 20   | 16QAM | 1/3 | 24 |  | ≥ 1 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 1/3 | 25 |  | ≥ 1 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 1/3 | 27 |  | ≥ 1 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 30 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 32 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 36 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 40 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 45 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 48 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 15 - 20  | 16QAM | 3/4 | 50 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 15 - 20  | 16QAM | 3/4 | 54 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 15 - 20  | 16QAM | 2/3 | 60 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 15 - 20  | 16QAM | 2/3 | 64 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 15 - 20  | 16QAM | 1/2 | 72 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 20       | 16QAM | 1/2 | 75 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 20       | 16QAM | 1/2 | 80 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 20       | 16QAM | 1/2 | 81 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 20       | 16QAM | 2/5 | 90 |  | ≥ 2 |                   |
| FDD          | Table A.2.2.2.2-1  |  | 20       | 16QAM | 2/5 | 96 |  | ≥ 2 |                   |
| FDD / HD-FDD | Table A.2.2.2.2-1a |  | 1.4 - 20 | 16QAM | 3/4 | 1  |  | -   | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.2-1a |  | 1.4 - 20 | 16QAM | 3/4 | 2  |  | -   | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.2-1a |  | 1.4 - 20 | 16QAM | 2/5 | 4  |  | -   | UE UL category 0  |
| FDD / HD-FDD | Table A.2.2.2.2-1b |  | 1.4 - 20 | 16QAM | 3/4 | 1  |  | -   | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.2-1b |  | 1.4 - 20 | 16QAM | 3/4 | 2  |  | -   | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.2-1b |  | 1.4 - 20 | 16QAM | 2/5 | 4  |  | -   | UE UL category M1 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 1  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 2  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 3  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 4  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 5  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 6  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 9  |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 12 |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 15 |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 18 |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 21 |  | -   | UE UL category M2 |
| FDD / HD-FDD | Table A.2.2.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 24 |  | -   | UE UL category M2 |

**Table A.2.1.3-1E: Overview of UL reference measurement channels (FDD, Partial RB allocation, 64-QAM)**

| Duplex | Table             | Name | BW       | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes                    |
|--------|-------------------|------|----------|-------|-----|----|------------|-----------|--------------------------|
| FDD    | Table A.2.2.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 1  |            | 5,8       | UL category 5, 8, 13, 14 |
| FDD    | Table A.2.2.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 2  |            | 5,8       | UL category 5, 8, 13, 14 |

|     |                   |  |          |       |     |    |  |     |                          |
|-----|-------------------|--|----------|-------|-----|----|--|-----|--------------------------|
| FDD | Table A.2.2.2.3-1 |  | 1.4 - 20 | 64QAM | 3/4 | 3  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 1.4 - 20 | 64QAM | 3/4 | 4  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 1.4 - 20 | 64QAM | 3/4 | 5  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 3 - 20   | 64QAM | 3/4 | 6  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 3 - 20   | 64QAM | 3/4 | 8  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 3 - 20   | 64QAM | 3/4 | 9  |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 3 - 20   | 64QAM | 3/4 | 10 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 3 - 20   | 64QAM | 3/4 | 12 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 5 - 20   | 64QAM | 3/4 | 15 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 5 - 20   | 64QAM | 3/4 | 16 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 5 - 20   | 64QAM | 3/4 | 18 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 5 - 20   | 64QAM | 3/4 | 20 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 5 - 20   | 64QAM | 3/4 | 24 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 25 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 27 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 30 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 32 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 36 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 40 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 45 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 10 - 20  | 64QAM | 3/4 | 48 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 15 - 20  | 64QAM | 3/4 | 50 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 15 - 20  | 64QAM | 3/4 | 54 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 15 - 20  | 64QAM | 3/4 | 60 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 15 - 20  | 64QAM | 3/4 | 64 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 15 - 20  | 64QAM | 3/4 | 72 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 20       | 64QAM | 3/4 | 75 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 20       | 64QAM | 3/4 | 80 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 20       | 64QAM | 3/4 | 81 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 20       | 64QAM | 3/4 | 90 |  | 5,8 | UL category 5, 8, 13, 14 |
| FDD | Table A.2.2.2.3-1 |  | 20       | 64QAM | 3/4 | 96 |  | 5,8 | UL category 5, 8, 13, 14 |

**Table A.2.1.3-1Ea: Overview of UL reference measurement channels (FDD, Partial RB allocation, 256-QAM)**

| Duplex | Table             | Name | BW       | Mod    | TCR | RB | RB Off set | UE Cat eg | Notes                 |
|--------|-------------------|------|----------|--------|-----|----|------------|-----------|-----------------------|
| FDD    | Table A.2.2.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 1  |            |           | UL category $\geq$ 15 |
| FDD    | Table A.2.2.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 2  |            |           | UL category $\geq$ 15 |

|     |                   |  |          |        |     |    |  |  |                       |
|-----|-------------------|--|----------|--------|-----|----|--|--|-----------------------|
| FDD | Table A.2.2.2.4-1 |  | 1.4 - 20 | 256QAM | 4/5 | 3  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 1.4 - 20 | 256QAM | 4/5 | 4  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 1.4 - 20 | 256QAM | 4/5 | 5  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 3 - 20   | 256QAM | 4/5 | 6  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 3 - 20   | 256QAM | 4/5 | 8  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 3 - 20   | 256QAM | 4/5 | 9  |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 3 - 20   | 256QAM | 4/5 | 10 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 3 - 20   | 256QAM | 4/5 | 12 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 5 - 20   | 256QAM | 4/5 | 15 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 5 - 20   | 256QAM | 4/5 | 16 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 5 - 20   | 256QAM | 4/5 | 18 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 5 - 20   | 256QAM | 4/5 | 20 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 5 - 20   | 256QAM | 4/5 | 24 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 25 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 27 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 30 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 32 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 36 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 40 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 45 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 10 - 20  | 256QAM | 4/5 | 48 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 15 - 20  | 256QAM | 4/5 | 50 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 15 - 20  | 256QAM | 4/5 | 54 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 15 - 20  | 256QAM | 4/5 | 60 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 15 - 20  | 256QAM | 4/5 | 64 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 15 - 20  | 256QAM | 4/5 | 72 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 20       | 256QAM | 4/5 | 75 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 20       | 256QAM | 4/5 | 80 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 20       | 256QAM | 4/5 | 81 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 20       | 256QAM | 4/5 | 90 |  |  | UL category $\geq 15$ |
| FDD | Table A.2.2.2.4-1 |  | 20       | 256QAM | 4/5 | 96 |  |  | UL category $\geq 15$ |

Table A.2.1.3-1F: Overview of UL reference measurement channels (TDD, Full RB allocation, QPSK)

| Duplex | Table              | Name | BW  | Mod  | TCR | RB  | RB Off set | UE Cat eg | Notes                 |
|--------|--------------------|------|-----|------|-----|-----|------------|-----------|-----------------------|
| TDD    | Table A.2.3.1.1-1  |      | 1.4 | QPSK | 1/3 | 6   |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1  |      | 3   | QPSK | 1/3 | 15  |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1  |      | 5   | QPSK | 1/3 | 25  |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1  |      | 10  | QPSK | 1/3 | 50  |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1  |      | 15  | QPSK | 1/5 | 75  |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1  |      | 20  | QPSK | 1/6 | 100 |            | $\geq 1$  |                       |
| TDD    | Table A.2.3.1.1-1A |      | 1.4 | QPSK | 1/3 | 6   |            | $\geq 1$  | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.1-1A |      | 3   | QPSK | 1/3 | 15  |            | $\geq 1$  | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.1-1A |      | 5   | QPSK | 1/3 | 25  |            | $\geq 1$  | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.1-1A |      | 10  | QPSK | 1/3 | 50  |            | $\geq 1$  | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.1-1A |      | 15  | QPSK | 1/5 | 75  |            | $\geq 1$  | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.1-1A |      | 20  | QPSK | 1/6 | 100 |            | $\geq 1$  | UL-DL configuration 0 |

|     |                    |  |     |      |      |    |  |   |                   |
|-----|--------------------|--|-----|------|------|----|--|---|-------------------|
| TDD | Table A.2.3.1.1-1a |  | 1.4 | QPSK | 1/3  | 6  |  | - | UE UL category 0  |
| TDD | Table A.2.3.1.1-1a |  | 3   | QPSK | 1/5  | 15 |  | - | UE UL category 0  |
| TDD | Table A.2.3.1.1-1a |  | 5   | QPSK | 1/8  | 25 |  | - | UE UL category 0  |
| TDD | Table A.2.3.1.1-1a |  | 10  | QPSK | 1/10 | 36 |  | - | UE UL category 0  |
| -   | Table A.2.3.1.1-1a |  | 15  | QPSK | 1/10 | 36 |  | - | UE UL category 0  |
| TDD | Table A.2.3.1.1-1a |  | 20  | QPSK | 1/10 | 36 |  | - | UE UL category 0  |
| TDD | Table A.2.3.1.1-1b |  | 1.4 | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1b |  | 3   | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1b |  | 5   | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1b |  | 10  | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1b |  | 15  | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1b |  | 20  | QPSK | 1/3  | 6  |  | - | UE UL category M1 |
| TDD | Table A.2.3.1.1-1c |  | 1.4 | QPSK | 1/3  | 6  |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 3   | QPSK | 1/3  | 12 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 5   | QPSK | 1/3  | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 10  | QPSK | 1/3  | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 15  | QPSK | 1/3  | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 20  | QPSK | 1/3  | 24 |  | - | UE UL category M2 |

**Table A.2.1.3-1G: Overview of UL reference measurement channels (TDD, Full RB allocation, 16-QAM)**

| Duplex | Table              | Name | BW  | Mod   | TCR | RB  | RB Off set | UE Cat eg | Notes                 |
|--------|--------------------|------|-----|-------|-----|-----|------------|-----------|-----------------------|
| TDD    | Table A.2.3.1.2-1  |      | 1.4 | 16QAM | 3/4 | 6   |            | ≥ 1       |                       |
| TDD    | Table A.2.3.1.2-1  |      | 3   | 16QAM | 1/2 | 15  |            | ≥ 1       |                       |
| TDD    | Table A.2.3.1.2-1  |      | 5   | 16QAM | 1/3 | 25  |            | ≥ 1       |                       |
| TDD    | Table A.2.3.1.2-1  |      | 10  | 16QAM | 3/4 | 50  |            | ≥ 2       |                       |
| TDD    | Table A.2.3.1.2-1  |      | 15  | 16QAM | 1/2 | 75  |            | ≥ 2       |                       |
| TDD    | Table A.2.3.1.2-1  |      | 20  | 16QAM | 1/3 | 100 |            | ≥ 2       |                       |
| TDD    | Table A.2.3.1.2-1A |      | 1.4 | 16QAM | 3/4 | 6   |            | ≥ 1       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1A |      | 3   | 16QAM | 1/2 | 15  |            | ≥ 1       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1A |      | 5   | 16QAM | 1/3 | 25  |            | ≥ 1       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1A |      | 10  | 16QAM | 3/4 | 50  |            | ≥ 2       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1A |      | 15  | 16QAM | 1/2 | 75  |            | ≥ 2       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1A |      | 20  | 16QAM | 1/3 | 100 |            | ≥ 2       | UL-DL configuration 0 |
| TDD    | Table A.2.3.1.2-1a |      | 1.4 | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.2-1a |      | 3   | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.2-1a |      | 5   | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.2-1a |      | 10  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.2-1a |      | 15  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.2-1a |      | 20  | 16QAM | 1/3 | 5   |            | -         | UE UL category 0      |
| TDD    | Table A.2.3.1.1-1b |      | 1.4 | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1b |      | 3   | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1b |      | 5   | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1b |      | 10  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1b |      | 15  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1b |      | 20  | 16QAM | 1/3 | 5   |            | -         | UE UL category M1     |
| TDD    | Table A.2.3.1.1-1c |      | 1.4 | 16QAM | 1/3 | 6   |            | -         | UE UL category M2     |

|     |                    |  |    |       |     |    |  |   |                   |
|-----|--------------------|--|----|-------|-----|----|--|---|-------------------|
| TDD | Table A.2.3.1.1-1c |  | 3  | 16QAM | 1/3 | 12 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 5  | 16QAM | 1/3 | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 10 | 16QAM | 1/3 | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 15 | 16QAM | 1/3 | 24 |  | - | UE UL category M2 |
| TDD | Table A.2.3.1.1-1c |  | 20 | 16QAM | 1/3 | 24 |  | - | UE UL category M2 |

**Table A.2.1.3-1H: Overview of UL reference measurement channels (TDD, Full RB allocation, 64-QAM)**

| Duplex | Table             | Name | BW  | Mod   | TCR | RB  | RB Off set | UE Cat eg | Notes                    |
|--------|-------------------|------|-----|-------|-----|-----|------------|-----------|--------------------------|
| TDD    | Table A.2.3.1.3-1 |      | 1.4 | 64QAM | 3/4 | 6   |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.1.3-1 |      | 3   | 64QAM | 3/4 | 15  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.1.3-1 |      | 5   | 64QAM | 3/4 | 25  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.1.3-1 |      | 10  | 64QAM | 3/4 | 50  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.1.3-1 |      | 15  | 64QAM | 3/4 | 75  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.1.3-1 |      | 20  | 64QAM | 3/4 | 100 |            | 5,8       | UL category 5, 8, 13, 14 |

**Table A.2.1.3-1Ha: Overview of UL reference measurement channels (TDD, Full RB allocation, 256-QAM)**

| Duplex | Table             | Name | BW  | Mod    | TCR | RB  | RB Off set | UE Cat eg | Notes            |
|--------|-------------------|------|-----|--------|-----|-----|------------|-----------|------------------|
| TDD    | Table A.2.3.1.4-1 |      | 1.4 | 256QAM | 4/5 | 6   |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.1.4-1 |      | 3   | 256QAM | 4/5 | 15  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.1.4-1 |      | 5   | 256QAM | 4/5 | 25  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.1.4-1 |      | 10  | 256QAM | 4/5 | 50  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.1.4-1 |      | 15  | 256QAM | 4/5 | 75  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.1.4-1 |      | 20  | 256QAM | 4/5 | 100 |            |           | UL category ≥ 15 |

**Table A.2.1.3-1I: Overview of UL reference measurement channels (TDD, Partial RB allocation, QPSK)**

| Duplex | Table             | Name | BW       | Mod  | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------|-------------------|------|----------|------|-----|----|------------|-----------|-------|
| TDD    | Table A.2.3.2.1-1 |      | 1.4 - 20 | QPSK | 1/3 | 1  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 1.4 - 20 | QPSK | 1/3 | 2  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 1.4 - 20 | QPSK | 1/3 | 3  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 1.4 - 20 | QPSK | 1/3 | 4  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 1.4 - 20 | QPSK | 1/3 | 5  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 3 - 20   | QPSK | 1/3 | 6  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 3 - 20   | QPSK | 1/3 | 8  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 3 - 20   | QPSK | 1/3 | 9  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 3 - 20   | QPSK | 1/3 | 10 |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 3 - 20   | QPSK | 1/3 | 12 |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 5 - 20   | QPSK | 1/3 | 15 |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 5 - 20   | QPSK | 1/3 | 16 |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.1-1 |      | 5 - 20   | QPSK | 1/3 | 18 |            | ≥ 1       |       |

|     |                    |  |          |      |     |    |  |     |                       |
|-----|--------------------|--|----------|------|-----|----|--|-----|-----------------------|
| TDD | Table A.2.3.2.1-1  |  | 5 - 20   | QPSK | 1/3 | 20 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 5 - 20   | QPSK | 1/3 | 24 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 25 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 27 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 30 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 32 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 36 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 40 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 45 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 10 - 20  | QPSK | 1/3 | 48 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 15 - 20  | QPSK | 1/3 | 50 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 15 - 20  | QPSK | 1/3 | 54 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 15 - 20  | QPSK | 1/4 | 60 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 15 - 20  | QPSK | 1/4 | 64 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 15 - 20  | QPSK | 1/4 | 72 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 20       | QPSK | 1/5 | 75 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 20       | QPSK | 1/5 | 80 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 20       | QPSK | 1/5 | 81 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 20       | QPSK | 1/6 | 90 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1  |  | 20       | QPSK | 1/6 | 96 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.1-1A |  | 1.4 - 20 | QPSK | 1/3 | 1  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 1.4 - 20 | QPSK | 1/3 | 2  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 1.4 - 20 | QPSK | 1/3 | 3  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 1.4 - 20 | QPSK | 1/3 | 4  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 1.4 - 20 | QPSK | 1/3 | 5  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 3 - 20   | QPSK | 1/3 | 6  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 3 - 20   | QPSK | 1/3 | 8  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 3 - 20   | QPSK | 1/3 | 9  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 3 - 20   | QPSK | 1/3 | 10 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 3 - 20   | QPSK | 1/3 | 12 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 5 - 20   | QPSK | 1/3 | 15 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 5 - 20   | QPSK | 1/3 | 16 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 5 - 20   | QPSK | 1/3 | 18 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 5 - 20   | QPSK | 1/3 | 20 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 5 - 20   | QPSK | 1/3 | 24 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 25 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 27 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 30 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 32 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 36 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 40 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 45 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 10 - 20  | QPSK | 1/3 | 48 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 15 - 20  | QPSK | 1/3 | 50 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 15 - 20  | QPSK | 1/3 | 54 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 15 - 20  | QPSK | 1/4 | 60 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 15 - 20  | QPSK | 1/4 | 64 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 15 - 20  | QPSK | 1/4 | 72 |  | ≥ 1 | UL-DL configuration 0 |

|     |                    |  |          |      |      |    |  |     |                       |
|-----|--------------------|--|----------|------|------|----|--|-----|-----------------------|
| TDD | Table A.2.3.2.1-1A |  | 20       | QPSK | 1/5  | 75 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 20       | QPSK | 1/5  | 80 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 20       | QPSK | 1/5  | 81 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 20       | QPSK | 1/6  | 90 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1A |  | 20       | QPSK | 1/6  | 96 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.1-1a |  | 1.4 - 20 | QPSK | 1/3  | 1  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 1.4 - 20 | QPSK | 1/3  | 2  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 1.4 - 20 | QPSK | 1/3  | 3  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 1.4 - 20 | QPSK | 1/3  | 4  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 1.4 - 20 | QPSK | 1/3  | 5  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 3-20     | QPSK | 1/3  | 6  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 3-20     | QPSK | 1/3  | 8  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 3-20     | QPSK | 1/3  | 9  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 3-20     | QPSK | 1/3  | 10 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 3-20     | QPSK | 1/4  | 12 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 5-20     | QPSK | 1/5  | 15 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 5-20     | QPSK | 1/5  | 16 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 5-20     | QPSK | 1/6  | 18 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 5-20     | QPSK | 1/6  | 20 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 5-20     | QPSK | 1/8  | 24 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 10-20    | QPSK | 1/8  | 25 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 10-20    | QPSK | 1/8  | 27 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1a |  | 10-20    | QPSK | 1/10 | 30 |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.1-1b |  | 1.4-20   | QPSK | 1/3  | 1  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1b |  | 1.4-20   | QPSK | 1/3  | 2  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1b |  | 1.4-20   | QPSK | 1/3  | 3  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1b |  | 1.4-20   | QPSK | 1/3  | 4  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1b |  | 1.4-20   | QPSK | 1/3  | 5  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1b |  | 3-20     | QPSK | 1/3  | 6  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.1-1c |  | 1.4-20   | QPSK | 1/3  | 1  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 1.4-20   | QPSK | 1/3  | 2  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 1.4-20   | QPSK | 1/3  | 3  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 1.4-20   | QPSK | 1/3  | 4  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 1.4-20   | QPSK | 1/3  | 5  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 3-20     | QPSK | 1/3  | 6  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 3-20     | QPSK | 1/3  | 9  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 3-20     | QPSK | 1/3  | 12 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 5-20     | QPSK | 1/3  | 15 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 5-20     | QPSK | 1/3  | 18 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.1-1c |  | 5-20     | QPSK | 1/3  | 21 |  | -   | UE UL category M2     |

**Table A.2.1.3-1J: Overview of UL reference measurement channels (TDD, Partial RB allocation, 16-QAM)**

| Duplex | Table             | Name | BW       | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------|-------------------|------|----------|-------|-----|----|------------|-----------|-------|
| TDD    | Table A.2.3.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 1  |            | ≥ 1       |       |
| TDD    | Table A.2.3.2.2-1 |      | 1.4 - 20 | 16QAM | 3/4 | 2  |            | ≥ 1       |       |



|     |                    |  |          |       |     |    |  |     |                       |
|-----|--------------------|--|----------|-------|-----|----|--|-----|-----------------------|
| TDD | Table A.2.3.2.2-1  |  | 1.4 - 20 | 16QAM | 3/4 | 3  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 1.4 - 20 | 16QAM | 3/4 | 4  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 1.4 - 20 | 16QAM | 3/4 | 5  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 3 - 20   | 16QAM | 3/4 | 6  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 3 - 20   | 16QAM | 3/4 | 8  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 3 - 20   | 16QAM | 3/4 | 9  |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 3 - 20   | 16QAM | 3/4 | 10 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 3 - 20   | 16QAM | 3/4 | 12 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 5 - 20   | 16QAM | 1/2 | 15 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 5 - 20   | 16QAM | 1/2 | 16 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 5 - 20   | 16QAM | 1/2 | 18 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 5 - 20   | 16QAM | 1/3 | 20 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 5 - 20   | 16QAM | 1/3 | 24 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 1/3 | 25 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 1/3 | 27 |  | ≥ 1 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 30 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 32 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 36 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 40 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 45 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 10 - 20  | 16QAM | 3/4 | 48 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 15 - 20  | 16QAM | 3/4 | 50 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 15 - 20  | 16QAM | 3/4 | 54 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 15 - 20  | 16QAM | 2/3 | 60 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 15 - 20  | 16QAM | 2/3 | 64 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 15 - 20  | 16QAM | 1/2 | 72 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 20       | 16QAM | 1/2 | 75 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 20       | 16QAM | 1/2 | 80 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 20       | 16QAM | 1/2 | 81 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 20       | 16QAM | 2/5 | 90 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1  |  | 20       | 16QAM | 2/5 | 96 |  | ≥ 2 |                       |
| TDD | Table A.2.3.2.2-1A |  | 1.4 - 20 | 16QAM | 3/4 | 1  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 1.4 - 20 | 16QAM | 3/4 | 2  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 1.4 - 20 | 16QAM | 3/4 | 3  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 1.4 - 20 | 16QAM | 3/4 | 4  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 1.4 - 20 | 16QAM | 3/4 | 5  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 3 - 20   | 16QAM | 3/4 | 6  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 3 - 20   | 16QAM | 3/4 | 8  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 3 - 20   | 16QAM | 3/4 | 9  |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 3 - 20   | 16QAM | 3/4 | 10 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 3 - 20   | 16QAM | 3/4 | 12 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 5 - 20   | 16QAM | 1/2 | 15 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 5 - 20   | 16QAM | 1/2 | 16 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 5 - 20   | 16QAM | 1/2 | 18 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 5 - 20   | 16QAM | 1/3 | 20 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 5 - 20   | 16QAM | 1/3 | 24 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 1/3 | 25 |  | ≥ 1 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 1/3 | 27 |  | ≥ 1 | UL-DL configuration 0 |

|     |                    |  |          |       |     |    |  |     |                       |
|-----|--------------------|--|----------|-------|-----|----|--|-----|-----------------------|
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 30 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 32 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 36 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 40 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 45 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 10 - 20  | 16QAM | 3/4 | 48 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 15 - 20  | 16QAM | 3/4 | 50 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 15 - 20  | 16QAM | 3/4 | 54 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 15 - 20  | 16QAM | 2/3 | 60 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 15 - 20  | 16QAM | 2/3 | 64 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 15 - 20  | 16QAM | 1/2 | 72 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 20       | 16QAM | 1/2 | 75 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 20       | 16QAM | 1/2 | 80 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 20       | 16QAM | 1/2 | 81 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 20       | 16QAM | 2/5 | 90 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1A |  | 20       | 16QAM | 2/5 | 96 |  | ≥ 2 | UL-DL configuration 0 |
| TDD | Table A.2.3.2.2-1a |  | 1.4 - 20 | 16QAM | 3/4 | 1  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.2-1a |  | 1.4 - 20 | 16QAM | 3/4 | 2  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.2-1a |  | 1.4 - 20 | 16QAM | 2/5 | 4  |  | -   | UE UL category 0      |
| TDD | Table A.2.3.2.2-1b |  | 1.4 - 20 | 16QAM | 3/4 | 1  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.2-1b |  | 1.4 - 20 | 16QAM | 3/4 | 2  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.2-1b |  | 1.4 - 20 | 16QAM | 2/5 | 4  |  | -   | UE UL category M1     |
| TDD | Table A.2.3.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 1  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 2  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 3  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 4  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 1.4 - 20 | 16QAM | 1/2 | 5  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 6  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 9  |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 3 - 20   | 16QAM | 1/2 | 12 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 15 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 18 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 21 |  | -   | UE UL category M2     |
| TDD | Table A.2.3.2.2-1c |  | 5 - 20   | 16QAM | 1/2 | 24 |  | -   | UE UL category M2     |

**Table A.2.1.3-1K: Overview of UL reference measurement channels (TDD, Partial RB allocation, 64-QAM)**

| Duplex | Table             | Name | BW       | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes                    |
|--------|-------------------|------|----------|-------|-----|----|------------|-----------|--------------------------|
| TDD    | Table A.2.3.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 1  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 2  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 3  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 4  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.2.3-1 |      | 1.4 - 20 | 64QAM | 3/4 | 5  |            | 5,8       | UL category 5, 8, 13, 14 |
| TDD    | Table A.2.3.2.3-1 |      | 3 - 20   | 64QAM | 3/4 | 6  |            | 5,8       | UL category 5, 8, 13, 14 |

|     |                   |  |         |       |     |    |  |     |                          |
|-----|-------------------|--|---------|-------|-----|----|--|-----|--------------------------|
| TDD | Table A.2.3.2.3-1 |  | 3 - 20  | 64QAM | 3/4 | 8  |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 3 - 20  | 64QAM | 3/4 | 9  |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 3 - 20  | 64QAM | 3/4 | 10 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 3 - 20  | 64QAM | 3/4 | 12 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 5 - 20  | 64QAM | 3/4 | 15 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 5 - 20  | 64QAM | 3/4 | 16 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 5 - 20  | 64QAM | 3/4 | 18 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 5 - 20  | 64QAM | 3/4 | 20 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 5 - 20  | 64QAM | 3/4 | 24 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 25 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 27 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 30 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 32 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 36 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 40 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 45 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 10 - 20 | 64QAM | 3/4 | 48 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 15 - 20 | 64QAM | 3/4 | 50 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 15 - 20 | 64QAM | 3/4 | 54 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 15 - 20 | 64QAM | 3/4 | 60 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 15 - 20 | 64QAM | 3/4 | 64 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 15 - 20 | 64QAM | 3/4 | 72 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 20      | 64QAM | 3/4 | 75 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 20      | 64QAM | 3/4 | 80 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 20      | 64QAM | 3/4 | 81 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 20      | 64QAM | 3/4 | 90 |  | 5,8 | UL category 5, 8, 13, 14 |
| TDD | Table A.2.3.2.3-1 |  | 20      | 64QAM | 3/4 | 96 |  | 5,8 | UL category 5, 8, 13, 14 |

**Table A.2.1.3-1Ka: Overview of UL reference measurement channels (TDD, Partial RB allocation, 256-QAM)**

| Duplex | Table             | Name | BW       | Mod    | TCR | RB | RB Off set | UE Cat eg | Notes            |
|--------|-------------------|------|----------|--------|-----|----|------------|-----------|------------------|
| TDD    | Table A.2.3.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 1  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 2  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 3  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 4  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 1.4 - 20 | 256QAM | 4/5 | 5  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 3 - 20   | 256QAM | 4/5 | 6  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 3 - 20   | 256QAM | 4/5 | 8  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 3 - 20   | 256QAM | 4/5 | 9  |            |           | UL category ≥ 15 |
| TDD    | Table A.2.3.2.4-1 |      | 3 - 20   | 256QAM | 4/5 | 10 |            |           | UL category ≥ 15 |

|     |                   |  |         |        |     |    |  |  |                  |
|-----|-------------------|--|---------|--------|-----|----|--|--|------------------|
| TDD | Table A.2.3.2.4-1 |  | 3 - 20  | 256QAM | 4/5 | 12 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 5 - 20  | 256QAM | 4/5 | 15 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 5 - 20  | 256QAM | 4/5 | 16 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 5 - 20  | 256QAM | 4/5 | 18 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 5 - 20  | 256QAM | 4/5 | 20 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 5 - 20  | 256QAM | 4/5 | 24 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 25 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 27 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 30 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 32 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 36 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 40 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 45 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 10 - 20 | 256QAM | 4/5 | 48 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 15 - 20 | 256QAM | 4/5 | 50 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 15 - 20 | 256QAM | 4/5 | 54 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 15 - 20 | 256QAM | 4/5 | 60 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 15 - 20 | 256QAM | 4/5 | 64 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 15 - 20 | 256QAM | 4/5 | 72 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 20      | 256QAM | 4/5 | 75 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 20      | 256QAM | 4/5 | 80 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 20      | 256QAM | 4/5 | 81 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 20      | 256QAM | 4/5 | 90 |  |  | UL category ≥ 15 |
| TDD | Table A.2.3.2.4-1 |  | 20      | 256QAM | 4/5 | 96 |  |  | UL category ≥ 15 |

**Table A.2.1.3-1L: Overview of UL reference measurement channels (HD-FDD, NB-IoT, QPSK)**

| Duplex | Table         | Name | BW  | Mod          | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------|---------------|------|-----|--------------|-----|----|------------|-----------|-------|
| HD-FDD | Table A.2.4-1 |      | 0.2 | $\pi/2$ BPSK | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | $\pi/4$ QPSK | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | $\pi/2$ BPSK | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | $\pi/4$ QPSK | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | QPSK         | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | QPSK         | 1/3 | 1  |            | NB1       |       |
| HD-FDD | Table A.2.4-1 |      | 0.2 | QPSK         | 1/3 | 1  |            | NB1       |       |

## A.2.2 Reference measurement channels for FDD

### A.2.2.1 Full RB allocation

#### A.2.2.1.1 QPSK

**Table A.2.2.1.1-1: Reference Channels for QPSK with full RB allocation**

| Parameter         | Unit | Value |   |   |    |    |    |
|-------------------|------|-------|---|---|----|----|----|
| Channel bandwidth | MHz  | 1.4   | 3 | 5 | 10 | 15 | 20 |

|  |      |      |      |      |       |       |       |
|--|------|------|------|------|-------|-------|-------|
| Allocated resource blocks  |      | 6    | 15   | 25   | 50    | 75    | 100   |
| DFT-OFDM Symbols per Sub-Frame   |      | 12   | 12   | 12   | 12    | 12    | 12    |
| Modulation   |      | QPSK | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3  | 1/3  | 1/3  | 1/3   | 1/5   | 1/6   |
| Payload size   | Bits | 600  | 1544 | 2216 | 5160  | 4392  | 4584  |
| Transport block CRC  | Bits | 24   | 24   | 24   | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1    | 1    | 1    | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 1728 | 4320 | 7200 | 14400 | 21600 | 28800 |
| Total symbols per Sub-Frame  |      | 864  | 2160 | 3600 | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1  | ≥ 1  | ≥ 1  | ≥ 1   | ≥ 1   | ≥ 1   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |      |      |      |       |       |       |

**Table A.2.2.1.1-1a: Reference Channels for QPSK with full/maximum RB allocation for UE UL category 0**

| Parameter  | Unit | Value |      |      |       |       |       |
|--|------|-------|------|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 15   | 25   | 36    | 36    | 36    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12   | 12   | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/5  | 1/8  | 1/10  | 1/10  | 1/10  |
| Payload size   | Bits | 600   | 872  | 904  | 1000  | 1000  | 1000  |
| Transport block CRC  | Bits | 24    | 24   | 24   | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (NOTE 1)   |      | 1     | 1    | 1    | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 1728  | 4320 | 7200 | 10368 | 10368 | 10368 |
| Total symbols per Sub-Frame  |      | 864   | 2160 | 3600 | 5184  | 5184  | 5184  |
| UE UL Category   |      | 0     | 0    | 0    | 0     | 0     | 0     |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |      |       |      |      |       |       |       |
| NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled. |      |       |      |      |       |       |       |

**Table A.2.2.1.1-1b: Reference Channels for QPSK with full/maximum RB allocation for UE UL category M1**

| Parameter   | Unit | Value |      |      |      |      |      |
|---|------|-------|------|------|------|------|------|
| Channel bandwidth   | MHz  | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks   |      | 6     | 6    | 6    | 6    | 6    | 6    |
| DFT-OFDM Symbols per Sub-Frame  |      | 12    | 12   | 12   | 12   | 12   | 12   |
| Modulation  |      | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate  |      | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Payload size  | Bits | 600   | 600  | 600  | 600  | 600  | 600  |
| Transport block CRC   | Bits | 24    | 24   | 24   | 24   | 24   | 24   |
| Number of code blocks per Sub-Frame (NOTE 1)  |      | 1     | 1    | 1    | 1    | 1    | 1    |
| Total number of bits per Sub-Frame  | Bits | 1728  | 1728 | 1728 | 1728 | 1728 | 1728 |
| Total symbols per Sub-Frame   |      | 864   | 864  | 864  | 864  | 864  | 864  |
| UE UL Category  |      | M1    | M1   | M1   | M1   | M1   | M1   |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  |      |       |      |      |      |      |      |
| NOTE 2: For HD-FDD UE with $N_{abs}^{PUSCH} = 1$ , the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled. $N_{abs}^{PUSCH}$ is total number of absolute subframes a PUSCH with repetition spans [4]. |      |       |      |      |      |      |      |

NOTE 3: For HD-FDD UE with  $N_{abs}^{PUSCH} > 1$ , MPDCCH are scheduled at 0th DL subframe every  $N_{abs}^{PUSCH} + 5$  subframes (starting from the 0th subframe). The associated PUSCH is scheduled at the 4th to  $(N_{abs}^{PUSCH} + 3)$ -th UL subframes every  $N_{abs}^{PUSCH} + 5$  subframes. Information bit payload is available if uplink subframe is scheduled.

**Table A.2.2.1.1-1c: Reference Channels for QPSK with full/maximum RB allocation for UE UL category M2**

| Parameter  | Unit | Value |      |      |      |      |      |
|--|------|-------|------|------|------|------|------|
| Channel bandwidth  | MHz  | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks  |      | 6     | 12   | 24   | 24   | 24   | 24   |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12   | 12   | 12   | 12   | 12   |
| Modulation   |      | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate   |      | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Payload size   | Bits | 600   | 1224 | 2472 | 2472 | 2472 | 2472 |
| Transport block CRC  | Bits | 24    | 24   | 24   | 24   | 24   | 24   |
| Number of code blocks per Sub-Frame (NOTE 1)   |      | 1     | 1    | 1    | 1    | 1    | 1    |
| Total number of bits per Sub-Frame   | Bits | 1728  | 3456 | 6912 | 6912 | 6912 | 6912 |
| Total symbols per Sub-Frame  |      | 864   | 1728 | 3456 | 3456 | 3456 | 3456 |
| UE UL Category   |      | M2    | M2   | M2   | M2   | M2   | M2   |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |      |       |      |      |      |      |      |
| NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled. |      |       |      |      |      |      |      |

A.2.2.1.2 16-QAM

**Table A.2.2.1.2-1: Reference Channels for 16-QAM with full RB allocation**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 15    | 25    | 50    | 75    | 100   |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   | 1/3   | 3/4   | 1/2   | 1/3   |
| Payload size   | Bits | 2600  | 4264  | 4968  | 21384 | 21384 | 19848 |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     | 1     | 4     | 4     | 4     |
| Total number of bits per Sub-Frame   | Bits | 3456  | 8640  | 14400 | 28800 | 43200 | 57600 |
| Total symbols per Sub-Frame  |      | 864   | 2160  | 3600  | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 2   | ≥ 2   | ≥ 2   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |       |       |       |       |       |

**Table A.2.2.1.2-1a: Reference Channels for 16-QAM with maximum RB allocation for UE UL category 0**

| Parameter                           | Unit | Value |       |       |       |       |       |
|-------------------------------------|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth                   | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks           |      | 5     | 5     | 5     | 5     | 5     | 5     |
| DFT-OFDM Symbols per Sub-Frame      |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation                          |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate                  |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size                        | Bits | 872   | 872   | 872   | 872   | 872   | 872   |
| Transport block CRC                 | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame |      | 1     | 1     | 1     | 1     | 1     | 1     |

|  |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|
| Total number of bits per Sub-Frame   | Bits | 2880 | 2880 | 2880 | 2880 | 2880 | 2880 |
| Total symbols per Sub-Frame  |      | 720  | 720  | 720  | 720  | 720  | 720  |
| UE UL Category   |      | 0    | 0    | 0    | 0    | 0    | 0    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |      |      |      |      |      |      |      |
| NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled. |      |      |      |      |      |      |      |

**Table A.2.2.1.2-1b: Reference Channels for 16-QAM with maximum RB allocation for UE UL category M1**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 5     | 5     | 5     | 5     | 5     | 5     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   | Bits | 872   | 872   | 872   | 872   | 872   | 872   |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame  |      | 1     | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 2880  | 2880  | 2880  | 2880  | 2880  | 2880  |
| Total symbols per Sub-Frame  |      | 720   | 720   | 720   | 720   | 720   | 720   |
| UE Category  |      | M1    | M1    | M1    | M1    | M1    | M1    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |      |       |       |       |       |       |       |
| NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled. |      |       |       |       |       |       |       |

**Table A.2.2.1.2-1c: Reference Channels for 16-QAM with maximum RB allocation for UE UL category M2**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 12    | 24    | 24    | 24    | 24    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   | Bits | 1032  | 2088  | 4264  | 4264  | 4264  | 4264  |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame  |      | 1     | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 3456  | 6912  | 13824 | 13824 | 13824 | 13824 |
| Total symbols per Sub-Frame  |      | 864   | 1728  | 3456  | 3456  | 3456  | 3456  |
| UE Category  |      | M2    | M2    | M2    | M2    | M2    | M2    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |      |       |       |       |       |       |       |
| NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled. |      |       |       |       |       |       |       |

**A.2.2.1.3 64-QAM**

**Table A.2.2.1.3-1: Reference Channels for 64-QAM with full RB allocation**

| Parameter                      | Unit | Value |       |       |       |       |       |
|--------------------------------|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth              | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks      |      | 6     | 15    | 25    | 50    | 75    | 100   |
| DFT-OFDM Symbols per Sub-Frame |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation                     |      | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |

|  |  |                 |                 |                 |                 |                 |                 |
|--|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Target Coding rate                           |  | 3/4             | 3/4             | 3/4             | 3/4             | 3/4             | 3/4             |
| Payload size                                 | Bits   | 3752            | 9528            | 15840           | 31704           | 46888           | 63776           |
| Transport block CRC                          | Bits   | 24              | 24              | 24              | 24              | 24              | 24              |
| Number of code blocks per Sub-Frame (Note 1) |  | 1               | 2               | 3               | 6               | 8               | 11              |
| Total number of bits per Sub-Frame           | Bits   | 5184            | 12960           | 21600           | 43200           | 64800           | 86400           |
| Total symbols per Sub-Frame                  |  | 864             | 2160            | 3600            | 7200            | 10800           | 14400           |
| UE Category (Note 2)                         |  | 5,8             | 5,8             | 5,8             | 5,8             | 5,8             | 5,8             |
| UE UL Category (Note 2)                      |  | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 |
| Note 1:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |                 |                 |                 |                 |                 |                 |
| Note2 :                                      | If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category. |                 |                 |                 |                 |                 |                 |

### A.2.2.1.4 256 QAM

**Table A.2.2.1.4-1: Reference Channels for 256 QAM with full RB allocation**

| Parameter                                    | Unit   | Value  |        |        |        |        |        |
|--|--|--------|--------|--------|--------|--------|--------|
| Channel bandwidth                            | MHz  | 1.4    | 3      | 5      | 10     | 15     | 20     |
| Allocated resource blocks                    |  | 6      | 15     | 25     | 50     | 75     | 100    |
| DFT-OFDM Symbols per Sub-Frame               |  | 12     | 12     | 12     | 12     | 12     | 12     |
| Modulation                                   |  | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding rate                           |  | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    |
| Payload size                                 | Bits   | 5160   | 12960  | 21384  | 42368  | 63776  | 84760  |
| Transport block CRC                          | Bits   | 24     | 24     | 24     | 24     | 24     | 24     |
| Number of code blocks per Sub-Frame (Note 1) |  | 1      | 3      | 4      | 8      | 11     | 15     |
| Total number of bits per Sub-Frame           | Bits   | 6912   | 17280  | 28800  | 57600  | 86400  | 115200 |
| Total symbols per Sub-Frame                  |  | 864    | 2160   | 3600   | 7200   | 10800  | 14400  |
| UE UL Category                               |  | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   |
| Note 1:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |        |        |        |        |        |        |

### A.2.2.2 Partial RB allocation

For each channel bandwidth, various partial RB allocations are specified. The number of allocated RBs is chosen according to values specified in the Tx and Rx requirements. The single allocated RB case is included.

The allocated RBs are contiguous and start from one end of the channel bandwidth. A single allocated RB is at one end of the channel bandwidth.

#### A.2.2.2.1 QPSK

**Table A.2.2.2.1-1: Reference Channels for QPSK with partial RB allocation**

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |             |
|           | 1.4 - 20 | 1             | 12                             | QPSK  | 1/3                | 72           | 24                  | 1  | 288                                | 144                         | ≥ 1         |
|           | 1.4 - 20 | 2             | 12                             | QPSK  | 1/3                | 176          | 24                  | 1  | 576                                | 288                         | ≥ 1         |
|           | 1.4 - 20 | 3             | 12                             | QPSK  | 1/3                | 256          | 24                  | 1  | 864                                | 432                         | ≥ 1         |
|           | 1.4 - 20 | 4             | 12                             | QPSK  | 1/3                | 392          | 24                  | 1  | 1152                               | 576                         | ≥ 1         |
|           | 1.4 - 20 | 5             | 12                             | QPSK  | 1/3                | 424          | 24                  | 1  | 1440                               | 720                         | ≥ 1         |
|           | 3-20     | 6             | 12                             | QPSK  | 1/3                | 600          | 24                  | 1  | 1728                               | 864                         | ≥ 1         |
|           | 3-20     | 8             | 12                             | QPSK  | 1/3                | 808          | 24                  | 1  | 2304                               | 1152                        | ≥ 1         |



|  |         |    |    |      |     |      |    |   |       |       |     |
|--|---------|----|----|------|-----|------|----|---|-------|-------|-----|
|  | 3-20    | 9  | 12 | QPSK | 1/3 | 776  | 24 | 1 | 2592  | 1296  | ≥ 1 |
|  | 3-20    | 10 | 12 | QPSK | 1/3 | 872  | 24 | 1 | 2880  | 1440  | ≥ 1 |
|  | 3-20    | 12 | 12 | QPSK | 1/3 | 1224 | 24 | 1 | 3456  | 1728  | ≥ 1 |
|  | 5-20    | 15 | 12 | QPSK | 1/3 | 1320 | 24 | 1 | 4320  | 2160  | ≥ 1 |
|  | 5-20    | 16 | 12 | QPSK | 1/3 | 1384 | 24 | 1 | 4608  | 2304  | ≥ 1 |
|  | 5-20    | 18 | 12 | QPSK | 1/3 | 1864 | 24 | 1 | 5184  | 2592  | ≥ 1 |
|  | 5-20    | 20 | 12 | QPSK | 1/3 | 1736 | 24 | 1 | 5760  | 2880  | ≥ 1 |
|  | 5-20    | 24 | 12 | QPSK | 1/3 | 2472 | 24 | 1 | 6912  | 3456  | ≥ 1 |
|  | 10-20   | 25 | 12 | QPSK | 1/3 | 2216 | 24 | 1 | 7200  | 3600  | ≥ 1 |
|  | 10-20   | 27 | 12 | QPSK | 1/3 | 2792 | 24 | 1 | 7776  | 3888  | ≥ 1 |
|  | 10-20   | 30 | 12 | QPSK | 1/3 | 2664 | 24 | 1 | 8640  | 4320  | ≥ 1 |
|  | 10-20   | 32 | 12 | QPSK | 1/3 | 2792 | 24 | 1 | 9216  | 4608  | ≥ 1 |
|  | 10-20   | 36 | 12 | QPSK | 1/3 | 3752 | 24 | 1 | 10368 | 5184  | ≥ 1 |
|  | 10-20   | 40 | 12 | QPSK | 1/3 | 4136 | 24 | 1 | 11520 | 5760  | ≥ 1 |
|  | 10-20   | 45 | 12 | QPSK | 1/3 | 4008 | 24 | 1 | 12960 | 6480  | ≥ 1 |
|  | 10-20   | 48 | 12 | QPSK | 1/3 | 4264 | 24 | 1 | 13824 | 6912  | ≥ 1 |
|  | 15 - 20 | 50 | 12 | QPSK | 1/3 | 5160 | 24 | 1 | 14400 | 7200  | ≥ 1 |
|  | 15 - 20 | 54 | 12 | QPSK | 1/3 | 4776 | 24 | 1 | 15552 | 7776  | ≥ 1 |
|  | 15 - 20 | 60 | 12 | QPSK | 1/4 | 4264 | 24 | 1 | 17280 | 8640  | ≥ 1 |
|  | 15 - 20 | 64 | 12 | QPSK | 1/4 | 4584 | 24 | 1 | 18432 | 9216  | ≥ 1 |
|  | 15 - 20 | 72 | 12 | QPSK | 1/4 | 5160 | 24 | 1 | 20736 | 10368 | ≥ 1 |
|  | 20      | 75 | 12 | QPSK | 1/5 | 4392 | 24 | 1 | 21600 | 10800 | ≥ 1 |
|  | 20      | 80 | 12 | QPSK | 1/5 | 4776 | 24 | 1 | 23040 | 11520 | ≥ 1 |
|  | 20      | 81 | 12 | QPSK | 1/5 | 4776 | 24 | 1 | 23328 | 11664 | ≥ 1 |
|  | 20      | 90 | 12 | QPSK | 1/6 | 4008 | 24 | 1 | 25920 | 12960 | ≥ 1 |
|  | 20      | 96 | 12 | QPSK | 1/6 | 4264 | 24 | 1 | 27648 | 13824 | ≥ 1 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.1-1a: Reference Channels for QPSK with partial RB allocation for UE UL category 0

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE UL Category |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |                |
|           | 1.4 - 20 | 1             | 12                             | QPSK  | 1/3                | 72           | 24                  | 1  | 288                                | 144                         | 0              |
|           | 1.4 - 20 | 2             | 12                             | QPSK  | 1/3                | 176          | 24                  | 1  | 576                                | 288                         | 0              |
|           | 1.4 - 20 | 3             | 12                             | QPSK  | 1/3                | 256          | 24                  | 1  | 864                                | 432                         | 0              |
|           | 1.4 - 20 | 4             | 12                             | QPSK  | 1/3                | 392          | 24                  | 1  | 1152                               | 576                         | 0              |
|           | 1.4 - 20 | 5             | 12                             | QPSK  | 1/3                | 424          | 24                  | 1  | 1440                               | 720                         | 0              |
|           | 3-20     | 6             | 12                             | QPSK  | 1/3                | 600          | 24                  | 1  | 1728                               | 864                         | 0              |
|           | 3-20     | 8             | 12                             | QPSK  | 1/3                | 808          | 24                  | 1  | 2304                               | 1152                        | 0              |
|           | 3-20     | 9             | 12                             | QPSK  | 1/3                | 776          | 24                  | 1  | 2592                               | 1296                        | 0              |
|           | 3-20     | 10            | 12                             | QPSK  | 1/3                | 872          | 24                  | 1  | 2880                               | 1440                        | 0              |
|           | 3-20     | 12            | 12                             | QPSK  | 1/4                | 840          | 24                  | 1  | 3456                               | 1728                        | 0              |
|           | 5-20     | 15            | 12                             | QPSK  | 1/5                | 872          | 24                  | 1  | 4320                               | 2160                        | 0              |
|           | 5-20     | 16            | 12                             | QPSK  | 1/5                | 904          | 24                  | 1  | 4608                               | 2304                        | 0              |
|           | 5-20     | 18            | 12                             | QPSK  | 1/6                | 776          | 24                  | 1  | 5184                               | 2592                        | 0              |
|           | 5-20     | 20            | 12                             | QPSK  | 1/6                | 872          | 24                  | 1  | 5760                               | 2880                        | 0              |
|           | 5-20     | 24            | 12                             | QPSK  | 1/8                | 872          | 24                  | 1  | 6912                               | 3456                        | 0              |
|           | 10-20    | 25            | 12                             | QPSK  | 1/8                | 904          | 24                  | 1  | 7200                               | 3600                        | 0              |
|           | 10-20    | 27            | 12                             | QPSK  | 1/8                | 968          | 24                  | 1  | 7776                               | 3888                        | 0              |
|           | 10-20    | 30            | 12                             | QPSK  | 1/10               | 808          | 24                  | 1  | 8640                               | 4320                        | 0              |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled.

Table A.2.2.1-1b: Reference Channels for QPSK with partial RB allocation for UE UL category M1

| Parameter | Ch BW | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|-----------|-------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
|-----------|-------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|

| Unit | MHz      |   |    |      |     | Bits | Bits |   | Bits |     |    |
|------|----------|---|----|------|-----|------|------|---|------|-----|----|
|      | 1.4 - 20 | 1 | 12 | QPSK | 1/3 | 72   | 24   | 1 | 288  | 144 | M1 |
|      | 1.4 - 20 | 2 | 12 | QPSK | 1/3 | 176  | 24   | 1 | 576  | 288 | M1 |
|      | 1.4 - 20 | 3 | 12 | QPSK | 1/3 | 256  | 24   | 1 | 864  | 432 | M1 |
|      | 1.4 - 20 | 4 | 12 | QPSK | 1/3 | 392  | 24   | 1 | 1152 | 576 | M1 |
|      | 1.4 - 20 | 5 | 12 | QPSK | 1/3 | 424  | 24   | 1 | 1440 | 720 | M1 |
|      | 3-20     | 6 | 12 | QPSK | 1/3 | 600  | 24   | 1 | 1728 | 864 | M1 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled.

**Table A.2.2.2.1-1c: Reference Channels for QPSK with partial RB allocation for UE UL category M2**

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |             |
|           | 1.4 - 20 | 1             | 12                             | QPSK  | 1/3                | 72           | 24                  | 1  | 288                                | 144                         | M2          |
|           | 1.4 - 20 | 2             | 12                             | QPSK  | 1/3                | 176          | 24                  | 1  | 576                                | 288                         | M2          |
|           | 1.4 - 20 | 3             | 12                             | QPSK  | 1/3                | 256          | 24                  | 1  | 864                                | 432                         | M2          |
|           | 1.4 - 20 | 4             | 12                             | QPSK  | 1/3                | 392          | 24                  | 1  | 1152                               | 576                         | M2          |
|           | 1.4 - 20 | 5             | 12                             | QPSK  | 1/3                | 424          | 24                  | 1  | 1440                               | 720                         | M2          |
|           | 3-20     | 6             | 12                             | QPSK  | 1/3                | 600          | 24                  | 1  | 1728                               | 864                         | M2          |
|           | 3-20     | 9             | 12                             | QPSK  | 1/3                | 776          | 24                  | 1  | 2592                               | 1296                        | M2          |
|           | 3-20     | 12            | 12                             | QPSK  | 1/3                | 1032         | 24                  | 1  | 3456                               | 1728                        | M2          |
|           | 5-20     | 15            | 12                             | QPSK  | 1/3                | 1320         | 24                  | 1  | 4320                               | 2160                        | M2          |
|           | 5-20     | 18            | 12                             | QPSK  | 1/3                | 1864         | 24                  | 1  | 5184                               | 2592                        | M2          |
|           | 5-20     | 21            | 12                             | QPSK  | 1/3                | 2216         | 24                  | 1  | 6068                               | 3024                        | M2          |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled.

**A.2.2.2.2 16-QAM**

**Table A.2.2.2.2-1 Reference Channels for 16-QAM with partial RB allocation**

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |             |
|           | 1.4 - 20 | 1             | 12                             | 16QAM | 3/4                | 408          | 24                  | 1  | 576                                | 144                         | ≥ 1         |
|           | 1.4 - 20 | 2             | 12                             | 16QAM | 3/4                | 840          | 24                  | 1  | 1152                               | 288                         | ≥ 1         |
|           | 1.4 - 20 | 3             | 12                             | 16QAM | 3/4                | 1288         | 24                  | 1  | 1728                               | 432                         | ≥ 1         |
|           | 1.4 - 20 | 4             | 12                             | 16QAM | 3/4                | 1736         | 24                  | 1  | 2304                               | 576                         | ≥ 1         |
|           | 1.4 - 20 | 5             | 12                             | 16QAM | 3/4                | 2152         | 24                  | 1  | 2880                               | 720                         | ≥ 1         |
|           | 3-20     | 6             | 12                             | 16QAM | 3/4                | 2600         | 24                  | 1  | 3456                               | 864                         | ≥ 1         |
|           | 3-20     | 8             | 12                             | 16QAM | 3/4                | 3496         | 24                  | 1  | 4608                               | 1152                        | ≥ 1         |
|           | 3-20     | 9             | 12                             | 16QAM | 3/4                | 3880         | 24                  | 1  | 5184                               | 1296                        | ≥ 1         |
|           | 3-20     | 10            | 12                             | 16QAM | 3/4                | 4264         | 24                  | 1  | 5760                               | 1440                        | ≥ 1         |
|           | 3-20     | 12            | 12                             | 16QAM | 3/4                | 5160         | 24                  | 1  | 6912                               | 1728                        | ≥ 1         |
|           | 5-20     | 15            | 12                             | 16QAM | 1/2                | 4264         | 24                  | 1  | 8640                               | 2160                        | ≥ 1         |
|           | 5-20     | 16            | 12                             | 16QAM | 1/2                | 4584         | 24                  | 1  | 9216                               | 2304                        | ≥ 1         |
|           | 5-20     | 18            | 12                             | 16QAM | 1/2                | 5160         | 24                  | 1  | 10368                              | 2592                        | ≥ 1         |
|           | 5-20     | 20            | 12                             | 16QAM | 1/3                | 4008         | 24                  | 1  | 11520                              | 2880                        | ≥ 1         |
|           | 5-20     | 24            | 12                             | 16QAM | 1/3                | 4776         | 24                  | 1  | 13824                              | 3456                        | ≥ 1         |
|           | 10-20    | 25            | 12                             | 16QAM | 1/3                | 4968         | 24                  | 1  | 14400                              | 3600                        | ≥ 1         |
|           | 10-20    | 27            | 12                             | 16QAM | 1/3                | 4776         | 24                  | 1  | 15552                              | 3888                        | ≥ 1         |

|  |         |    |    |       |     |       |    |   |       |       |     |
|--|---------|----|----|-------|-----|-------|----|---|-------|-------|-----|
|  | 10-20   | 30 | 12 | 16QAM | 3/4 | 12960 | 24 | 3 | 17280 | 4320  | ≥ 2 |
|  | 10-20   | 32 | 12 | 16QAM | 3/4 | 13536 | 24 | 3 | 18432 | 4608  | ≥ 2 |
|  | 10-20   | 36 | 12 | 16QAM | 3/4 | 15264 | 24 | 3 | 20736 | 5184  | ≥ 2 |
|  | 10-20   | 40 | 12 | 16QAM | 3/4 | 16992 | 24 | 3 | 23040 | 5760  | ≥ 2 |
|  | 10-20   | 45 | 12 | 16QAM | 3/4 | 19080 | 24 | 4 | 25920 | 6480  | ≥ 2 |
|  | 10-20   | 48 | 12 | 16QAM | 3/4 | 20616 | 24 | 4 | 27648 | 6912  | ≥ 2 |
|  | 15 - 20 | 50 | 12 | 16QAM | 3/4 | 21384 | 24 | 4 | 28800 | 7200  | ≥ 2 |
|  | 15 - 20 | 54 | 12 | 16QAM | 3/4 | 22920 | 24 | 4 | 31104 | 7776  | ≥ 2 |
|  | 15 - 20 | 60 | 12 | 16QAM | 2/3 | 23688 | 24 | 4 | 34560 | 8640  | ≥ 2 |
|  | 15 - 20 | 64 | 12 | 16QAM | 2/3 | 25456 | 24 | 4 | 36864 | 9216  | ≥ 2 |
|  | 15 - 20 | 72 | 12 | 16QAM | 1/2 | 20616 | 24 | 4 | 41472 | 10368 | ≥ 2 |
|  | 20      | 75 | 12 | 16QAM | 1/2 | 21384 | 24 | 4 | 43200 | 10800 | ≥ 2 |
|  | 20      | 80 | 12 | 16QAM | 1/2 | 22920 | 24 | 4 | 46080 | 11520 | ≥ 2 |
|  | 20      | 81 | 12 | 16QAM | 1/2 | 22920 | 24 | 4 | 46656 | 11664 | ≥ 2 |
|  | 20      | 90 | 12 | 16QAM | 2/5 | 20616 | 24 | 4 | 51840 | 12960 | ≥ 2 |
|  | 20      | 96 | 12 | 16QAM | 2/5 | 22152 | 24 | 4 | 55296 | 13824 | ≥ 2 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

**Table A.2.2.2-1a Reference Channels for 16-QAM with partial RB allocation for UE UL category 0**

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbol s per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbol s per Sub-Frame | UE UL Category |
|-----------|----------|---------------|---------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|------------------------------|----------------|
| Unit      | MHz      |               |                                 |       |                    | Bits         | Bits                |  | Bits                               |                              |                |
|           | 1.4 - 20 | 1             | 12                              | 16QAM | 3/4                | 408          | 24                  | 1  | 576                                | 144                          | 0              |
|           | 1.4 - 20 | 2             | 12                              | 16QAM | 3/4                | 840          | 24                  | 1  | 1152                               | 288                          | 0              |
|           | 1.4 - 20 | 4             | 12                              | 16QAM | 2/5                | 904          | 24                  | 1  | 2304                               | 576                          | 0              |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled.

**Table A.2.2.2-1b Reference Channels for 16-QAM with partial RB allocation for UE UL category M1**

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbol s per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbol s per Sub-Frame | UE Category |
|-----------|----------|---------------|---------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|------------------------------|-------------|
| Unit      | MHz      |               |                                 |       |                    | Bits         | Bits                |  | Bits                               |                              |             |
|           | 1.4 - 20 | 1             | 12                              | 16QAM | 1/2                | 256          | 24                  | 1  | 576                                | 144                          | M1          |
|           | 1.4 - 20 | 2             | 12                              | 16QAM | 1/2                | 552          | 24                  | 1  | 1152                               | 288                          | M1          |
|           | 1.4 - 20 | 3             | 12                              | 16QAM | 1/2                | 840          | 24                  | 1  | 1728                               | 432                          | M1          |
|           | 1.4 - 20 | 4             | 12                              | 16QAM | 2/5                | 904          | 24                  | 1  | 2304                               | 576                          | M1          |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled.

**Table A.2.2.2-1c Reference Channels for 16-QAM with partial RB allocation for UE UL category M2**

| Parameter | Ch BW | Allocated RBs | DFT-OFDM Symbol s per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame | Total number of bits per Sub-Frame | Total symbol s per Sub-Frame | UE Category |
|-----------|-------|---------------|---------------------------------|-------|--------------------|--------------|---------------------|-------------------------------------|------------------------------------|------------------------------|-------------|
|-----------|-------|---------------|---------------------------------|-------|--------------------|--------------|---------------------|-------------------------------------|------------------------------------|------------------------------|-------------|

| Unit | MHz      |    |    |       |     | Bits | Bits | (Note 1) | Bits  |      |    |
|------|----------|----|----|-------|-----|------|------|----------|-------|------|----|
|      | 1.4 - 20 | 1  | 12 | 16QAM | 1/2 | 256  | 24   | 1        | 576   | 144  | M2 |
|      | 1.4 - 20 | 2  | 12 | 16QAM | 1/2 | 552  | 24   | 1        | 1152  | 288  | M2 |
|      | 1.4 - 20 | 3  | 12 | 16QAM | 1/2 | 840  | 24   | 1        | 1728  | 432  | M2 |
|      | 1.4 - 20 | 4  | 12 | 16QAM | 1/2 | 1128 | 24   | 1        | 2304  | 576  | M2 |
|      | 1.4 - 20 | 5  | 12 | 16QAM | 1/2 | 1416 | 24   | 1        | 2880  | 720  | M2 |
|      | 3 - 20   | 6  | 12 | 16QAM | 1/2 | 1736 | 24   | 1        | 3456  | 864  | M2 |
|      | 3 - 20   | 9  | 12 | 16QAM | 1/2 | 2600 | 24   | 1        | 5184  | 1296 | M2 |
|      | 3 - 20   | 12 | 12 | 16QAM | 1/2 | 3496 | 24   | 1        | 6912  | 1728 | M2 |
|      | 5 - 20   | 15 | 12 | 16QAM | 1/2 | 4264 | 24   | 1        | 8640  | 2160 | M2 |
|      | 5 - 20   | 18 | 12 | 16QAM | 1/2 | 5160 | 24   | 1        | 10368 | 2592 | M2 |
|      | 5 - 20   | 21 | 12 | 16QAM | 1/2 | 5992 | 24   | 1        | 12096 | 3024 | M2 |
|      | 5 - 20   | 24 | 12 | 16QAM | 1/2 | 6968 | 24   | 2        | 13824 | 3456 | M2 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD, the uplink subframes are scheduled at the 5th, 6th, and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled.

A.2.2.2.3 64-QAM

Table A.2.2.2.3-1: Reference Channels for 64-QAM with partial RB allocation

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category (Note 2) | UE UL Category (Note 2) |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------------|-------------------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |                      |                         |
|           | 1.4 - 20 | 1             | 12                             | 64QAM | 3/4                | 616          | 24                  | 1  | 864                                | 144                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 2             | 12                             | 64QAM | 3/4                | 1256         | 24                  | 1  | 1728                               | 288                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 3             | 12                             | 64QAM | 3/4                | 1864         | 24                  | 1  | 2592                               | 432                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 4             | 12                             | 64QAM | 3/4                | 2536         | 24                  | 1  | 3456                               | 576                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 5             | 12                             | 64QAM | 3/4                | 3112         | 24                  | 1  | 4320                               | 720                         | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 6             | 12                             | 64QAM | 3/4                | 3752         | 24                  | 1  | 5184                               | 864                         | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 8             | 12                             | 64QAM | 3/4                | 5160         | 24                  | 1  | 6912                               | 1152                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 9             | 12                             | 64QAM | 3/4                | 5736         | 24                  | 1  | 7776                               | 1296                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 10            | 12                             | 64QAM | 3/4                | 6200         | 24                  | 2  | 8640                               | 1440                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 12            | 12                             | 64QAM | 3/4                | 7480         | 24                  | 2  | 10368                              | 1728                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 15            | 12                             | 64QAM | 3/4                | 9528         | 24                  | 2  | 12960                              | 2160                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 16            | 12                             | 64QAM | 3/4                | 10296        | 24                  | 2  | 13824                              | 2304                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 18            | 12                             | 64QAM | 3/4                | 11448        | 24                  | 2  | 15552                              | 2592                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 20            | 12                             | 64QAM | 3/4                | 12576        | 24                  | 3  | 17280                              | 2880                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 24            | 12                             | 64QAM | 3/4                | 15264        | 24                  | 3  | 20736                              | 3456                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 25            | 12                             | 64QAM | 3/4                | 15840        | 24                  | 3  | 21600                              | 3600                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 27            | 12                             | 64QAM | 3/4                | 16992        | 24                  | 3  | 23328                              | 3888                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 30            | 12                             | 64QAM | 3/4                | 19080        | 24                  | 4  | 25920                              | 4320                        | 5,8                  | 5, 8, 13, 14            |

|         |   |    |    |       |     |       |    |    |       |       |     |              |
|---------|---|----|----|-------|-----|-------|----|----|-------|-------|-----|--------------|
|         | 10-20   | 32 | 12 | 64QAM | 3/4 | 20616 | 24 | 4  | 27648 | 4608  | 5,8 | 5, 8, 13, 14 |
|         | 10-20   | 36 | 12 | 64QAM | 3/4 | 22920 | 24 | 4  | 31104 | 5184  | 5,8 | 5, 8, 13, 14 |
|         | 10-20   | 40 | 12 | 64QAM | 3/4 | 25456 | 24 | 5  | 34560 | 5760  | 5,8 | 5, 8, 13, 14 |
|         | 10-20   | 45 | 12 | 64QAM | 3/4 | 28336 | 24 | 5  | 38880 | 6480  | 5,8 | 5, 8, 13, 14 |
|         | 10-20   | 48 | 12 | 64QAM | 3/4 | 30576 | 24 | 5  | 41472 | 6912  | 5,8 | 5, 8, 13, 14 |
|         | 15 - 20   | 50 | 12 | 64QAM | 3/4 | 31704 | 24 | 6  | 43200 | 7200  | 5,8 | 5, 8, 13, 14 |
|         | 15 - 20   | 54 | 12 | 64QAM | 3/4 | 34008 | 24 | 6  | 46656 | 7776  | 5,8 | 5, 8, 13, 14 |
|         | 15 - 20   | 60 | 12 | 64QAM | 3/4 | 37888 | 24 | 7  | 51840 | 8640  | 5,8 | 5, 8, 13, 14 |
|         | 15 - 20   | 64 | 12 | 64QAM | 3/4 | 40576 | 24 | 7  | 55296 | 9216  | 5,8 | 5, 8, 13, 14 |
|         | 15 - 20   | 72 | 12 | 64QAM | 3/4 | 45352 | 24 | 8  | 62208 | 10368 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 75 | 12 | 64QAM | 3/4 | 46888 | 24 | 8  | 64800 | 10800 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 80 | 12 | 64QAM | 3/4 | 51024 | 24 | 9  | 69120 | 11520 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 81 | 12 | 64QAM | 3/4 | 51024 | 24 | 9  | 69984 | 11664 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 90 | 12 | 64QAM | 2/3 | 51024 | 24 | 9  | 77760 | 12960 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 96 | 12 | 64QAM | 3/4 | 61664 | 24 | 11 | 82944 | 13824 | 5,8 | 5, 8, 13, 14 |
| Note 1: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  |    |    |       |     |       |    |    |       |       |     |              |
| Note2:  | If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category |    |    |       |     |       |    |    |       |       |     |              |

A.2.2.2.4 256 QAM

Table A.2.2.2.4-1: Reference Channels for 256 QAM with partial RB allocation

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n  | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE UL Category |
|-----------|----------|---------------|--------------------------------|--------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------|
| Unit      | MHz      |               |                                |        |                    | Bits         | Bits                |  | Bits                               |                             |                |
|           | 1.4 - 20 | 1             | 12                             | 256QAM | 3/4                | 840          | 24                  | 1  | 1152                               | 144                         | ≥ 15           |
|           | 1.4 - 20 | 2             | 12                             | 256QAM | 3/4                | 1672         | 24                  | 1  | 2304                               | 288                         | ≥ 15           |
|           | 1.4 - 20 | 3             | 12                             | 256QAM | 3/4                | 2536         | 24                  | 1  | 3456                               | 432                         | ≥ 15           |
|           | 1.4 - 20 | 4             | 12                             | 256QAM | 3/4                | 3368         | 24                  | 1  | 4608                               | 576                         | ≥ 15           |
|           | 1.4 - 20 | 5             | 12                             | 256QAM | 3/4                | 4264         | 24                  | 1  | 5760                               | 720                         | ≥ 15           |
|           | 3-20     | 6             | 12                             | 256QAM | 3/4                | 5160         | 24                  | 1  | 6912                               | 864                         | ≥ 15           |
|           | 3-20     | 8             | 12                             | 256QAM | 3/4                | 6712         | 24                  | 2  | 9216                               | 1152                        | ≥ 15           |
|           | 3-20     | 9             | 12                             | 256QAM | 3/4                | 7736         | 24                  | 2  | 10368                              | 1296                        | ≥ 15           |
|           | 3-20     | 10            | 12                             | 256QAM | 3/4                | 8504         | 24                  | 2  | 11520                              | 1440                        | ≥ 15           |
|           | 3-20     | 12            | 12                             | 256QAM | 3/4                | 10296        | 24                  | 2  | 13824                              | 1728                        | ≥ 15           |
|           | 5-20     | 15            | 12                             | 256QAM | 3/4                | 12960        | 24                  | 3  | 17280                              | 2160                        | ≥ 15           |
|           | 5-20     | 16            | 12                             | 256QAM | 3/4                | 13536        | 24                  | 3  | 18432                              | 2304                        | ≥ 15           |
|           | 5-20     | 18            | 12                             | 256QAM | 3/4                | 15264        | 24                  | 3  | 20736                              | 2592                        | ≥ 15           |
|           | 5-20     | 20            | 12                             | 256QAM | 3/4                | 16992        | 24                  | 3  | 23040                              | 2880                        | ≥ 15           |
|           | 5-20     | 24            | 12                             | 256QAM | 3/4                | 20616        | 24                  | 4  | 27648                              | 3456                        | ≥ 15           |
|           | 10-20    | 25            | 12                             | 256QAM | 3/4                | 21384        | 24                  | 4  | 28800                              | 3600                        | ≥ 15           |
|           | 10-20    | 27            | 12                             | 256QAM | 3/4                | 22920        | 24                  | 4  | 31104                              | 3888                        | ≥ 15           |
|           | 10-20    | 30            | 12                             | 256QAM | 3/4                | 25456        | 24                  | 5  | 34560                              | 4320                        | ≥ 15           |
|           | 10-20    | 32            | 12                             | 256QAM | 3/4                | 27376        | 24                  | 5  | 36864                              | 4608                        | ≥ 15           |
|           | 10-20    | 36            | 12                             | 256QAM | 3/4                | 30576        | 24                  | 6  | 41472                              | 5184                        | ≥ 15           |
|           | 10-20    | 40            | 12                             | 256QAM | 3/4                | 34008        | 24                  | 6  | 46080                              | 5760                        | ≥ 15           |

|  |         |    |    |        |     |       |    |    |        |       |      |
|--|---------|----|----|--------|-----|-------|----|----|--------|-------|------|
|  | 10-20   | 45 | 12 | 256QAM | 3/4 | 37888 | 24 | 7  | 51840  | 6480  | ≥ 15 |
|  | 10-20   | 48 | 12 | 256QAM | 3/4 | 40576 | 24 | 8  | 55296  | 6912  | ≥ 15 |
|  | 15 - 20 | 50 | 12 | 256QAM | 3/4 | 42368 | 24 | 8  | 57600  | 7200  | ≥ 15 |
|  | 15 - 20 | 54 | 12 | 256QAM | 3/4 | 46888 | 24 | 8  | 62208  | 7776  | ≥ 15 |
|  | 15 - 20 | 60 | 12 | 256QAM | 3/4 | 51024 | 24 | 9  | 69120  | 8640  | ≥ 15 |
|  | 15 - 20 | 64 | 12 | 256QAM | 3/4 | 55056 | 24 | 9  | 73728  | 9216  | ≥ 15 |
|  | 15 - 20 | 72 | 12 | 256QAM | 3/4 | 61664 | 24 | 11 | 82944  | 10368 | ≥ 15 |
|  | 20      | 75 | 12 | 256QAM | 3/4 | 63776 | 24 | 11 | 86400  | 10800 | ≥ 15 |
|  | 20      | 80 | 12 | 256QAM | 3/4 | 68808 | 24 | 12 | 92160  | 11520 | ≥ 15 |
|  | 20      | 81 | 12 | 256QAM | 3/4 | 68808 | 24 | 12 | 93312  | 11664 | ≥ 15 |
|  | 20      | 90 | 12 | 256QAM | 3/4 | 76208 | 24 | 13 | 103680 | 12960 | ≥ 15 |
|  | 20      | 96 | 12 | 256QAM | 3/4 | 81176 | 24 | 14 | 110592 | 13824 | ≥ 15 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

### A.2.2.3 Void

Table A.2.2.3-1: Void

### A.2.2.4 subPRB allocation

The location of allocated RB for subPRB allocation is chosen according to values specified in the Tx requirements.

Table A.2.2.4-1: Reference Channels for SubPRB allocation

| Parameter                              | Unit | Value        |          |          |
|--|------|--------------|----------|----------|
|  |      | 1.4 – 20     | 1.4 – 20 | 1.4 – 20 |
| Channel bandwidth                      | MHz  | 1.4 – 20     | 1.4 – 20 | 1.4 – 20 |
| Allocated resource blocks              |      | 1            | 1        | 1        |
| Number of subcarriers                  |      | 2 out of 3   | 3        | 6        |
| DFT-OFDM Symbols per Sub-Frame         |      | 12           | 12       | 12       |
| Modulation                             |      | $\pi/2$ BPSK | QPSK     | QPSK     |
| Target Coding rate                     |      | 1/3          | 1/3      | 1/3      |
| Payload size                           | Bits | 32           | 72       | 72       |
| Transport block CRC                    | Bits | 24           | 24       | 24       |
| Number of code blocks                  |      | 1            | 1        | 1        |
| Total number of bits per resource unit | Bits | 192          | 288      | 288      |
| Total symbols per resource unit        |      | 192          | 144      | 144      |
| Tx time                                | ms   | 8            | 4        | 2        |
| UE UL Category                         |      | M1/M2        | M1/M2    | M1/M2    |

NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

## A.2.3 Reference measurement channels for TDD

For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL:2UL, or 1DL:4UL. 2DL:2UL is the default and used unless explicitly specified in the test case

### A.2.3.1 Full RB allocation

#### A.2.3.1.1 QPSK

Table A.2.3.1.1-1: Reference Channels for QPSK with full RB allocation

| Parameter                              | Unit | Value |    |    |    |    |     |
|--|------|-------|----|----|----|----|-----|
|  |      | 1.4   | 3  | 5  | 10 | 15 | 20  |
| Channel bandwidth                      | MHz  | 1.4   | 3  | 5  | 10 | 15 | 20  |
| Allocated resource blocks              |      | 6     | 15 | 25 | 50 | 75 | 100 |
| Uplink-Downlink Configuration (Note 2) |      | 1     | 1  | 1  | 1  | 1  | 1   |

|  |      |      |      |      |       |       |       |
|--|------|------|------|------|-------|-------|-------|
| DFT-OFDM Symbols per Sub-Frame   |      | 12   | 12   | 12   | 12    | 12    | 12    |
| Modulation   |      | QPSK | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3  | 1/3  | 1/3  | 1/3   | 1/5   | 1/6   |
| Payload size   |      |      |      |      |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 600  | 1544 | 2216 | 5160  | 4392  | 4584  |
| Transport block CRC  | Bits | 24   | 24   | 24   | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |      |      |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1    | 1    | 1    | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |      |      |      |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 1728 | 4320 | 7200 | 14400 | 21600 | 28800 |
| Total symbols per Sub-Frame  |      |      |      |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 864  | 2160 | 3600 | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1  | ≥ 1  | ≥ 1  | ≥ 1   | ≥ 1   | ≥ 1   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |      |      |      |       |       |       |
| Note 2: As per Table 4.2-2 in TS 36.211 [4]  |      |      |      |      |       |       |       |

**Table A.2.3.1.1-1A: Reference Channels for QPSK with full RB allocation, UL-DL configuration 0**

| Parameter  | Unit | Value |      |      |       |       |       |
|--|------|-------|------|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 15   | 25   | 50    | 75    | 100   |
| Uplink-Downlink Configuration (Note 2)   |      | 0     | 0    | 0    | 0     | 0     | 0     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12   | 12   | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3  | 1/3  | 1/3   | 1/5   | 1/6   |
| Payload size   |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  | Bits | 600   | 1544 | 2216 | 5160  | 4392  | 4584  |
| Transport block CRC  | Bits | 24    | 24   | 24   | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1    | 1    | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  | Bits | 1728  | 4320 | 7200 | 14400 | 21600 | 28800 |
| Total symbols per Sub-Frame  |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  |      | 864   | 2160 | 3600 | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1   | ≥ 1  | ≥ 1  | ≥ 1   | ≥ 1   | ≥ 1   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |      |      |       |       |       |
| Note 2: As per Table 4.2-2 in TS 36.211 [4]  |      |       |      |      |       |       |       |

**Table A.2.3.1.1-1a: Reference Channels for QPSK with full/maximum RB allocation for UE UL category 0**

| Parameter                                    | Unit | Value |      |      |       |       |       |
|--|------|-------|------|------|-------|-------|-------|
| Channel bandwidth                            | MHz  | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Allocated resource blocks                    |      | 6     | 15   | 25   | 36    | 36    | 36    |
| Uplink-Downlink Configuration (Note 2)       |      | 1     | 1    | 1    | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame               |      | 12    | 12   | 12   | 12    | 12    | 12    |
| Modulation                                   |      | QPSK  | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding rate                           |      | 1/3   | 1/5  | 1/8  | 1/10  | 1/10  | 1/10  |
| Payload size                                 |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,7,8                        | Bits | 600   | 872  | 904  | 1000  | 1000  | 1000  |
| Transport block CRC                          | Bits | 24    | 24   | 24   | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1) |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,7,8                        |      | 1     | 1    | 1    | 1     | 1     | 1     |
| Total number of bits per Sub-Frame           |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,7,8                        | Bits | 1728  | 4320 | 7200 | 10368 | 10368 | 10368 |
| Total symbols per Sub-Frame                  |      |       |      |      |       |       |       |
| For Sub-Frame 2,3,7,8                        |      | 864   | 2160 | 3600 | 5184  | 5184  | 5184  |

|  |  |   |   |   |   |   |   |
|--|--|---|---|---|---|---|---|
| UE UL Category   |  | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |  |   |   |   |   |   |   |
| NOTE 2: As per Table 4.2-2 in TS 36.211  |  |   |   |   |   |   |   |

**Table A.2.3.1.1-1b: Reference Channels for QPSK with full/maximum RB allocation for UE UL category M1**

| Parameter  | Unit | Value |      |      |      |      |      |
|--|------|-------|------|------|------|------|------|
| Channel bandwidth  | MHz  | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks  |      | 6     | 6    | 6    | 6    | 6    | 6    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1    | 1    | 1    | 1    | 1    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12   | 12   | 12   | 12   | 12   |
| Modulation   |      | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate   |      | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Payload size   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  | Bits | 600   | 600  | 600  | 600  | 600  | 600  |
| Transport block CRC  | Bits | 24    | 24   | 24   | 24   | 24   | 24   |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  |      | 1     | 1    | 1    | 1    | 1    | 1    |
| Total number of bits per Sub-Frame   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  | Bits | 1728  | 1728 | 1728 | 1728 | 1728 | 1728 |
| Total symbols per Sub-Frame  |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  |      | 864   | 864  | 864  | 864  | 864  | 864  |
| UE UL Category   |      | M1    | M1   | M1   | M1   | M1   | M1   |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |      |      |      |      |      |
| NOTE 2: As per Table 4.2-2 in TS 36.211  |      |       |      |      |      |      |      |

**Table A.2.3.1.1-1c: Reference Channels for QPSK with full/maximum RB allocation for UE UL category M2**

| Parameter  | Unit | Value |      |      |      |      |      |
|--|------|-------|------|------|------|------|------|
| Channel bandwidth  | MHz  | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks  |      | 6     | 12   | 24   | 24   | 24   | 24   |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1    | 1    | 1    | 1    | 1    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12   | 12   | 12   | 12   | 12   |
| Modulation   |      | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate   |      | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Payload size   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  | Bits | 600   | 1224 | 2472 | 2472 | 2472 | 2472 |
| Transport block CRC  | Bits | 24    | 24   | 24   | 24   | 24   | 24   |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  |      | 1     | 1    | 1    | 1    | 1    | 1    |
| Total number of bits per Sub-Frame   |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  | Bits | 1728  | 3456 | 6912 | 6912 | 6912 | 6912 |
| Total symbols per Sub-Frame  |      |       |      |      |      |      |      |
| For Sub-Frame 2,3,7,8  |      | 864   | 1728 | 3456 | 3456 | 3456 | 3456 |
| UE UL Category   |      | M2    | M2   | M2   | M2   | M2   | M2   |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |      |      |      |      |      |
| NOTE 2: As per Table 4.2-2 in TS 36.211  |      |       |      |      |      |      |      |

A.2.3.1.2 16-QAM

**Table A.2.3.1.2-1: Reference Channels for 16-QAM with full RB allocation**

| Parameter                 | Unit | Value |    |    |    |    |     |
|---------------------------|------|-------|----|----|----|----|-----|
| Channel bandwidth         | MHz  | 1.4   | 3  | 5  | 10 | 15 | 20  |
| Allocated resource blocks |      | 6     | 15 | 25 | 50 | 75 | 100 |



|  |      |       |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   | 1/3   | 3/4   | 1/2   | 1/3   |
| Payload size   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 2600  | 4264  | 4968  | 21384 | 21384 | 19848 |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     | 4     | 4     | 4     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 3456  | 8640  | 14400 | 28800 | 43200 | 57600 |
| Total symbols per Sub-Frame  |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 864   | 2160  | 3600  | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 2   | ≥ 2   | ≥ 2   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |       |       |       |       |       |
| Note 2: As per Table 4.2-2 in TS 36.211 [4]  |      |       |       |       |       |       |       |

**Table A.2.3.1.2-1A: Reference Channels for 16-QAM with full RB allocation, UL-DL configuration 0**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
|  |      | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 15    | 25    | 50    | 75    | 100   |
| Uplink-Downlink Configuration (Note 2)   |      | 0     | 0     | 0     | 0     | 0     | 0     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   | 1/3   | 3/4   | 1/2   | 1/3   |
| Payload size   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  | Bits | 2600  | 4264  | 4968  | 21384 | 21384 | 19848 |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks - C  |      | 1     | 1     | 1     | 4     | 4     | 4     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  | Bits | 3456  | 8640  | 14400 | 28800 | 43200 | 57600 |
| Total symbols per Sub-Frame  |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,4,7,8,9  |      | 864   | 2160  | 3600  | 7200  | 10800 | 14400 |
| UE Category  |      | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 2   | ≥ 2   | ≥ 2   |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |       |       |       |       |       |
| Note 2: As per Table 4.2-2 in TS 36.211 [4]  |      |       |       |       |       |       |       |

**Table A.2.3.1.2-1a: Reference Channels for 16-QAM with maximum RB allocation for UE UL category 0**

| Parameter                                    | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
|  |      | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth                            | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks                    |      | 5     | 5     | 5     | 5     | 5     | 5     |
| Uplink-Downlink Configuration (Note 2)       |      | 1     | 1     | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame               |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation                                   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate                           |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size                                 |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8                        | Bits | 872   | 872   | 872   | 872   | 872   | 872   |
| Transport block CRC                          | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1) |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8                        |      | 1     | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame           |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8                        | Bits | 2880  | 2880  | 2880  | 2880  | 2880  | 2880  |
| Total symbols per Sub-Frame                  |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8                        |      | 720   | 720   | 720   | 720   | 720   | 720   |

|  |  |   |   |   |   |   |   |
|--|--|---|---|---|---|---|---|
| UE UL Category   |  | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |  |   |   |   |   |   |   |
| NOTE 2: As per Table 4.2-2 in TS 36.211[4]   |  |   |   |   |   |   |   |

**Table A.2.3.1.2-1b: Reference Channels for 16-QAM with maximum RB allocation for UE UL category M1**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 5     | 5     | 5     | 5     | 5     | 5     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 872   | 872   | 872   | 872   | 872   | 872   |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 2880  | 2880  | 2880  | 2880  | 2880  | 2880  |
| Total symbols per Sub-Frame  |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 720   | 720   | 720   | 720   | 720   | 720   |
| UE Category  |      | M1    | M1    | M1    | M1    | M1    | M1    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |       |       |       |       |       |
| NOTE 2: As per Table 4.2-2 in TS 36.211[4]   |      |       |       |       |       |       |       |

**Table A.2.3.1.2-1c: Reference Channels for 16-QAM with maximum RB allocation for UE UL category M2**

| Parameter  | Unit | Value |       |       |       |       |       |
|--|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks  |      | 6     | 12    | 24    | 24    | 24    | 24    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 1032  | 2088  | 4264  | 4264  | 4264  | 4264  |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 3456  | 6912  | 13824 | 13824 | 13824 | 13824 |
| Total symbols per Sub-Frame  |      |       |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 864   | 1728  | 3456  | 3456  | 3456  | 3456  |
| UE Category  |      | M2    | M2    | M2    | M2    | M2    | M2    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |       |       |       |       |       |       |
| NOTE 2: As per Table 4.2-2 in TS 36.211[4]   |      |       |       |       |       |       |       |

A.2.3.1.3 64-QAM

**Table A.2.3.1.3-1: Reference Channels for 64-QAM with full RB allocation**

| Parameter                 | Unit | Value |    |    |    |    |     |
|---------------------------|------|-------|----|----|----|----|-----|
| Channel bandwidth         | MHz  | 1.4   | 3  | 5  | 10 | 15 | 20  |
| Allocated resource blocks |      | 6     | 15 | 25 | 50 | 75 | 100 |

|  |  |                 |                 |                 |                 |                 |                 |
|--|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Uplink-Downlink Configuration (Note 2)       |  | 1               | 1               | 1               | 1               | 1               | 1               |
| DFT-OFDM Symbols per Sub-Frame               |  | 12              | 12              | 12              | 12              | 12              | 12              |
| Modulation                                   |  | 64QAM           | 64QAM           | 64QAM           | 64QAM           | 64QAM           | 64QAM           |
| Target Coding rate                           |  | 3/4             | 3/4             | 3/4             | 3/4             | 3/4             | 3/4             |
| Payload size                                 |  |                 |                 |                 |                 |                 |                 |
| For Sub-Frame 2,3,7,8                        | Bits   | 3752            | 9528            | 15840           | 31704           | 46888           | 63776           |
| Transport block CRC                          | Bits   | 24              | 24              | 24              | 24              | 24              | 24              |
| Number of code blocks per Sub-Frame (Note 1) |  |                 |                 |                 |                 |                 |                 |
| For Sub-Frame 2,3,7,8                        |  | 1               | 2               | 3               | 6               | 8               | 11              |
| Total number of bits per Sub-Frame           |  |                 |                 |                 |                 |                 |                 |
| For Sub-Frame 2,3,7,8                        | Bits   | 5184            | 12960           | 21600           | 43200           | 64800           | 86400           |
| Total symbols per Sub-Frame                  |  |                 |                 |                 |                 |                 |                 |
| For Sub-Frame 2,3,7,8                        |  | 864             | 2160            | 3600            | 7200            | 10800           | 14400           |
| UE Category (Note 3)                         |  | 5, 8            | 5, 8            | 5, 8            | 5, 8            | 5, 8            | 5, 8            |
| UE UL Category (Note 3)                      |  | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 | 5, 8,<br>13, 14 |
| Note 1:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |                 |                 |                 |                 |                 |                 |
| Note 2:                                      | As per Table 4.2-2 in TS 36.211 [4]  |                 |                 |                 |                 |                 |                 |
| Note 3:                                      | If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category. |                 |                 |                 |                 |                 |                 |

#### A.2.3.1.4 256 QAM

**Table A.2.3.1.4-1: Reference Channels for 256 QAM with full RB allocation**

| Parameter                                    | Unit   | Value  |        |        |        |        |        |
|--|--|--------|--------|--------|--------|--------|--------|
|  |  | 1.4    | 3      | 5      | 10     | 15     | 20     |
| Channel bandwidth                            | MHz  | 1.4    | 3      | 5      | 10     | 15     | 20     |
| Allocated resource blocks                    |  | 6      | 15     | 25     | 50     | 75     | 100    |
| Uplink-Downlink Configuration (Note 2)       |  | 1      | 1      | 1      | 1      | 1      | 1      |
| DFT-OFDM Symbols per Sub-Frame               |  | 12     | 12     | 12     | 12     | 12     | 12     |
| Modulation                                   |  | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding rate                           |  | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    |
| Payload size                                 |  |        |        |        |        |        |        |
| For Sub-Frame 2,3,7,8                        | Bits   | 5160   | 12960  | 21384  | 42368  | 63776  | 84760  |
| Transport block CRC                          | Bits   | 24     | 24     | 24     | 24     | 24     | 24     |
| Number of code blocks per Sub-Frame (Note 1) |  |        |        |        |        |        |        |
| For Sub-Frame 2,3,7,8                        |  | 1      | 3      | 4      | 8      | 11     | 15     |
| Total number of bits per Sub-Frame           |  |        |        |        |        |        |        |
| For Sub-Frame 2,3,7,8                        | Bits   | 6912   | 17280  | 28800  | 57600  | 86400  | 115200 |
| Total symbols per Sub-Frame                  |  |        |        |        |        |        |        |
| For Sub-Frame 2,3,7,8                        |  | 864    | 2160   | 3600   | 7200   | 10800  | 14400  |
| UE UL Category                               |  | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   | ≥ 15   |
| Note 1:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |        |        |        |        |        |        |
| Note 2:                                      | As per Table 4.2-2 in TS 36.211 [4]  |        |        |        |        |        |        |

#### A.2.3.2 Partial RB allocation

For each channel bandwidth, various partial RB allocations are specified. The number of allocated RBs is chosen according to values specified in the Tx and Rx requirements. The single allocated RB case is included.

The allocated RBs are contiguous and start from one end of the channel bandwidth. A single allocated RB is at one end of the channel bandwidth.

A.2.3.2.1 QPSK

Table A.2.3.2.1-1: Reference Channels for QPSK with partial RB allocation

| Parameter | Ch BW    | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|-----------|----------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|-------------|
| Unit      | MHz      |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |             |
|           | 1.4 - 20 | 1             | 1                          | 12                             | QPSK  | 1/3                | 72                                    | 24                  | 1  | 288   | 144  | ≥ 1         |
|           | 1.4 - 20 | 2             | 1                          | 12                             | QPSK  | 1/3                | 176                                   | 24                  | 1  | 576   | 288  | ≥ 1         |
|           | 1.4 - 20 | 3             | 1                          | 12                             | QPSK  | 1/3                | 256                                   | 24                  | 1  | 864   | 432  | ≥ 1         |
|           | 1.4 - 20 | 4             | 1                          | 12                             | QPSK  | 1/3                | 392                                   | 24                  | 1  | 1152  | 576  | ≥ 1         |
|           | 1.4 - 20 | 5             | 1                          | 12                             | QPSK  | 1/3                | 424                                   | 24                  | 1  | 1440  | 720  | ≥ 1         |
|           | 3-20     | 6             | 1                          | 12                             | QPSK  | 1/3                | 600                                   | 24                  | 1  | 1728  | 864  | ≥ 1         |
|           | 3-20     | 8             | 1                          | 12                             | QPSK  | 1/3                | 808                                   | 24                  | 1  | 2304  | 1152   | ≥ 1         |
|           | 3-20     | 9             | 1                          | 12                             | QPSK  | 1/3                | 776                                   | 24                  | 1  | 2592  | 1296   | ≥ 1         |
|           | 3-20     | 10            | 1                          | 12                             | QPSK  | 1/3                | 872                                   | 24                  | 1  | 2880  | 1440   | ≥ 1         |
|           | 3-20     | 12            | 1                          | 12                             | QPSK  | 1/3                | 1224                                  | 24                  | 1  | 3456  | 1728   | ≥ 1         |
|           | 5-20     | 15            | 1                          | 12                             | QPSK  | 1/3                | 1320                                  | 24                  | 1  | 4320  | 2160   | ≥ 1         |
|           | 5-20     | 16            | 1                          | 12                             | QPSK  | 1/3                | 1384                                  | 24                  | 1  | 4608  | 2304   | ≥ 1         |
|           | 5-20     | 18            | 1                          | 12                             | QPSK  | 1/3                | 1864                                  | 24                  | 1  | 5184  | 2592   | ≥ 1         |
|           | 5-20     | 20            | 1                          | 12                             | QPSK  | 1/3                | 1736                                  | 24                  | 1  | 5760  | 2880   | ≥ 1         |
|           | 5-20     | 24            | 1                          | 12                             | QPSK  | 1/3                | 2472                                  | 24                  | 1  | 6912  | 3456   | ≥ 1         |
|           | 10-20    | 25            | 1                          | 12                             | QPSK  | 1/3                | 2216                                  | 24                  | 1  | 7200  | 3600   | ≥ 1         |
|           | 10-20    | 27            | 1                          | 12                             | QPSK  | 1/3                | 2792                                  | 24                  | 1  | 7776  | 3888   | ≥ 1         |
|           | 10-20    | 30            | 1                          | 12                             | QPSK  | 1/3                | 2664                                  | 24                  | 1  | 8640  | 4320   | ≥ 1         |
|           | 10-20    | 32            | 1                          | 12                             | QPSK  | 1/3                | 2792                                  | 24                  | 1  | 9216  | 4608   | ≥ 1         |
|           | 10-20    | 36            | 1                          | 12                             | QPSK  | 1/3                | 3752                                  | 24                  | 1  | 10368   | 5184   | ≥ 1         |
|           | 10-20    | 40            | 1                          | 12                             | QPSK  | 1/3                | 4136                                  | 24                  | 1  | 11520   | 5760   | ≥ 1         |
|           | 10-20    | 45            | 1                          | 12                             | QPSK  | 1/3                | 4008                                  | 24                  | 1  | 12960   | 6480   | ≥ 1         |
|           | 10-20    | 48            | 1                          | 12                             | QPSK  | 1/3                | 4264                                  | 24                  | 1  | 13824   | 6912   | ≥ 1         |
|           | 15 - 20  | 50            | 1                          | 12                             | QPSK  | 1/3                | 5160                                  | 24                  | 1  | 14400   | 7200   | ≥ 1         |
|           | 15 - 20  | 54            | 1                          | 12                             | QPSK  | 1/3                | 4776                                  | 24                  | 1  | 15552   | 7776   | ≥ 1         |
|           | 15 - 20  | 60            | 1                          | 12                             | QPSK  | 1/4                | 4264                                  | 24                  | 1  | 17280   | 8640   | ≥ 1         |
|           | 15 - 20  | 64            | 1                          | 12                             | QPSK  | 1/4                | 4584                                  | 24                  | 1  | 18432   | 9216   | ≥ 1         |
|           | 15 - 20  | 72            | 1                          | 12                             | QPSK  | 1/4                | 5160                                  | 24                  | 1  | 20736   | 10368  | ≥ 1         |
|           | 20       | 75            | 1                          | 12                             | QPSK  | 1/5                | 4392                                  | 24                  | 1  | 21600   | 10800  | ≥ 1         |
|           | 20       | 80            | 1                          | 12                             | QPSK  | 1/5                | 4776                                  | 24                  | 1  | 23040   | 11520  | ≥ 1         |
|           | 20       | 81            | 1                          | 12                             | QPSK  | 1/5                | 4776                                  | 24                  | 1  | 23328   | 11664  | ≥ 1         |
|           | 20       | 90            | 1                          | 12                             | QPSK  | 1/6                | 4008                                  | 24                  | 1  | 25920   | 12960  | ≥ 1         |
|           | 20       | 96            | 1                          | 12                             | QPSK  | 1/6                | 4264                                  | 24                  | 1  | 27648   | 13824  | ≥ 1         |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: As per Table 4.2-2 in TS 36.211 [4]

Table A.2.3.2.1-1A: Reference Channels for QPSK with partial RB allocation, UL-DL configuration 0

| Parameter | Ch BW | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 4, 7, 8, 9 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 4, 7, 8, 9 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 4, 7, 8, 9 | UE Category |
|-----------|-------|---------------|----------------------------|--------------------------------|-------|--------------------|---|---------------------|--|---|--|-------------|
|-----------|-------|---------------|----------------------------|--------------------------------|-------|--------------------|---|---------------------|--|---|--|-------------|

| Unit | MHz    |    |   |    |      |     | Bits | Bits |   | 4, 7, 8, 9 |       |     |
|------|--------|----|---|----|------|-----|------|------|---|------------|-------|-----|
|      | 1.4-20 | 1  | 0 | 12 | QPSK | 1/3 | 72   | 24   | 1 | 288        | 144   | ≥ 1 |
|      | 1.4-20 | 2  | 0 | 12 | QPSK | 1/3 | 176  | 24   | 1 | 576        | 288   | ≥ 1 |
|      | 1.4-20 | 3  | 0 | 12 | QPSK | 1/3 | 256  | 24   | 1 | 864        | 432   | ≥ 1 |
|      | 1.4-20 | 4  | 0 | 12 | QPSK | 1/3 | 392  | 24   | 1 | 1152       | 576   | ≥ 1 |
|      | 1.4-20 | 5  | 0 | 12 | QPSK | 1/3 | 424  | 24   | 1 | 1440       | 720   | ≥ 1 |
|      | 3-20   | 6  | 0 | 12 | QPSK | 1/3 | 600  | 24   | 1 | 1728       | 864   | ≥ 1 |
|      | 3-20   | 8  | 0 | 12 | QPSK | 1/3 | 808  | 24   | 1 | 2304       | 1152  | ≥ 1 |
|      | 3-20   | 9  | 0 | 12 | QPSK | 1/3 | 776  | 24   | 1 | 2592       | 1296  | ≥ 1 |
|      | 3-20   | 10 | 0 | 12 | QPSK | 1/3 | 872  | 24   | 1 | 2880       | 1440  | ≥ 1 |
|      | 3-20   | 12 | 0 | 12 | QPSK | 1/3 | 1224 | 24   | 1 | 3456       | 1728  | ≥ 1 |
|      | 5-20   | 15 | 0 | 12 | QPSK | 1/3 | 1320 | 24   | 1 | 4320       | 2160  | ≥ 1 |
|      | 5-20   | 16 | 0 | 12 | QPSK | 1/3 | 1384 | 24   | 1 | 4608       | 2304  | ≥ 1 |
|      | 5-20   | 18 | 0 | 12 | QPSK | 1/3 | 1864 | 24   | 1 | 5184       | 2592  | ≥ 1 |
|      | 5-20   | 20 | 0 | 12 | QPSK | 1/3 | 1736 | 24   | 1 | 5760       | 2880  | ≥ 1 |
|      | 5-20   | 24 | 0 | 12 | QPSK | 1/3 | 2472 | 24   | 1 | 6912       | 3456  | ≥ 1 |
|      | 10-20  | 25 | 0 | 12 | QPSK | 1/3 | 2216 | 24   | 1 | 7200       | 3600  | ≥ 1 |
|      | 10-20  | 27 | 0 | 12 | QPSK | 1/3 | 2792 | 24   | 1 | 7776       | 3888  | ≥ 1 |
|      | 10-20  | 30 | 0 | 12 | QPSK | 1/3 | 2664 | 24   | 1 | 8640       | 4320  | ≥ 1 |
|      | 10-20  | 32 | 0 | 12 | QPSK | 1/3 | 2792 | 24   | 1 | 9216       | 4608  | ≥ 1 |
|      | 10-20  | 36 | 0 | 12 | QPSK | 1/3 | 3752 | 24   | 1 | 10368      | 5184  | ≥ 1 |
|      | 10-20  | 40 | 0 | 12 | QPSK | 1/3 | 4136 | 24   | 1 | 11520      | 5760  | ≥ 1 |
|      | 10-20  | 45 | 0 | 12 | QPSK | 1/3 | 4008 | 24   | 1 | 12960      | 6480  | ≥ 1 |
|      | 10-20  | 48 | 0 | 12 | QPSK | 1/3 | 4264 | 24   | 1 | 13824      | 6912  | ≥ 1 |
|      | 15-20  | 50 | 0 | 12 | QPSK | 1/3 | 5160 | 24   | 1 | 14400      | 7200  | ≥ 1 |
|      | 15-20  | 54 | 0 | 12 | QPSK | 1/3 | 4776 | 24   | 1 | 15552      | 7776  | ≥ 1 |
|      | 15-20  | 60 | 0 | 12 | QPSK | 1/4 | 4264 | 24   | 1 | 17280      | 8640  | ≥ 1 |
|      | 15-20  | 64 | 0 | 12 | QPSK | 1/4 | 4584 | 24   | 1 | 18432      | 9216  | ≥ 1 |
|      | 15-20  | 72 | 0 | 12 | QPSK | 1/4 | 5160 | 24   | 1 | 20736      | 10368 | ≥ 1 |
|      | 20     | 75 | 0 | 12 | QPSK | 1/5 | 4392 | 24   | 1 | 21600      | 10800 | ≥ 1 |
|      | 20     | 80 | 0 | 12 | QPSK | 1/5 | 4776 | 24   | 1 | 23040      | 11520 | ≥ 1 |
|      | 20     | 81 | 0 | 12 | QPSK | 1/5 | 4776 | 24   | 1 | 23328      | 11664 | ≥ 1 |
|      | 20     | 90 | 0 | 12 | QPSK | 1/6 | 4008 | 24   | 1 | 25920      | 12960 | ≥ 1 |
|      | 20     | 96 | 0 | 12 | QPSK | 1/6 | 4264 | 24   | 1 | 27648      | 13824 | ≥ 1 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: As per Table 4.2-2 in TS 36.211 [4]

Table A.2.3.2.1-1a: Reference Channels for QPSK with partial RB allocation for UE UL category 0

| Parameter | Ch BW    | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE UL Category |
|-----------|----------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|----------------|
| Unit      | MHz      |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |                |
|           | 1.4 - 20 | 1             | 1                          | 12                             | QPSK  | 1/3                | 72                                    | 24                  | 1  | 288   | 144  | 0              |
|           | 1.4 - 20 | 2             | 1                          | 12                             | QPSK  | 1/3                | 176                                   | 24                  | 1  | 576   | 288  | 0              |
|           | 1.4 - 20 | 3             | 1                          | 12                             | QPSK  | 1/3                | 256                                   | 24                  | 1  | 864   | 432  | 0              |
|           | 1.4 - 20 | 4             | 1                          | 12                             | QPSK  | 1/3                | 392                                   | 24                  | 1  | 1152  | 576  | 0              |
|           | 1.4 - 20 | 5             | 1                          | 12                             | QPSK  | 1/3                | 424                                   | 24                  | 1  | 1440  | 720  | 0              |
|           | 3-20     | 6             | 1                          | 12                             | QPSK  | 1/3                | 600                                   | 24                  | 1  | 1728  | 864  | 0              |
|           | 3-20     | 8             | 1                          | 12                             | QPSK  | 1/3                | 808                                   | 24                  | 1  | 2304  | 1152   | 0              |
|           | 3-20     | 9             | 1                          | 12                             | QPSK  | 1/3                | 776                                   | 24                  | 1  | 2592  | 1296   | 0              |
|           | 3-20     | 10            | 1                          | 12                             | QPSK  | 1/3                | 872                                   | 24                  | 1  | 2880  | 1440   | 0              |
|           | 3-20     | 12            | 1                          | 12                             | QPSK  | 1/4                | 840                                   | 24                  | 1  | 3456  | 1728   | 0              |
|           | 5-20     | 15            | 1                          | 12                             | QPSK  | 1/5                | 872                                   | 24                  | 1  | 4320  | 2160   | 0              |
|           | 5-20     | 16            | 1                          | 12                             | QPSK  | 1/5                | 904                                   | 24                  | 1  | 4608  | 2304   | 0              |
|           | 5-20     | 18            | 1                          | 12                             | QPSK  | 1/6                | 776                                   | 24                  | 1  | 5184  | 2592   | 0              |
|           | 5-20     | 20            | 1                          | 12                             | QPSK  | 1/6                | 872                                   | 24                  | 1  | 5760  | 2880   | 0              |

|         |  |    |   |    |      |      |     |    |   |      |      |   |
|---------|--|----|---|----|------|------|-----|----|---|------|------|---|
|         | 5-20   | 24 | 1 | 12 | QPSK | 1/8  | 872 | 24 | 1 | 6912 | 3456 | 0 |
|         | 10-20  | 25 | 1 | 12 | QPSK | 1/8  | 904 | 24 | 1 | 7200 | 3600 | 0 |
|         | 10-20  | 27 | 1 | 12 | QPSK | 1/8  | 968 | 24 | 1 | 7776 | 3888 | 0 |
|         | 10-20  | 30 | 1 | 12 | QPSK | 1/10 | 808 | 24 | 1 | 8640 | 4320 | 0 |
| Note 1: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |    |   |    |      |      |     |    |   |      |      |   |
| Note 2: | As per Table 4.2-2 in TS 36.211 [4]  |    |   |    |      |      |     |    |   |      |      |   |

**Table A.2.3.2.1-1b: Reference Channels for QPSK with partial RB allocation for UE UL category M1**

| Parameter | Ch BW   | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|-----------|---|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|-------------|
| Unit      | MHz   |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |             |
|           | 1.4 - 20  | 1             | 1                          | 12                             | QPSK  | 1/3                | 72                                    | 24                  | 1  | 288   | 144  | M1          |
|           | 1.4 - 20  | 2             | 1                          | 12                             | QPSK  | 1/3                | 176                                   | 24                  | 1  | 576   | 288  | M1          |
|           | 1.4 - 20  | 3             | 1                          | 12                             | QPSK  | 1/3                | 256                                   | 24                  | 1  | 864   | 432  | M1          |
|           | 1.4 - 20  | 4             | 1                          | 12                             | QPSK  | 1/3                | 392                                   | 24                  | 1  | 1152  | 576  | M1          |
|           | 1.4 - 20  | 5             | 1                          | 12                             | QPSK  | 1/3                | 424                                   | 24                  | 1  | 1440  | 720  | M1          |
|           | 3-20  | 6             | 1                          | 12                             | QPSK  | 1/3                | 600                                   | 24                  | 1  | 1728  | 864  | M1          |
| Note 1:   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |               |                            |                                |       |                    |                                       |                     |  |   |  |             |
| Note 2:   | As per Table 4.2-2 in TS 36.211 [4].  |               |                            |                                |       |                    |                                       |                     |  |   |  |             |

**Table A.2.3.2.1-1c: Reference Channels for QPSK with partial RB allocation for UE UL category M2**

| Parameter | Ch BW   | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|-----------|---|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|-------------|
| Unit      | MHz   |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |             |
|           | 1.4 - 20  | 1             | 1                          | 12                             | QPSK  | 1/3                | 72                                    | 24                  | 1  | 288   | 144  | M2          |
|           | 1.4 - 20  | 2             | 1                          | 12                             | QPSK  | 1/3                | 176                                   | 24                  | 1  | 576   | 288  | M2          |
|           | 1.4 - 20  | 3             | 1                          | 12                             | QPSK  | 1/3                | 256                                   | 24                  | 1  | 864   | 432  | M2          |
|           | 1.4 - 20  | 4             | 1                          | 12                             | QPSK  | 1/3                | 392                                   | 24                  | 1  | 1152  | 576  | M2          |
|           | 1.4 - 20  | 5             | 1                          | 12                             | QPSK  | 1/3                | 424                                   | 24                  | 1  | 1440  | 720  | M2          |
|           | 3-20  | 6             | 1                          | 12                             | QPSK  | 1/3                | 600                                   | 24                  | 1  | 1728  | 864  | M2          |
|           | 3-20  | 9             | 1                          | 12                             | QPSK  | 1/3                | 776                                   | 24                  | 1  | 2592  | 1296   | M2          |
|           | 3-20  | 12            | 1                          | 12                             | QPSK  | 1/3                | 1032                                  | 24                  | 1  | 3456  | 1728   | M2          |
|           | 5-20  | 15            | 1                          | 12                             | QPSK  | 1/3                | 1320                                  | 24                  | 1  | 4320  | 2160   | M2          |
|           | 5-20  | 18            | 1                          | 12                             | QPSK  | 1/3                | 1864                                  | 24                  | 1  | 5184  | 2592   | M2          |
|           | 5-20  | 21            | 1                          | 12                             | QPSK  | 1/3                | 2216                                  | 24                  | 1  | 6068  | 3024   | M2          |
| Note 1:   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |               |                            |                                |       |                    |                                       |                     |  |   |  |             |
| Note 2:   | As per Table 4.2-2 in TS 36.211 [4].  |               |                            |                                |       |                    |                                       |                     |  |   |  |             |

**A.2.3.2.2 16-QAM**

**Table A.2.3.2.2-1: Reference Channels for 16QAM with partial RB allocation**

| Parameter | Ch BW | Allocated RBs | UDL Configu | DFT-OFDM Symbol | Mod'n | Target Coding rate | Payload size for | Transport | Number of code blocks | Total number of bits | Total symbols per | UE Category |
|-----------|-------|---------------|-------------|-----------------|-------|--------------------|------------------|-----------|-----------------------|----------------------|-------------------|-------------|
|-----------|-------|---------------|-------------|-----------------|-------|--------------------|------------------|-----------|-----------------------|----------------------|-------------------|-------------|

| Unit | MHz      |    | ration (Note 2) | s per Sub-Frame |       |     | Sub-Frame 2, 3, 7, 8 | block CRC | per Sub-Frame (Note 1) | per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Sub-Frame for Sub-Frame 2, 3, 7, 8 |     |
|------|----------|----|-----------------|-----------------|-------|-----|----------------------|-----------|------------------------|--|------------------------------------|-----|
|      |          |    |                 |                 |       |     | Bits                 | Bits      |                        | Bits                                   |                                    |     |
|      | 1.4 - 20 | 1  | 1               | 12              | 16QAM | 3/4 | 408                  | 24        | 1                      | 576                                    | 144                                | ≥ 1 |
|      | 1.4 - 20 | 2  | 1               | 12              | 16QAM | 3/4 | 840                  | 24        | 1                      | 1152                                   | 288                                | ≥ 1 |
|      | 1.4 - 20 | 3  | 1               | 12              | 16QAM | 3/4 | 1288                 | 24        | 1                      | 1728                                   | 432                                | ≥ 1 |
|      | 1.4 - 20 | 4  | 1               | 12              | 16QAM | 3/4 | 1736                 | 24        | 1                      | 2304                                   | 576                                | ≥ 1 |
|      | 1.4 - 20 | 5  | 1               | 12              | 16QAM | 3/4 | 2152                 | 24        | 1                      | 2880                                   | 720                                | ≥ 1 |
|      | 3-20     | 6  | 1               | 12              | 16QAM | 3/4 | 2600                 | 24        | 1                      | 3456                                   | 864                                | ≥ 1 |
|      | 3-20     | 8  | 1               | 12              | 16QAM | 3/4 | 3496                 | 24        | 1                      | 4608                                   | 1152                               | ≥ 1 |
|      | 3-20     | 9  | 1               | 12              | 16QAM | 3/4 | 3880                 | 24        | 1                      | 5184                                   | 1296                               | ≥ 1 |
|      | 3-20     | 10 | 1               | 12              | 16QAM | 3/4 | 4264                 | 24        | 1                      | 5760                                   | 1440                               | ≥ 1 |
|      | 3-20     | 12 | 1               | 12              | 16QAM | 3/4 | 5160                 | 24        | 1                      | 6912                                   | 1728                               | ≥ 1 |
|      | 5-20     | 15 | 1               | 12              | 16QAM | 1/2 | 4264                 | 24        | 1                      | 8640                                   | 2160                               | ≥ 1 |
|      | 5-20     | 16 | 1               | 12              | 16QAM | 1/2 | 4584                 | 24        | 1                      | 9216                                   | 2304                               | ≥ 1 |
|      | 5-20     | 18 | 1               | 12              | 16QAM | 1/2 | 5160                 | 24        | 1                      | 10368                                  | 2592                               | ≥ 1 |
|      | 5-20     | 20 | 1               | 12              | 16QAM | 1/3 | 4008                 | 24        | 1                      | 11520                                  | 2880                               | ≥ 1 |
|      | 5-20     | 24 | 1               | 12              | 16QAM | 1/3 | 4776                 | 24        | 1                      | 13824                                  | 3456                               | ≥ 1 |
|      | 10-20    | 25 | 1               | 12              | 16QAM | 1/3 | 4968                 | 24        | 1                      | 14400                                  | 3600                               | ≥ 1 |
|      | 10-20    | 27 | 1               | 12              | 16QAM | 1/3 | 4776                 | 24        | 1                      | 15552                                  | 3888                               | ≥ 1 |
|      | 10-20    | 30 | 1               | 12              | 16QAM | 3/4 | 12960                | 24        | 3                      | 17280                                  | 4320                               | ≥ 2 |
|      | 10-20    | 32 | 1               | 12              | 16QAM | 3/4 | 13536                | 24        | 3                      | 18432                                  | 4608                               | ≥ 2 |
|      | 10-20    | 36 | 1               | 12              | 16QAM | 3/4 | 15264                | 24        | 3                      | 20736                                  | 5184                               | ≥ 2 |
|      | 10-20    | 40 | 1               | 12              | 16QAM | 3/4 | 16992                | 24        | 3                      | 23040                                  | 5760                               | ≥ 2 |
|      | 10-20    | 45 | 1               | 12              | 16QAM | 3/4 | 19080                | 24        | 4                      | 25920                                  | 6480                               | ≥ 2 |
|      | 10-20    | 48 | 1               | 12              | 16QAM | 3/4 | 20616                | 24        | 4                      | 27648                                  | 6912                               | ≥ 2 |
|      | 15 - 20  | 50 | 1               | 12              | 16QAM | 3/4 | 21384                | 24        | 4                      | 28800                                  | 7200                               | ≥ 2 |
|      | 15 - 20  | 54 | 1               | 12              | 16QAM | 3/4 | 22920                | 24        | 4                      | 31104                                  | 7776                               | ≥ 2 |
|      | 15 - 20  | 60 | 1               | 12              | 16QAM | 2/3 | 23688                | 24        | 4                      | 34560                                  | 8640                               | ≥ 2 |
|      | 15 - 20  | 64 | 1               | 12              | 16QAM | 2/3 | 25456                | 24        | 4                      | 36864                                  | 9216                               | ≥ 2 |
|      | 15 - 20  | 72 | 1               | 12              | 16QAM | 1/2 | 20616                | 24        | 4                      | 41472                                  | 10368                              | ≥ 2 |
|      | 20       | 75 | 1               | 12              | 16QAM | 1/2 | 21384                | 24        | 4                      | 43200                                  | 10800                              | ≥ 2 |
|      | 20       | 80 | 1               | 12              | 16QAM | 1/2 | 22920                | 24        | 4                      | 46080                                  | 11520                              | ≥ 2 |
|      | 20       | 81 | 1               | 12              | 16QAM | 1/2 | 22920                | 24        | 4                      | 46656                                  | 11664                              | ≥ 2 |
|      | 20       | 90 | 1               | 12              | 16QAM | 2/5 | 20616                | 24        | 4                      | 51840                                  | 12960                              | ≥ 2 |
|      | 20       | 96 | 1               | 12              | 16QAM | 2/5 | 22152                | 24        | 4                      | 55296                                  | 13824                              | ≥ 2 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  
 Note 2: As per Table 4.2-2 in TS 36.211 [4]

Table A.2.3.2.2-1A: Reference Channels for 16-QAM with partial RB allocation, UL-DL configuration 0

| Parameter | Ch BW  | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 4, 7, 8, 9 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 4, 7, 8, 9 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 4, 7, 8, 9 | UE Category |
|-----------|--------|---------------|----------------------------|--------------------------------|-------|--------------------|---|---------------------|--|---|--|-------------|
| Unit      | MHz    |               |                            |                                |       |                    | Bits  | Bits                |  | Bits  |  |             |
|           | 1.4-20 | 1             | 0                          | 12                             | 16QAM | 3/4                | 408   | 24                  | 1  | 576   | 144  | ≥ 1         |
|           | 1.4-20 | 2             | 0                          | 12                             | 16QAM | 3/4                | 840   | 24                  | 1  | 1152  | 288  | ≥ 1         |
|           | 1.4-20 | 3             | 0                          | 12                             | 16QAM | 3/4                | 1288  | 24                  | 1  | 1728  | 432  | ≥ 1         |
|           | 1.4-20 | 4             | 0                          | 12                             | 16QAM | 3/4                | 1736  | 24                  | 1  | 2304  | 576  | ≥ 1         |
|           | 1.4-20 | 5             | 0                          | 12                             | 16QAM | 3/4                | 2152  | 24                  | 1  | 2880  | 720  | ≥ 1         |
|           | 3-20   | 6             | 0                          | 12                             | 16QAM | 3/4                | 2600  | 24                  | 1  | 3456  | 864  | ≥ 1         |

|  |       |    |   |    |       |     |       |    |   |       |       |     |
|--|-------|----|---|----|-------|-----|-------|----|---|-------|-------|-----|
|  | 3-20  | 8  | 0 | 12 | 16QAM | 3/4 | 3496  | 24 | 1 | 4608  | 1152  | ≥ 1 |
|  | 3-20  | 9  | 0 | 12 | 16QAM | 3/4 | 3880  | 24 | 1 | 5184  | 1296  | ≥ 1 |
|  | 3-20  | 10 | 0 | 12 | 16QAM | 3/4 | 4264  | 24 | 1 | 5760  | 1440  | ≥ 1 |
|  | 3-20  | 12 | 0 | 12 | 16QAM | 3/4 | 5160  | 24 | 1 | 6912  | 1728  | ≥ 1 |
|  | 5-20  | 15 | 0 | 12 | 16QAM | 1/2 | 4264  | 24 | 1 | 8640  | 2160  | ≥ 1 |
|  | 5-20  | 16 | 0 | 12 | 16QAM | 1/2 | 4584  | 24 | 1 | 9216  | 2304  | ≥ 1 |
|  | 5-20  | 18 | 0 | 12 | 16QAM | 1/2 | 5160  | 24 | 1 | 10368 | 2592  | ≥ 1 |
|  | 5-20  | 20 | 0 | 12 | 16QAM | 1/3 | 4008  | 24 | 1 | 11520 | 2880  | ≥ 1 |
|  | 5-20  | 24 | 0 | 12 | 16QAM | 1/3 | 4776  | 24 | 1 | 13824 | 3456  | ≥ 1 |
|  | 10-20 | 25 | 0 | 12 | 16QAM | 1/3 | 4968  | 24 | 1 | 14400 | 3600  | ≥ 1 |
|  | 10-20 | 27 | 0 | 12 | 16QAM | 1/3 | 4776  | 24 | 1 | 15552 | 3888  | ≥ 1 |
|  | 10-20 | 30 | 0 | 12 | 16QAM | 3/4 | 12960 | 24 | 3 | 17280 | 4320  | ≥ 2 |
|  | 10-20 | 32 | 0 | 12 | 16QAM | 3/4 | 13536 | 24 | 3 | 18432 | 4608  | ≥ 2 |
|  | 10-20 | 36 | 0 | 12 | 16QAM | 3/4 | 15264 | 24 | 3 | 20736 | 5184  | ≥ 2 |
|  | 10-20 | 40 | 0 | 12 | 16QAM | 3/4 | 16992 | 24 | 3 | 23040 | 5760  | ≥ 2 |
|  | 10-20 | 45 | 0 | 12 | 16QAM | 3/4 | 19080 | 24 | 4 | 25920 | 6480  | ≥ 2 |
|  | 10-20 | 48 | 0 | 12 | 16QAM | 3/4 | 20616 | 24 | 4 | 27648 | 6912  | ≥ 2 |
|  | 15-20 | 50 | 0 | 12 | 16QAM | 3/4 | 21384 | 24 | 4 | 28800 | 7200  | ≥ 2 |
|  | 15-20 | 54 | 0 | 12 | 16QAM | 3/4 | 22920 | 24 | 4 | 31104 | 7776  | ≥ 2 |
|  | 15-20 | 60 | 0 | 12 | 16QAM | 2/3 | 23688 | 24 | 4 | 34560 | 8640  | ≥ 2 |
|  | 15-20 | 64 | 0 | 12 | 16QAM | 2/3 | 25456 | 24 | 4 | 36864 | 9216  | ≥ 2 |
|  | 15-20 | 72 | 0 | 12 | 16QAM | 1/2 | 20616 | 24 | 4 | 41472 | 10368 | ≥ 2 |
|  | 20    | 75 | 0 | 12 | 16QAM | 1/2 | 21384 | 24 | 4 | 43200 | 10800 | ≥ 2 |
|  | 20    | 80 | 0 | 12 | 16QAM | 1/2 | 22920 | 24 | 4 | 46080 | 11520 | ≥ 2 |
|  | 20    | 81 | 0 | 12 | 16QAM | 1/2 | 22920 | 24 | 4 | 46656 | 11664 | ≥ 2 |
|  | 20    | 90 | 0 | 12 | 16QAM | 2/5 | 20616 | 24 | 4 | 51840 | 12960 | ≥ 2 |
|  | 20    | 96 | 0 | 12 | 16QAM | 2/5 | 22152 | 24 | 4 | 55296 | 13824 | ≥ 2 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: As per Table 4.2-2 in TS 36.211 [4]

**Table A.2.3.2.2-1a: Reference Channels for 16QAM with partial RB allocation UE UL category 0**

| Parameter | Ch BW | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame | Total number of bits per Sub-Frame for | Total symbols per Sub-Frame for Sub- | UE UL Category |
|-----------|-------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|-------------------------------------|--|--------------------------------------|----------------|
|-----------|-------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|-------------------------------------|--|--------------------------------------|----------------|



|      |          |   |   |    |       |     |      |      | (Note 1) | Sub-Frame 2, 3, 7, 8 | Frame 2, 3, 7, 8 |   |
|------|----------|---|---|----|-------|-----|------|------|----------|----------------------|------------------|---|
| Unit | MHz      |   |   |    |       |     | Bits | Bits |          | Bits                 |                  |   |
|      | 1.4 - 20 | 1 | 1 | 12 | 16QAM | 3/4 | 408  | 24   | 1        | 576                  | 144              | 0 |
|      | 1.4 - 20 | 2 |   | 12 | 16QAM | 3/4 | 840  | 24   | 1        | 1152                 | 288              | 0 |
|      | 1.4 - 20 | 4 |   | 12 | 16QAM | 2/5 | 904  | 24   | 1        | 2304                 | 576              | 0 |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: As per Table 4.2-2 in TS 36.211 [4]

**Table A.2.3.2.2-1b: Reference Channels for 16QAM with partial RB allocation UE UL category M1**

| Parameter | Ch BW    | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|-----------|----------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|-------------|
| Unit      | MHz      |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |             |
|           | 1.4 - 20 | 1             | 1                          | 12                             | 16QAM | 1/2                | 256                                   | 24                  | 1  | 576   | 144  | M1          |
|           | 1.4 - 20 | 2             | 1                          | 12                             | 16QAM | 1/2                | 552                                   | 24                  | 1  | 1152  | 288  | M1          |
|           | 1.4 - 20 | 3             | 1                          | 12                             | 16QAM | 1/2                | 840                                   | 24                  | 1  | 1728  | 432  | M1          |
|           | 1.4 - 20 | 4             | 1                          | 12                             | 16QAM | 2/5                | 904                                   | 24                  | 1  | 2304  | 576  | M1          |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 2: As per Table 4.2-2 in TS 36.211 [4].

**Table A.2.3.2.2-1c: Reference Channels for 16QAM with partial RB allocation UE UL category M2**

| Parameter | Ch BW    | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|-----------|----------|---------------|----------------------------|--------------------------------|-------|--------------------|---------------------------------------|---------------------|--|---|--|-------------|
| Unit      | MHz      |               |                            |                                |       |                    | Bits                                  | Bits                |  | Bits  |  |             |
|           | 1.4 - 20 | 1             | 1                          | 12                             | 16QAM | 1/2                | 256                                   | 24                  | 1  | 576   | 144  | M2          |
|           | 1.4 - 20 | 2             | 1                          | 12                             | 16QAM | 1/2                | 552                                   | 24                  | 1  | 1152  | 288  | M2          |
|           | 1.4 - 20 | 3             | 1                          | 12                             | 16QAM | 1/2                | 840                                   | 24                  | 1  | 1728  | 432  | M2          |
|           | 1.4 - 20 | 4             | 1                          | 12                             | 16QAM | 1/2                | 1128                                  | 24                  | 1  | 2304  | 576  | M2          |
|           | 1.4 - 20 | 5             | 1                          | 12                             | 16QAM | 1/2                | 1416                                  | 24                  | 1  | 2880  | 720  | M2          |
|           | 3 - 20   | 6             | 1                          | 12                             | 16QAM | 1/2                | 1736                                  | 24                  | 1  | 3456  | 864  | M2          |
|           | 3 - 20   | 9             | 1                          | 12                             | 16QAM | 1/2                | 2600                                  | 24                  | 1  | 5184  | 1296   | M2          |
|           | 3 - 20   | 12            | 1                          | 12                             | 16QAM | 1/2                | 3496                                  | 24                  | 1  | 6912  | 1728   | M2          |
|           | 5 - 20   | 15            | 1                          | 12                             | 16QAM | 1/2                | 4264                                  | 24                  | 1  | 8640  | 2160   | M2          |
|           | 5 - 20   | 18            | 1                          | 12                             | 16QAM | 1/2                | 5160                                  | 24                  | 1  | 10368   | 2592   | M2          |
|           | 5 - 20   | 21            | 1                          | 12                             | 16QAM | 1/2                | 5992                                  | 24                  | 1  | 12096   | 3024   | M2          |
|           | 5 - 20   | 24            | 1                          | 12                             | 16QAM | 1/2                | 6968                                  | 24                  | 2  | 13824   | 3456   | M2          |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 2: As per Table 4.2-2 in TS 36.211 [4].

## A.2.3.2.3 64-QAM

Table A.2.3.2.3-1: Reference Channels for 64-QAM with partial RB allocation

| Parameter | Ch BW    | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category (Note 3) | UE UL Category (Note 3) |
|-----------|----------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------------|-------------------------|
| Unit      | MHz      |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |                      |                         |
|           | 1.4 - 20 | 1             | 12                             | 64QAM | 3/4                | 616          | 24                  | 1  | 864                                | 144                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 2             | 12                             | 64QAM | 3/4                | 1256         | 24                  | 1  | 1728                               | 288                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 3             | 12                             | 64QAM | 3/4                | 1864         | 24                  | 1  | 2592                               | 432                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 4             | 12                             | 64QAM | 3/4                | 2536         | 24                  | 1  | 3456                               | 576                         | 5,8                  | 5, 8, 13, 14            |
|           | 1.4 - 20 | 5             | 12                             | 64QAM | 3/4                | 3112         | 24                  | 1  | 4320                               | 720                         | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 6             | 12                             | 64QAM | 3/4                | 3752         | 24                  | 1  | 5184                               | 864                         | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 8             | 12                             | 64QAM | 3/4                | 5160         | 24                  | 1  | 6912                               | 1152                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 9             | 12                             | 64QAM | 3/4                | 5736         | 24                  | 1  | 7776                               | 1296                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 10            | 12                             | 64QAM | 3/4                | 6200         | 24                  | 2  | 8640                               | 1440                        | 5,8                  | 5, 8, 13, 14            |
|           | 3-20     | 12            | 12                             | 64QAM | 3/4                | 7480         | 24                  | 2  | 10368                              | 1728                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 15            | 12                             | 64QAM | 3/4                | 9528         | 24                  | 2  | 12960                              | 2160                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 16            | 12                             | 64QAM | 3/4                | 10296        | 24                  | 2  | 13824                              | 2304                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 18            | 12                             | 64QAM | 3/4                | 11448        | 24                  | 2  | 15552                              | 2592                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 20            | 12                             | 64QAM | 3/4                | 12576        | 24                  | 3  | 17280                              | 2880                        | 5,8                  | 5, 8, 13, 14            |
|           | 5-20     | 24            | 12                             | 64QAM | 3/4                | 15264        | 24                  | 3  | 20736                              | 3456                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 25            | 12                             | 64QAM | 3/4                | 15840        | 24                  | 3  | 21600                              | 3600                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 27            | 12                             | 64QAM | 3/4                | 16992        | 24                  | 3  | 23328                              | 3888                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 30            | 12                             | 64QAM | 3/4                | 19080        | 24                  | 4  | 25920                              | 4320                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 32            | 12                             | 64QAM | 3/4                | 20616        | 24                  | 4  | 27648                              | 4608                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 36            | 12                             | 64QAM | 3/4                | 22920        | 24                  | 4  | 31104                              | 5184                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 40            | 12                             | 64QAM | 3/4                | 25456        | 24                  | 5  | 34560                              | 5760                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 45            | 12                             | 64QAM | 3/4                | 28336        | 24                  | 5  | 38880                              | 6480                        | 5,8                  | 5, 8, 13, 14            |
|           | 10-20    | 48            | 12                             | 64QAM | 3/4                | 30576        | 24                  | 5  | 41472                              | 6912                        | 5,8                  | 5, 8, 13, 14            |
|           | 15 - 20  | 50            | 12                             | 64QAM | 3/4                | 31704        | 24                  | 6  | 43200                              | 7200                        | 5,8                  | 5, 8, 13, 14            |
|           | 15 - 20  | 54            | 12                             | 64QAM | 3/4                | 34008        | 24                  | 6  | 46656                              | 7776                        | 5,8                  | 5, 8, 13, 14            |
|           | 15 - 20  | 60            | 12                             | 64QAM | 3/4                | 37888        | 24                  | 7  | 51840                              | 8640                        | 5,8                  | 5, 8, 13, 14            |
|           | 15 - 20  | 64            | 12                             | 64QAM | 3/4                | 40576        | 24                  | 7  | 55296                              | 9216                        | 5,8                  | 5, 8, 13, 14            |
|           | 15 - 20  | 72            | 12                             | 64QAM | 3/4                | 45352        | 24                  | 8  | 62208                              | 10368                       | 5,8                  | 5, 8, 13, 14            |
|           | 20       | 75            | 12                             | 64QAM | 3/4                | 46888        | 24                  | 8  | 64800                              | 10800                       | 5,8                  | 5, 8, 13, 14            |
|           | 20       | 80            | 12                             | 64QAM | 3/4                | 51024        | 24                  | 9  | 69120                              | 11520                       | 5,8                  | 5, 8, 13, 14            |

|         |   |    |    |       |     |       |    |    |       |       |     |              |
|---------|---|----|----|-------|-----|-------|----|----|-------|-------|-----|--------------|
|         | 20  | 81 | 12 | 64QAM | 3/4 | 51024 | 24 | 9  | 69984 | 11664 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 90 | 12 | 64QAM | 3/4 | 51024 | 24 | 9  | 77760 | 12960 | 5,8 | 5, 8, 13, 14 |
|         | 20  | 96 | 12 | 64QAM | 3/4 | 61664 | 24 | 11 | 82944 | 13824 | 5,8 | 5, 8, 13, 14 |
| Note 1: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  |    |    |       |     |       |    |    |       |       |     |              |
| Note 2: | As per Table 4.2-2 in TS 36.211 [4].  |    |    |       |     |       |    |    |       |       |     |              |
| Note 3: | If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category |    |    |       |     |       |    |    |       |       |     |              |

A.2.3.2.4 256 QAM

Table A.2.3.2.4-1: Reference Channels for 256 QAM with partial RB allocation

| Parameter | Ch BW  | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n  | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE UL Category |
|-----------|--|---------------|----------------------------|--------------------------------|--------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------|
| Unit      | MHz  |               |                            |                                |        |                    | Bits         | Bits                |  | Bits                               |                             |                |
|           | 1.4 - 20   | 1             | 1                          | 12                             | 256QAM | 3/4                | 840          | 24                  | 1  | 1152                               | 144                         | ≥ 15           |
|           | 1.4 - 20   | 2             | 1                          | 12                             | 256QAM | 3/4                | 1672         | 24                  | 1  | 2304                               | 288                         | ≥ 15           |
|           | 1.4 - 20   | 3             | 1                          | 12                             | 256QAM | 3/4                | 2536         | 24                  | 1  | 3456                               | 432                         | ≥ 15           |
|           | 1.4 - 20   | 4             | 1                          | 12                             | 256QAM | 3/4                | 3368         | 24                  | 1  | 4608                               | 576                         | ≥ 15           |
|           | 1.4 - 20   | 5             | 1                          | 12                             | 256QAM | 3/4                | 4264         | 24                  | 1  | 5760                               | 720                         | ≥ 15           |
|           | 3-20   | 6             | 1                          | 12                             | 256QAM | 3/4                | 5160         | 24                  | 1  | 6912                               | 864                         | ≥ 15           |
|           | 3-20   | 8             | 1                          | 12                             | 256QAM | 3/4                | 6712         | 24                  | 2  | 9216                               | 1152                        | ≥ 15           |
|           | 3-20   | 9             | 1                          | 12                             | 256QAM | 3/4                | 7736         | 24                  | 2  | 10368                              | 1296                        | ≥ 15           |
|           | 3-20   | 10            | 1                          | 12                             | 256QAM | 3/4                | 8504         | 24                  | 2  | 11520                              | 1440                        | ≥ 15           |
|           | 3-20   | 12            | 1                          | 12                             | 256QAM | 3/4                | 10296        | 24                  | 2  | 13824                              | 1728                        | ≥ 15           |
|           | 5-20   | 15            | 1                          | 12                             | 256QAM | 3/4                | 12960        | 24                  | 3  | 17280                              | 2160                        | ≥ 15           |
|           | 5-20   | 16            | 1                          | 12                             | 256QAM | 3/4                | 13536        | 24                  | 3  | 18432                              | 2304                        | ≥ 15           |
|           | 5-20   | 18            | 1                          | 12                             | 256QAM | 3/4                | 15264        | 24                  | 3  | 20736                              | 2592                        | ≥ 15           |
|           | 5-20   | 20            | 1                          | 12                             | 256QAM | 3/4                | 16992        | 24                  | 3  | 23040                              | 2880                        | ≥ 15           |
|           | 5-20   | 24            | 1                          | 12                             | 256QAM | 3/4                | 20616        | 24                  | 4  | 27648                              | 3456                        | ≥ 15           |
|           | 10-20  | 25            | 1                          | 12                             | 256QAM | 3/4                | 21384        | 24                  | 4  | 28800                              | 3600                        | ≥ 15           |
|           | 10-20  | 27            | 1                          | 12                             | 256QAM | 3/4                | 22920        | 24                  | 4  | 31104                              | 3888                        | ≥ 15           |
|           | 10-20  | 30            | 1                          | 12                             | 256QAM | 3/4                | 25456        | 24                  | 5  | 34560                              | 4320                        | ≥ 15           |
|           | 10-20  | 32            | 1                          | 12                             | 256QAM | 3/4                | 27376        | 24                  | 5  | 36864                              | 4608                        | ≥ 15           |
|           | 10-20  | 36            | 1                          | 12                             | 256QAM | 3/4                | 30576        | 24                  | 6  | 41472                              | 5184                        | ≥ 15           |
|           | 10-20  | 40            | 1                          | 12                             | 256QAM | 3/4                | 34008        | 24                  | 6  | 46080                              | 5760                        | ≥ 15           |
|           | 10-20  | 45            | 1                          | 12                             | 256QAM | 3/4                | 37888        | 24                  | 7  | 51840                              | 6480                        | ≥ 15           |
|           | 10-20  | 48            | 1                          | 12                             | 256QAM | 3/4                | 40576        | 24                  | 8  | 55296                              | 6912                        | ≥ 15           |
|           | 15 - 20  | 50            | 1                          | 12                             | 256QAM | 3/4                | 42368        | 24                  | 8  | 57600                              | 7200                        | ≥ 15           |
|           | 15 - 20  | 54            | 1                          | 12                             | 256QAM | 3/4                | 46888        | 24                  | 8  | 62208                              | 7776                        | ≥ 15           |
|           | 15 - 20  | 60            | 1                          | 12                             | 256QAM | 3/4                | 51024        | 24                  | 9  | 69120                              | 8640                        | ≥ 15           |
|           | 15 - 20  | 64            | 1                          | 12                             | 256QAM | 3/4                | 55056        | 24                  | 9  | 73728                              | 9216                        | ≥ 15           |
|           | 15 - 20  | 72            | 1                          | 12                             | 256QAM | 3/4                | 61664        | 24                  | 11   | 82944                              | 10368                       | ≥ 15           |
|           | 20   | 75            | 1                          | 12                             | 256QAM | 3/4                | 63776        | 24                  | 11   | 86400                              | 10800                       | ≥ 15           |
|           | 20   | 80            | 1                          | 12                             | 256QAM | 3/4                | 68808        | 24                  | 12   | 92160                              | 11520                       | ≥ 15           |
|           | 20   | 81            | 1                          | 12                             | 256QAM | 3/4                | 68808        | 24                  | 12   | 93312                              | 11664                       | ≥ 15           |
|           | 20   | 90            | 1                          | 12                             | 256QAM | 3/4                | 76208        | 24                  | 13   | 103680                             | 12960                       | ≥ 15           |
|           | 20   | 96            | 1                          | 12                             | 256QAM | 3/4                | 81176        | 24                  | 14   | 110592                             | 13824                       | ≥ 15           |
| Note 1:   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |               |                            |                                |        |                    |              |                     |  |                                    |                             |                |
| Note 2:   | As per Table 4.2-2 in TS 36.211 [4]  |               |                            |                                |        |                    |              |                     |  |                                    |                             |                |

A.2.3.3 Void

Table A.2.3.3-1: Void

### A.2.3.4 subPRB allocation

The location of allocated RB for subPRB allocation is chosen according to values specified in the Tx requirements.

**Table A.2.3.4-1: Reference Channels for SubPRB allocation**

| Parameter  | Unit | Value        |          |          |
|--|------|--------------|----------|----------|
|  |      | 1.4 – 20     | 1.4 – 20 | 1.4 – 20 |
| Channel bandwidth  | MHz  | 1.4 – 20     | 1.4 – 20 | 1.4 – 20 |
| Allocated resource blocks  |      | 1            | 1        | 1        |
| Number of subcarriers  |      | 2 out of 3   | 3        | 6        |
| DFT-OFDM Symbols per Sub-Frame   |      | 12           | 12       | 12       |
| Modulation   |      | $\pi/2$ BPSK | QPSK     | QPSK     |
| Target Coding rate   |      | 1/3          | 1/3      | 1/3      |
| Payload size   | Bits | 32           | 72       | 72       |
| Transport block CRC  | Bits | 24           | 24       | 24       |
| Number of code blocks  |      | 1            | 1        | 1        |
| Total number of bits per resource unit   | Bits | 192          | 288      | 288      |
| Total symbols per resource unit  |      | 192          | 144      | 144      |
| Tx time  | ms   | 8            | 4        | 2        |
| UE UL Category   |      | M1/M2        | M1/M2    | M1/M2    |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |              |          |          |

### A.2.4 Reference measurement channels for UE category NB1

**Table A.2.4-1 Reference Channels for UE category NB1**

| Parameter  | Value        |              |              |              |       |       |       |
|--|--------------|--------------|--------------|--------------|-------|-------|-------|
|  | 3.75         | 3.75         | 15           | 15           | 15    | 15    | 15    |
| Sub-carrier spacing (kHz)  | 3.75         | 3.75         | 15           | 15           | 15    | 15    | 15    |
| Number of tone   | 1            | 1            | 1            | 1            | 3     | 6     | 12    |
| Modulation   | $\pi/2$ BPSK | $\pi/4$ QPSK | $\pi/2$ BPSK | $\pi/4$ QPSK | QPSK  | QPSK  | QPSK  |
| Number of NPUSCH repetition (NOTE 5)   | 1            | 1            | 1            | 1            | 1     | 1     | 1     |
| IMCS / ITBS  | 0 / 0        | 3 / 3        | 0 / 0        | 3 / 3        | 5 / 5 | 5 / 5 | 5 / 5 |
| Payload size (bits)  | 32           | 40           | 32           | 40           | 72    | 72    | 72    |
| Allocated resource unit  | 2            | 1            | 2            | 1            | 1     | 1     | 1     |
| Code rate (target)   | 1/3          | 1/3          | 1/3          | 1/3          | 1/3   | 1/3   | 1/3   |
| Code rate (effective)  | 0.29         | 0.33         | 0.29         | 0.33         | 0.33  | 0.33  | 0.33  |
| Transport block CRC (bits)   | 24           | 24           | 24           | 24           | 24    | 24    | 24    |
| Code block CRC size (bits)   | 0            | 0            | 0            | 0            | 0     | 0     | 0     |
| Number of code blocks – C  | 1            | 1            | 1            | 1            | 1     | 1     | 1     |
| Total number of bits per resource unit   | 96           | 192          | 96           | 192          | 288   | 288   | 288   |
| Total symbols per resource unit  | 96           | 96           | 96           | 96           | 144   | 144   | 144   |
| Tx time (ms)   | 64           | 32           | 16           | 8            | 4     | 2     | 1     |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |              |              |              |              |       |       |       |
| NOTE 2: Parameters related to NPUSCH format 1 scheduling are defined in Table A.2.4-2.   |              |              |              |              |       |       |       |
| NOTE 3: NPDCCH is not transmitted in the subframes used for transmission of SI messages.   |              |              |              |              |       |       |       |
| NOTE 4: SI messages transmission should be prioritized over NPDCCH transmission in case of collision. NPDCCH transmission is postponed until the next NB-IoT downlink subframe in case NPDCCH transmission occurs in a non NB-IoT downlink subframe, where an NB-IoT downlink subframe is a subframe that does not contain NPSS/NSSS/NPBCH/SIB1-NB transmission. |              |              |              |              |       |       |       |
| NOTE 5: Number of repetition $N_{Rep}$ as defined in table 16.5.1.1-3 in TS 36.213 [6].  |              |              |              |              |       |       |       |

**Table A.2.4-2: NPDCCH configuration for NPUSCH format 1 scheduling**

| Parameter                        | Unit | Value         |
|----------------------------------|------|---------------|
| DCI format                       |      | DCI format N0 |
| NPDCCH format                    |      | 1             |
| Scheduling delay ( $I_{Delay}$ ) |      | 0             |

|  |  |     |
|--|--|-----|
| DCI subframe repetition number                           |  | 00  |
| $R_{\max}$<br>( <i>npdcch-NumRepetitions</i> )           |  | 1   |
| G<br>( <i>NPDCCH-startSF-USS</i> )                       |  | 8   |
| $\alpha_{\text{offset}}$<br>( <i>npdcch-Offset-USS</i> ) |  | 1/4 |

## A.2.5 Reference measurement channels for LAA

### A.2.5.1 Full RB allocation

#### A.2.5.1.1 QPSK

**Table A.2.5.1.1-1: Reference Channels for QPSK with full RB allocation**

| Parameter  | Unit | Value    |          |
|--|------|----------|----------|
| Channel bandwidth  | MHz  | 10       | 20       |
| Allocated resource blocks  |      | 50       | 100      |
| DFT-OFDM Symbols per Sub-Frame   |      | 12       | 12       |
| Modulation   |      | QPSK     | QPSK     |
| Target Coding rate   |      | 1/3      | 1/6      |
| Payload size   | Bits | 5160     | 4584     |
| Transport block CRC  | Bits | 24       | 24       |
| Number of code blocks per Sub-Frame<br>(Note 1)  |      | 1        | 1        |
| Total number of bits per Sub-Frame   | Bits | 14400    | 28800    |
| Total symbols per Sub-Frame  |      | 7200     | 14400    |
| UE Category  |      | $\geq 1$ | $\geq 1$ |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |          |          |

#### A.2.5.1.2 16QAM

**Table A.2.5.1.2-1: Reference Channels for 16QAM with full RB allocation**

| Parameter  | Unit | Value    |          |
|--|------|----------|----------|
| Channel bandwidth  | MHz  | 10       | 20       |
| Allocated resource blocks  |      | 50       | 100      |
| DFT-OFDM Symbols per Sub-Frame   |      | 12       | 12       |
| Modulation   |      | 16QAM    | 16QAM    |
| Target Coding rate   |      | 3/4      | 1/3      |
| Payload size   | Bits | 21384    | 19848    |
| Transport block CRC  | Bits | 24       | 24       |
| Number of code blocks per Sub-Frame<br>(Note 1)  |      | 4        | 4        |
| Total number of bits per Sub-Frame   | Bits | 28800    | 57600    |
| Total symbols per Sub-Frame  |      | 7200     | 14400    |
| UE Category  |      | $\geq 2$ | $\geq 2$ |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |          |          |

A.2.5.1.3 64QAM

Table A.2.5.1.3-1: Reference Channels for 64QAM with full RB allocation

| Parameter  | Unit | Value         |               |
|--|------|---------------|---------------|
| Channel bandwidth  | MHz  | 10            | 20            |
| Allocated resource blocks  |      | 50            | 100           |
| DFT-OFDM Symbols per Sub-Frame   |      | 12            | 12            |
| Modulation   |      | 64QAM         | 64QAM         |
| Target Coding rate   |      | 3/4           | 3/4           |
| Payload size   | Bits | 31704         | 63776         |
| Transport block CRC  | Bits | 24            | 24            |
| Number of code blocks per Sub-Frame (Note 1)   |      | 8             | 11            |
| Total number of bits per Sub-Frame   | Bits | 43200         | 86400         |
| Total symbols per Sub-Frame  |      | 7200          | 14400         |
| UE Category (Note 2)   |      | 5,8           | 5,8           |
| UE UL Category (Note 2)  |      | 5,8,13,<br>14 | 5,8,13,<br>14 |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 2: If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category. |      |               |               |

A.2.5.2 Partial RB allocation

For each channel bandwidth, various partial RB allocations are specified. The number of allocated RBs is chosen according to values specified in the Tx and Rx requirements.

A.2.5.2.1 QPSK

Table A.2.5.2.1-1: Reference Channels for QPSK with partial RB allocation

| Parameter   | Ch BW   | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|---|---------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
| Unit  | MHz     |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |             |
|   | 10 - 20 | 10            | 12                             | QPSK  | 1/3                | 872          | 24                  | 1  | 2880                               | 1440                        | ≥ 1         |
|   | 10 - 20 | 20            | 12                             | QPSK  | 1/3                | 1736         | 24                  | 1  | 5760                               | 2880                        | ≥ 1         |
|   | 10 - 20 | 30            | 12                             | QPSK  | 1/3                | 2664         | 24                  | 1  | 8640                               | 4320                        | ≥ 1         |
|   | 10 - 20 | 40            | 12                             | QPSK  | 1/3                | 4136         | 24                  | 1  | 11520                              | 5760                        | ≥ 1         |
|   | 20      | 50            | 12                             | QPSK  | 1/3                | 5160         | 24                  | 1  | 14400                              | 7200                        | ≥ 1         |
|   | 20      | 60            | 12                             | QPSK  | 1/4                | 4264         | 24                  | 1  | 17280                              | 8640                        | ≥ 1         |
|   | 20      | 70            | 12                             | QPSK  | 1/4                | 4968         | 24                  | 1  | 20160                              | 10080                       | ≥ 1         |
|   | 20      | 80            | 12                             | QPSK  | 1/5                | 4776         | 24                  | 1  | 23040                              | 11520                       | ≥ 1         |
|   | 20      | 90            | 12                             | QPSK  | 1/6                | 4008         | 24                  | 1  | 25920                              | 12960                       | ≥ 1         |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 2: For the channel bandwidth of 10Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+5, N+10, ..., N+45 for N = 0, ..., N <sub>Interlace</sub> -1 } where N <sub>Interlace</sub> is 1, ..., 4 for the allocated RBs of 10, ..., 40, respectively.<br>Note 3: For the channel bandwidth of 20Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+10, N+20, ..., N+90 for N = 0, ..., N <sub>Interlace</sub> -1 } where N <sub>Interlace</sub> is 1, ..., 9 for the allocated RBs of 10, ..., 90, respectively. |         |               |                                |       |                    |              |                     |  |                                    |                             |             |

A.2.5.2.2 16QAM

Table A.2.5.2.2-1: Reference Channels for 16QAM with partial RB allocation

| Parameter | Ch BW   | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category |
|-----------|---------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|-------------|
| Unit      | MHz     |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |             |
|           | 10 - 20 | 10            | 12                             | 16QAM | 3/4                | 4264         | 24                  | 1  | 5760                               | 1440                        | ≥ 2         |
|           | 10 - 20 | 20            | 12                             | 16QAM | 1/3                | 4008         | 24                  | 1  | 11520                              | 2880                        | ≥ 2         |
|           | 10 - 20 | 30            | 12                             | 16QAM | 3/4                | 12960        | 24                  | 3  | 17280                              | 4320                        | ≥ 2         |
|           | 10 - 20 | 40            | 12                             | 16QAM | 3/4                | 16992        | 24                  | 3  | 23040                              | 5760                        | ≥ 2         |
|           | 20      | 50            | 12                             | 16QAM | 3/4                | 21384        | 24                  | 4  | 28800                              | 7200                        | ≥ 2         |
|           | 20      | 60            | 12                             | 16QAM | 2/3                | 23688        | 24                  | 4  | 34560                              | 8640                        | ≥ 2         |
|           | 20      | 70            | 12                             | 16QAM | 1/2                | 19848        | 24                  | 4  | 40320                              | 10080                       | ≥ 2         |
|           | 20      | 80            | 12                             | 16QAM | 1/2                | 22920        | 24                  | 4  | 46080                              | 11520                       | ≥ 2         |
|           | 20      | 90            | 12                             | 16QAM | 2/5                | 20616        | 24                  | 4  | 51840                              | 12960                       | ≥ 2         |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: For the channel bandwidth of 10Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+5, N+10, ..., N+45 for N = 0, ..., N<sub>Interface-1</sub>} where N<sub>Interface</sub> is 1, ..., 4 for the allocated RBs of 10, ..., 40, respectively.

Note 3: For the channel bandwidth of 20Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+10, N+20, ..., N+90 for N = 0, ..., N<sub>Interface-1</sub>} where N<sub>Interface</sub> is 1, ..., 9 for the allocated RBs of 10, ..., 90, respectively.

A.2.5.2.3 64QAM

Table A.2.5.2.3-1: Reference Channels for 64QAM with partial RB allocation

| Parameter | Ch BW   | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE Category (Note 2) | UE UL Category (Note 2) |
|-----------|---------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|----------------------|-------------------------|
| Unit      | MHz     |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |                      |                         |
|           | 10 - 20 | 10            | 12                             | 64QAM | 3/4                | 6200         | 24                  | 2  | 8640                               | 1440                        | 5,8                  | 5, 8, 13, 14            |
|           | 10 - 20 | 20            | 12                             | 64QAM | 3/4                | 12576        | 24                  | 3  | 17280                              | 2880                        | 5,8                  | 5, 8, 13, 14            |
|           | 10 - 20 | 30            | 12                             | 64QAM | 3/4                | 19080        | 24                  | 4  | 25920                              | 4320                        | 5,8                  | 5, 8, 13, 14            |
|           | 10 - 20 | 40            | 12                             | 64QAM | 3/4                | 25456        | 24                  | 5  | 34560                              | 5760                        | 5,8                  | 5, 8, 13, 14            |
|           | 20      | 50            | 12                             | 64QAM | 3/4                | 31704        | 24                  | 6  | 43200                              | 7200                        | 5,8                  | 5, 8, 13, 14            |
|           | 20      | 60            | 12                             | 64QAM | 3/4                | 37888        | 24                  | 7  | 51840                              | 8640                        | 5,8                  | 5, 8, 13, 14            |
|           | 20      | 70            | 12                             | 64QAM | 3/4                | 43816        | 24                  | 4  | 60480                              | 10080                       | 5,8                  | 5, 8, 13, 14            |
|           | 20      | 80            | 12                             | 64QAM | 3/4                | 51024        | 24                  | 9  | 69120                              | 11520                       | 5,8                  | 5, 8, 13, 14            |
|           | 20      | 90            | 12                             | 64QAM | 2/3                | 51024        | 24                  | 9  | 77760                              | 12960                       | 5,8                  | 5, 8, 13, 14            |

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: If UE does not report UE UL category, then the applicability of reference channel is determined by UE category. If UE reports UE UL category, then the applicability of reference channel is determined by UE UL category

Note 3: For the channel bandwidth of 10Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+5, N+10, ..., N+45 for N = 0, ..., N<sub>Interface-1</sub>} where N<sub>Interface</sub> is 1, ..., 4 for the allocated RBs of 10, ..., 40, respectively.

Note 4: For the channel bandwidth of 20Mhz, the allocated RBs are distributed over the channel bandwidth at the RB index = {N, N+10, N+20, ..., N+90 for N = 0, ..., N<sub>Interface-1</sub>} where N<sub>Interface</sub> is 1, ..., 9 for the allocated RBs of 10, ..., 90, respectively.

## A.3 DL reference measurement channels

### A.3.1 General

The number of available channel bits varies across the sub-frames due to PBCH and PSS/SSS overhead. The payload size per sub-frame is varied in order to keep the code rate constant throughout a frame.

Unless otherwise stated, no user data is scheduled on subframes #5 in order to facilitate the transmission of system information blocks (SIB).

The algorithm for determining the payload size  $A$  is as follows; given a desired coding rate  $R$  and radio block allocation  $N_{RB}$

1. Calculate the number of channel bits  $N_{ch}$  that can be transmitted during the first transmission of a given sub-frame.
2. Find  $A$  such that the resulting coding rate is as close to  $R$  as possible, that is,

$$\min |R - (A + 24 * (N_{CB} + 1)) / N_{ch}|, \text{ where } N_{CB} = \begin{cases} 0, & \text{if } C = 1 \\ C, & \text{if } C > 1 \end{cases}$$

subject to

- a)  $A$  is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of  $N_{RB}$  resource blocks.
  - b)  $C$  is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].
3. If there is more than one  $A$  that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.
  4. For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL+DwPTS (12 OFDM symbol):  
2UL

#### A.3.1.1 Overview of DL reference measurement channels

In Table A.3.1.1-1 to A.3.1.1-1V are listed the DL reference measurement channels specified in annexes A.3.2 to A.3.15 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.3.2 to A.3.15 as appropriate.

**Table A.3.1.1-1: Overview of DL reference measurement channels (FDD, Receiver requirements)**

| Duplex       | Table          | Name | BW  | Mod  | TCR | RB  | RB Off set | UE Cat eg | Notes            |
|--------------|----------------|------|-----|------|-----|-----|------------|-----------|------------------|
| FDD          | Table A.3.2-1  |      | 1.4 | QPSK | 1/3 | 6   |            | ≥ 1       |                  |
| FDD          | Table A.3.2-1  |      | 3   | QPSK | 1/3 | 15  |            | ≥ 1       |                  |
| FDD          | Table A.3.2-1  |      | 5   | QPSK | 1/3 | 25  |            | ≥ 1       |                  |
| FDD          | Table A.3.2-1  |      | 10  | QPSK | 1/3 | 50  |            | ≥ 1       |                  |
| FDD          | Table A.3.2-1  |      | 15  | QPSK | 1/3 | 75  |            | ≥ 1       |                  |
| FDD          | Table A.3.2-1  |      | 20  | QPSK | 1/3 | 100 |            | ≥ 1       |                  |
| FDD / HD-FDD | Table A.3.2-1a |      | 1.4 | QPSK | 1/3 | 6   |            | -         | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a |      | 3   | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a |      | 5   | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a |      | 10  | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a |      | 15  | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |



|              |                |  |     |      |     |    |  |     |                  |
|--------------|----------------|--|-----|------|-----|----|--|-----|------------------|
| FDD / HD-FDD | Table A.3.2-1a |  | 20  | QPSK | 1/3 | 14 |  | -   | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1b |  | 1.4 | QPSK | 1/3 | 4  |  | M1  |                  |
| FDD / HD-FDD | Table A.3.2-1b |  | 3   | QPSK | 1/3 | 4  |  | M1  |                  |
| FDD / HD-FDD | Table A.3.2-1b |  | 5   | QPSK | 1/3 | 4  |  | M1  |                  |
| FDD / HD-FDD | Table A.3.2-1b |  | 10  | QPSK | 1/3 | 4  |  | M1  |                  |
| FDD / HD-FDD | Table A.3.2-1b |  | 15  | QPSK | 1/3 | 4  |  | M1  |                  |
| FDD / HD-FDD | Table A.3.2-1b |  | 20  | QPSK | 1/3 | 4  |  | M1  |                  |
| HD-FDD       | Table A.3.2-1c |  | 0.2 | QPSK | 1/3 | 1  |  | NB1 |                  |
| HD-FDD       | Table A.3.2-1d |  | 0.2 | QPSK | 1/3 | 1  |  | NB1 |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 1.4 | QPSK | 1/3 | 4  |  | M2  |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 3   | QPSK | 1/3 | 8  |  | M2  |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 5   | QPSK | 1/3 | 16 |  | M2  |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 10  | QPSK | 1/3 | 16 |  | M2  |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 15  | QPSK | 1/3 | 16 |  | M2  |                  |
| FDD / HD-FDD | Table A.3.2-1h |  | 20  | QPSK | 1/3 | 16 |  | M2  |                  |

Table A.3.1.1-1A: Overview of DL reference measurement channels (TDD, Receiver requirements)

| Duplex      | Table          | Name | BW  | Mod  | TCR | RB  | RB Off set | UE Cat eg | Notes            |
|-------------|----------------|------|-----|------|-----|-----|------------|-----------|------------------|
| TDD         | Table A.3.2-2  |      | 1.4 | QPSK | 1/3 | 6   |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2  |      | 3   | QPSK | 1/3 | 15  |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2  |      | 5   | QPSK | 1/3 | 25  |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2  |      | 10  | QPSK | 1/3 | 50  |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2  |      | 15  | QPSK | 1/3 | 75  |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2  |      | 20  | QPSK | 1/3 | 100 |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2a |      | 1.4 | QPSK | 1/3 | 6   |            | -         | UE DL Category 0 |
| TDD         | Table A.3.2-2a |      | 3   | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| TDD         | Table A.3.2-2a |      | 5   | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| TDD         | Table A.3.2-2a |      | 10  | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| TDD         | Table A.3.2-2a |      | 15  | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| -           | Table A.3.2-2a |      | 20  | QPSK | 1/3 | 14  |            | -         | UE DL Category 0 |
| TDD Band 46 | Table A.3.2-2c |      | 10  | QPSK | 1/3 | 50  |            | ≥ 1       |                  |
| TDD Band 46 | Table A.3.2-2c |      | 20  | QPSK | 1/3 | 100 |            | ≥ 1       |                  |
| TDD         | Table A.3.2-2b |      | 1.4 | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2b |      | 3   | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2b |      | 5   | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2b |      | 10  | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2b |      | 15  | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2b |      | 20  | QPSK | 1/3 | 4   |            | M1        |                  |
| TDD         | Table A.3.2-2d |      | 1.4 | QPSK | 1/3 | 4   |            | M2        |                  |
| TDD         | Table A.3.2-2d |      | 3   | QPSK | 1/3 | 8   |            | M2        |                  |
| TDD         | Table A.3.2-2d |      | 5   | QPSK | 1/3 | 16  |            | M2        |                  |
| TDD         | Table A.3.2-2d |      | 10  | QPSK | 1/3 | 16  |            | M2        |                  |

|     |                |  |    |      |     |    |  |    |  |
|-----|----------------|--|----|------|-----|----|--|----|--|
| TDD | Table A.3.2-2d |  | 15 | QPSK | 1/3 | 16 |  | M2 |  |
| TDD | Table A.3.2-2d |  | 20 | QPSK | 1/3 | 16 |  | M2 |  |

**Table A.3.1.1-1B: Overview of DL reference measurement channels (FDD, Receiver requirements, Maximum input level)**

| Duplex   | Table          | Name | BW  | Mod    | TCR | RB  | RB Off set | UE Cat eg | Notes |
|--|----------------|------|-----|--------|-----|-----|------------|-----------|-------|
| <b>UE Categories ≥ 3</b>                             |                |      |     |        |     |     |            |           |       |
| FDD  | Table A.3.2-3  |      | 1.4 | 64QAM  | 3/4 | 6   |            | -         |       |
| FDD  | Table A.3.2-3  |      | 3   | 64QAM  | 3/4 | 15  |            | -         |       |
| FDD  | Table A.3.2-3  |      | 5   | 64QAM  | 3/4 | 25  |            | -         |       |
| FDD  | Table A.3.2-3  |      | 10  | 64QAM  | 3/4 | 50  |            | -         |       |
| FDD  | Table A.3.2-3  |      | 15  | 64QAM  | 3/4 | 75  |            | -         |       |
| FDD  | Table A.3.2-3  |      | 20  | 64QAM  | 3/4 | 100 |            | -         |       |
| <b>UE Category 1</b>                                 |                |      |     |        |     |     |            |           |       |
| FDD  | Table A.3.2-3a |      | 1.4 | 64QAM  | 3/4 | 6   |            | -         |       |
| FDD  | Table A.3.2-3a |      | 3   | 64QAM  | 3/4 | 15  |            | -         |       |
| FDD  | Table A.3.2-3a |      | 5   | 64QAM  | 3/4 | 18  |            | -         |       |
| FDD  | Table A.3.2-3a |      | 10  | 64QAM  | 3/4 | 17  |            | -         |       |
| FDD  | Table A.3.2-3a |      | 15  | 64QAM  | 3/4 | 17  |            | -         |       |
| FDD  | Table A.3.2-3a |      | 20  | 64QAM  | 3/4 | 17  |            | -         |       |
| <b>UE Category 2</b>                                 |                |      |     |        |     |     |            |           |       |
| FDD  | Table A.3.2-3b |      | 1.4 | 64QAM  | 3/4 | 6   |            | -         |       |
| FDD  | Table A.3.2-3b |      | 3   | 64QAM  | 3/4 | 15  |            | -         |       |
| FDD  | Table A.3.2-3b |      | 5   | 64QAM  | 3/4 | 25  |            | -         |       |
| FDD  | Table A.3.2-3b |      | 10  | 64QAM  | 3/4 | 50  |            | -         |       |
| FDD  | Table A.3.2-3b |      | 15  | 64QAM  | 3/4 | 75  |            | -         |       |
| FDD  | Table A.3.2-3b |      | 20  | 64QAM  | 3/4 | 83  |            | -         |       |
| <b>UE DL Category 0</b>                              |                |      |     |        |     |     |            |           |       |
| FDD  | Table A.3.2-3c |      | 1.4 | 64QAM  | 3/4 | 2   |            | -         |       |
| FDD  | Table A.3.2-3c |      | 3   | 64QAM  | 3/4 | 2   |            | -         |       |
| FDD  | Table A.3.2-3c |      | 5   | 64QAM  | 3/4 | 2   |            | -         |       |
| FDD  | Table A.3.2-3c |      | 10  | 64QAM  | 3/4 | 2   |            | -         |       |
| FDD  | Table A.3.2-3c |      | 15  | 64QAM  | 3/4 | 2   |            | -         |       |
| FDD  | Table A.3.2-3c |      | 20  | 64QAM  | 3/4 | 2   |            | -         |       |
| <b>UE Categories 11/12 and UE DL categories ≥ 11</b> |                |      |     |        |     |     |            |           |       |
| FDD  | Table A.3.2-5  |      | 1.4 | 256QAM | 4/5 | 6   |            | -         |       |
| FDD  | Table A.3.2-5  |      | 3   | 256QAM | 4/5 | 15  |            | -         |       |
| FDD  | Table A.3.2-5  |      | 5   | 256QAM | 4/5 | 25  |            | -         |       |
| FDD  | Table A.3.2-5  |      | 10  | 256QAM | 4/5 | 50  |            | -         |       |
| FDD  | Table A.3.2-5  |      | 15  | 256QAM | 4/5 | 75  |            | -         |       |
| FDD  | Table A.3.2-5  |      | 20  | 256QAM | 4/5 | 100 |            | -         |       |
| <b>UE DL Category M1</b>                             |                |      |     |        |     |     |            |           |       |
| FDD/HD-FDD   | Table A.3.2-3d |      | 1.4 | 16QAM  | 3/5 | 2   |            | -         |       |
| FDD/HD-FDD   | Table A.3.2-3d |      | 3   | 16QAM  | 3/5 | 2   |            | -         |       |
| FDD/HD-FDD   | Table A.3.2-3d |      | 5   | 16QAM  | 3/5 | 2   |            | -         |       |

|  |                |  |     |         |     |     |  |   |  |
|--|----------------|--|-----|---------|-----|-----|--|---|--|
| FDD/HD-FDD   | Table A.3.2-3d |  | 10  | 16QAM   | 3/5 | 2   |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3d |  | 15  | 16QAM   | 3/5 | 2   |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3d |  | 20  | 16QAM   | 3/5 | 2   |  | - |  |
| <b>UE DL Category M2</b>                           |                |  |     |         |     |     |  |   |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 1.4 | 16QAM   | 3/5 | 2   |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 3   | 16QAM   | 3/5 | 8   |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 5   | 16QAM   | 1/2 | 15  |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 10  | 16QAM   | 1/2 | 15  |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 15  | 16QAM   | 1/2 | 15  |  | - |  |
| FDD/HD-FDD   | Table A.3.2-3e |  | 20  | 16QAM   | 1/2 | 15  |  | - |  |
| <b>UE DL category 20 and UE DL categories ≥ 22</b> |                |  |     |         |     |     |  |   |  |
| FDD  | Table A.3.2-8  |  | 1.4 | 1024QAM | 4/5 | 6   |  | - |  |
| FDD  | Table A.3.2-8  |  | 3   | 1024QAM | 4/5 | 15  |  | - |  |
| FDD  | Table A.3.2-8  |  | 5   | 1024QAM | 4/5 | 25  |  | - |  |
| FDD  | Table A.3.2-8  |  | 10  | 1024QAM | 4/5 | 50  |  | - |  |
| FDD  | Table A.3.2-8  |  | 15  | 1024QAM | 4/5 | 75  |  | - |  |
| FDD  | Table A.3.2-8  |  | 20  | 1024QAM | 4/5 | 100 |  | - |  |

**Table A.3.1.1-1C: Overview of DL reference measurement channels (TDD, Receiver requirements, Maximum input level)**

| Duplex                   | Table          | Name | BW  | Mod   | TCR | RB  | RB Off set | UE Cat eg | Notes |
|--------------------------|----------------|------|-----|-------|-----|-----|------------|-----------|-------|
| <b>UE Categories ≥ 3</b> |                |      |     |       |     |     |            |           |       |
| TDD                      | Table A.3.2-4  |      | 1.4 | 64QAM | 3/4 | 6   |            | -         |       |
| TDD                      | Table A.3.2-4  |      | 3   | 64QAM | 3/4 | 15  |            | -         |       |
| TDD                      | Table A.3.2-4  |      | 5   | 64QAM | 3/4 | 25  |            | -         |       |
| TDD                      | Table A.3.2-4  |      | 10  | 64QAM | 3/4 | 50  |            | -         |       |
| TDD                      | Table A.3.2-4  |      | 15  | 64QAM | 3/4 | 75  |            | -         |       |
| TDD                      | Table A.3.2-4  |      | 20  | 64QAM | 3/4 | 100 |            | -         |       |
| TDD Band 46              | Table A.3.2-4d |      | 10  | 64QAM | 3/4 | 50  |            |           |       |
| TDD Band 46              | Table A.3.2-4d |      | 20  | 64QAM | 3/4 | 100 |            | -         |       |
| <b>UE Category 1</b>     |                |      |     |       |     |     |            |           |       |
| TDD                      | Table A.3.2-4a |      | 1.4 | 64QAM | 3/4 | 6   |            | -         |       |
| TDD                      | Table A.3.2-4a |      | 3   | 64QAM | 3/4 | 15  |            | -         |       |
| TDD                      | Table A.3.2-4a |      | 5   | 64QAM | 3/4 | 18  |            | -         |       |
| TDD                      | Table A.3.2-4a |      | 10  | 64QAM | 3/4 | 17  |            | -         |       |
| TDD                      | Table A.3.2-4a |      | 15  | 64QAM | 3/4 | 17  |            | -         |       |
| TDD                      | Table A.3.2-4a |      | 20  | 64QAM | 3/4 | 17  |            | -         |       |
| <b>UE Category 2</b>     |                |      |     |       |     |     |            |           |       |
| TDD                      | Table A.3.2-4b |      | 1.4 | 64QAM | 3/4 | 6   |            | -         |       |
| TDD                      | Table A.3.2-4b |      | 3   | 64QAM | 3/4 | 15  |            | -         |       |
| TDD                      | Table A.3.2-4b |      | 5   | 64QAM | 3/4 | 25  |            | -         |       |

|  |                |  |     |         |     |     |  |   |  |
|--|----------------|--|-----|---------|-----|-----|--|---|--|
| TDD  | Table A.3.2-4b |  | 10  | 64QAM   | 3/4 | 50  |  | - |  |
| TDD  | Table A.3.2-4b |  | 15  | 64QAM   | 3/4 | 75  |  | - |  |
| TDD  | Table A.3.2-4b |  | 20  | 64QAM   | 3/4 | 83  |  | - |  |
| <b>UE DL Category 0</b>                              |                |  |     |         |     |     |  |   |  |
| TDD  | Table A.3.2-4c |  | 1.4 | 64QAM   | 3/4 | 2   |  | - |  |
| TDD  | Table A.3.2-4c |  | 3   | 64QAM   | 3/4 | 2   |  | - |  |
| TDD  | Table A.3.2-4c |  | 5   | 64QAM   | 3/4 | 2   |  | - |  |
| TDD  | Table A.3.2-4c |  | 10  | 64QAM   | 3/4 | 2   |  | - |  |
| TDD  | Table A.3.2-4c |  | 15  | 64QAM   | 3/4 | 2   |  | - |  |
| TDD  | Table A.3.2-4c |  | 20  | 64QAM   | 3/4 | 2   |  | - |  |
| <b>UE Categories 11/12 and UE DL categories ≥ 11</b> |                |  |     |         |     |     |  |   |  |
| TDD  | Table A.3.2-6  |  | 1.4 | 256QAM  | 4/5 | 6   |  | - |  |
| TDD  | Table A.3.2-6  |  | 3   | 256QAM  | 4/5 | 15  |  | - |  |
| TDD  | Table A.3.2-6  |  | 5   | 256QAM  | 4/5 | 25  |  | - |  |
| TDD  | Table A.3.2-6  |  | 10  | 256QAM  | 4/5 | 50  |  | - |  |
| TDD  | Table A.3.2-6  |  | 15  | 256QAM  | 4/5 | 75  |  | - |  |
| TDD  | Table A.3.2-6  |  | 20  | 256QAM  | 4/5 | 100 |  | - |  |
| TDD<br>Band 46                                       | Table A.3.2-7  |  | 20  | 256QAM  | 4/5 | 100 |  | - |  |
| <b>UE DL Category M1</b>                             |                |  |     |         |     |     |  |   |  |
| TDD  | Table A.3.2-4e |  | 1.4 | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4e |  | 3   | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4e |  | 5   | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4e |  | 10  | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4e |  | 15  | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4e |  | 20  | 16QAM   | 3/5 | 2   |  | - |  |
| <b>UE DL Category M2</b>                             |                |  |     |         |     |     |  |   |  |
| TDD  | Table A.3.2-4f |  | 1.4 | 16QAM   | 3/5 | 2   |  | - |  |
| TDD  | Table A.3.2-4f |  | 3   | 16QAM   | 3/5 | 8   |  | - |  |
| TDD  | Table A.3.2-4f |  | 5   | 16QAM   | 1/2 | 15  |  | - |  |
| TDD  | Table A.3.2-4f |  | 10  | 16QAM   | 1/2 | 15  |  | - |  |
| TDD  | Table A.3.2-4f |  | 15  | 16QAM   | 1/2 | 15  |  | - |  |
| TDD  | Table A.3.2-4f |  | 20  | 16QAM   | 1/2 | 15  |  | - |  |
| <b>UE DL category 20 and UE DL categories ≥ 22</b>   |                |  |     |         |     |     |  |   |  |
| TDD  | Table A.3.2-9  |  | 1.4 | 1024QAM | 4/5 | 6   |  | - |  |
| TDD  | Table A.3.2-9  |  | 3   | 1024QAM | 4/5 | 15  |  | - |  |
| TDD  | Table A.3.2-9  |  | 5   | 1024QAM | 4/5 | 25  |  | - |  |
| TDD  | Table A.3.2-9  |  | 10  | 1024QAM | 4/5 | 50  |  | - |  |
| TDD  | Table A.3.2-9  |  | 15  | 1024QAM | 4/5 | 75  |  | - |  |
| TDD  | Table A.3.2-9  |  | 20  | 1024QAM | 4/5 | 100 |  | - |  |
| TDD<br>Band 46                                       | Table A.3.2-10 |  | 20  | 1024QAM | 4/5 | 100 |  | - |  |

**Table A.3.1.1-1D: Overview of DL reference measurement channels (FDD, PDSCH Performance, Single-antenna transmission (CRS))**

| Duplex | Table | Name | BW | Mod | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------|-------|------|----|-----|-----|----|------------|-----------|-------|
|--------|-------|------|----|-----|-----|----|------------|-----------|-------|

|   |                  |            |         |       |      |     |  |     |  |
|---|------------------|------------|---------|-------|------|-----|--|-----|--|
| FDD                                     | Table A.3.3.1-1  | R.4 FDD    | 1.4     | QPSK  | 1/3  | 6   |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-1  | R.42 FDD   | 20      | QPSK  | 1/3  | 100 |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-1  | R.42-1 FDD | 3       | QPSK  | 1/3  | 15  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-1  | R.42-2 FDD | 5       | QPSK  | 1/3  | 25  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-1  | R.42-3 FDD | 15      | QPSK  | 1/3  | 75  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-1  | R.2 FDD    | 10      | QPSK  | 1/3  | 50  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-2  | R.3-1 FDD  | 5       | 16QAM | 1/2  | 25  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-2  | R.3 FDD    | 10      | 16QAM | 1/2  | 50  |  | ≥ 2 |  |
| FDD                                     | Table A.3.3.1-3  | R.5 FDD    | 3       | 64QAM | 3/4  | 15  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-3  | R.6 FDD    | 5       | 64QAM | 3/4  | 25  |  | ≥ 2 |  |
| FDD                                     | Table A.3.3.1-3  | R.7 FDD    | 10      | 64QAM | 3/4  | 50  |  | ≥ 2 |  |
| FDD                                     | Table A.3.3.1-3  | R.8 FDD    | 15      | 64QAM | 3/4  | 75  |  | ≥ 2 |  |
| FDD                                     | Table A.3.3.1-3  | R.9 FDD    | 20      | 64QAM | 3/4  | 100 |  | ≥ 3 |  |
| FDD                                     | Table A.3.3.1-3a | R.6-1 FDD  | 5       | 64QAM | 3/4  | 18  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-3a | R.7-1 FDD  | 10      | 64QAM | 3/4  | 17  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-3a | R.8-1 FDD  | 15      | 64QAM | 3/4  | 17  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-3a | R.9-1 FDD  | 20      | 64QAM | 3/4  | 17  |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-3a | R.9-2 FDD  | 20      | 64QAM | 3/4  | 83  |  | ≥ 2 |  |
| FDD                                     | Table A.3.3.1-6  | R.41 FDD   | 10      | QPSK  | 1/10 | 50  |  | ≥ 1 |  |
| <b>Single PRB (Channel edge)</b>        |                  |            |         |       |      |     |  |     |  |
| FDD                                     | Table A.3.3.1-4  | R.0 FDD    | 3       | 16QAM | 1/2  | 1   |  | ≥ 1 |  |
| FDD                                     | Table A.3.3.1-4  | R.1 FDD    | 10 / 20 | 16QAM | 1/2  | 1   |  | ≥ 1 |  |
| <b>Single PRB (MBSFN Configuration)</b> |                  |            |         |       |      |     |  |     |  |
| FDD                                     | Table A.3.3.1-5  | R.29 FDD   | 10      | 16QAM | 1/2  | 1   |  | ≥ 1 |  |

**Table A.3.1.1-1E: Overview of DL reference measurement channels (PDSCH Performance: Carrier aggregation with power imbalance)**

| Duplex     | Table           | Name       | BW | Mod   | TCR       | RB  | RB Off set | UE Cat eg | Notes |
|------------|-----------------|------------|----|-------|-----------|-----|------------|-----------|-------|
| <b>FDD</b> |                 |            |    |       |           |     |            |           |       |
| FDD        | Table A.3.3.1-7 | R.49 FDD   | 20 | 64QAM | 0.84-0.87 | 100 |            | ≥ 5       |       |
| FDD        | Table A.3.3.1-7 | R.49-1 FDD | 10 | 64QAM | 0.84-0.87 | 50  |            | ≥ 2       |       |
| FDD        | Table A.3.3.1-7 | R.49-2 FDD | 5  | 64QAM | 0.84-0.86 | 25  |            | ≥ 2       |       |
| <b>TDD</b> |                 |            |    |       |           |     |            |           |       |
| TDD        | Table A.3.4.1-7 | R.49 TDD   | 20 | 64QAM | 0.81-0.87 | 100 |            | ≥ 5       |       |
| TDD        | Table A.3.4.1-7 | R.49-1 TDD | 15 | 64QAM | 0.80-0.86 | 75  |            | ≥ 3       |       |

**Table A.3.1.1-1F: Overview of DL reference measurement channels (FDD, PDSCH Performance, Multi-antenna transmission (CRS))**

| Duplex                   | Table             | Name     | BW | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes |
|--------------------------|-------------------|----------|----|-------|-----|----|------------|-----------|-------|
| <b>Two antenna ports</b> |                   |          |    |       |     |    |            |           |       |
| FDD                      | Table A.3.3.2.1-1 | R.10 FDD | 10 | QPSK  | 1/3 | 50 |            | ≥ 1       |       |
| FDD                      | Table A.3.3.2.1-1 | R.11 FDD | 10 | 16QAM | 1/2 | 50 |            | ≥ 2       |       |

|                           |                   |             |     |        |          |     |  |                   |  |
|---------------------------|-------------------|-------------|-----|--------|----------|-----|--|-------------------|--|
| FDD                       | Table A.3.3.2.1-1 | R.11-1 FDD  | 10  | 16QAM  | 1/2      | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.11-2 FDD  | 5   | 16QAM  | 1/2      | 25  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-1 | R.11-3 FDD  | 10  | 16QAM  | 1/2      | 40  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-1 | R.11-4 FDD  | 10  | QPSK   | 1/2      | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-9 | R.11-13 FDD | 10  | 16QAM  | 1/2      | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.30 FDD    | 20  | 16QAM  | 1/2      | 100 |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.30-1 FDD  | 15  | 16QAM  | 1/2      | 75  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.35 FDD    | 10  | 64QAM  | 1/2      | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.35-1 FDD  | 20  | 64QAM  | 0.39     | 100 |  | 4                 |  |
| FDD                       | Table A.3.3.2.1-1 | R.35-2 FDD  | 15  | 64QAM  | 0.39     | 75  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-1 | R.35-3 FDD  | 10  | 64QAM  | 0.39     | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-2 | R.35-4 FDD  | 10  | 64QAM  | 0.47     | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-2 | R.46 FDD    | 10  | QPSK   |          | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.47 FDD    | 10  | 16QAM  |          | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-7 | R.47-1 FDD  | 5   | 16QAM  |          | 25  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-7 | R.47-2 FDD  | 15  | 16QAM  |          | 75  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-7 | R.47-3 FDD  | 20  | 16QAM  |          | 100 |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-5 FDD  | 1.4 | 16QAM  | 1/2      | 6   |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-6 FDD  | 3   | 16QAM  | 1/2      | 15  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-7 FDD  | 15  | 16QAM  | 1/2      | 75  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-8 FDD  | 10  | QPSK   | 3/5      | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-9 FDD  | 10  | QPSK   | 0.58     | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.11-10 FDD | 10  | QPSK   | 0.67     | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.10-2 FDD  | 5   | QPSK   | 1/3      | 25  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-2 | R.10-3 FDD  | 10  | 16QAM  | 0.58     | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-2 | R.65 FDD    | 10  | 256QAM | 0.55     | 50  |  | 11-15             |  |
| FDD                       | Table A.3.3.2.1-3 | R.62 FDD    | 10  | 16QAM  | 1/2      | 3   |  | 0                 |  |
| FDD                       | Table A.3.3.2.1-3 | R.63 FDD    | 10  | 64QAM  | 1/2      | 1   |  | 0                 |  |
| FDD                       | Table A.3.3.2.1-4 | R.79 FDD    | 10  | 16QAM  | 1/2      | 3   |  | M1,<br>M2,<br>≥ 0 |  |
| FDD                       | Table A.3.3.2.1-5 | R.81 FDD    | 10  | QPSK   | 1/10     | 6   |  | M1,<br>≥ 0        |  |
| FDD                       | Table A.3.3.2.1-6 | R.84 FDD    | 10  | 16QAM  | 1/2      | 39  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.aa FDD    | 10  | QPSK   | 0.6-0.65 | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.bb FDD    | 10  | 16QAM  | 0.3-0.32 | 50  |  | ≥ 2               |  |
| FDD                       | Table A.3.3.2.1-6 | R.87 FDD    | 10  | 64QAM  | 0.39     | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.87-1 FDD  | 10  | 16QAM  | 0.44     | 50  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.87-2 FDD  | 5   | 64QAM  | 0.39     | 25  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.87-3 FDD  | 15  | 64QAM  | 0.39     | 75  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-6 | R.87-4 FDD  | 20  | 64QAM  | 0.39     | 100 |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-8 | R.90 FDD    | 10  | QPSK   | 1/3      | 18  |  | M2                |  |
| FDD                       | Table A.3.3.2.1-8 | R.91 FDD    | 10  | QPSK   | 1/10     | 18  |  | M2                |  |
| FDD                       | Table A.3.3.2.1-8 | R.92-1 FDD  | 10  | QPSK   | 1/2      | 36  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-8 | R.92-2 FDD  | 10  | QPSK   | 1/2      | 36  |  | ≥ 1               |  |
| FDD                       | Table A.3.3.2.1-4 | R.103 FDD   | 10  | QPSK   | 1/3      | 3   |  | M1,<br>M2         |  |
| FDD                       | Table A.3.3.2.1-4 | R.104 FDD   | 10  | 64QAM  | 0.4      | 3   |  | M1,<br>M2         |  |
| <b>Four antenna ports</b> |                   |             |     |        |          |     |  |                   |  |

|     |                   |            |     |         |      |     |  |          |                |
|-----|-------------------|------------|-----|---------|------|-----|--|----------|----------------|
| FDD | Table A.3.3.2.2-1 | R.12 FDD   | 1.4 | QPSK    | 1/3  | 6   |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.13 FDD   | 10  | QPSK    | 1/3  | 50  |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14 FDD   | 10  | 16QAM   | 1/2  | 50  |  | ≥ 2      |                |
| FDD | Table A.3.3.2.2-1 | R.14-1 FDD | 10  | 16QAM   | 1/2  | 6   |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14-2 FDD | 10  | 16QAM   | 1/2  | 3   |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14-3 FDD | 20  | 16QAM   | 1/2  | 100 |  | ≥ 2      |                |
| FDD | Table A.3.3.2.2-1 | R.36 FDD   | 10  | 64QAM   | 1/2  | 50  |  | ≥ 2      |                |
| FDD | Table A.3.3.2.2-1 | R.14-4 FDD | 1.4 | 16QAM   | 1/2  | 6   |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14-5 FDD | 3   | 16QAM   | 1/2  | 15  |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14-6 FDD | 5   | 16QAM   | 1/2  | 25  |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-1 | R.14-7 FDD | 15  | 16QAM   | 1/2  | 75  |  | ≥ 2      |                |
| FDD | Table A.3.3.2.2-2 | R.72 FDD   | 10  | 256QAM  | 0.62 | 50  |  | ≥ 11     |                |
| FDD | Table A.3.3.2.2-2 | R.72-1 FDD | 5   | 256QAM  | 0.62 | 25  |  | ≥ 11     |                |
| FDD | Table A.3.3.2.2-2 | R.72-2 FDD | 15  | 256QAM  | 0.62 | 75  |  | ≥ 11     |                |
| FDD | Table A.3.3.2.2-2 | R.72-3 FDD | 20  | 256QAM  | 0.62 | 100 |  | ≥ 11     |                |
| FDD | Table A.3.3.2.2-2 | R.73 FDD   | 10  | 64QAM   | 0.43 | 50  |  | ≥ 5      |                |
| FDD | Table A.3.3.2.2-2 | R.74 FDD   | 10  | 16QAM   | 1/2  | 50  |  | ≥ 5      |                |
| FDD | Table A.3.3.2.2-3 | R.74-1 FDD | 5   | 16QAM   | 1/2  | 25  |  | ≥ 5      |                |
| FDD | Table A.3.3.2.2-3 | R.74-2 FDD | 15  | 16QAM   | 1/2  | 75  |  | ≥ 5      |                |
| FDD | Table A.3.3.2.2-3 | R.74-3 FDD | 20  | 16QAM   | 1/2  | 100 |  | ≥ 5      |                |
| FDD | Table A.3.3.2.2-2 | R.85 FDD   | 10  | 64QAM   | 1/2  | 24  |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-2 | R.93 FDD   | 10  | 64QAM   | 0.52 | 24  |  | ≥ 1      |                |
| FDD | Table A.3.3.2.2-4 | R.95 FDD   | 10  | 16QAM   | 1/2  | 3   |  | M2       |                |
| FDD | Table A.3.3.2.2-3 | R.xx1 FDD  | 10  | 1024QAM |      | 50  |  | 20, ≥ 22 | UE DL Category |

**Table A.3.1.1-1G: Overview of DL reference measurement channels (FDD, PDSCH Performance (UE specific RS))**

| Duplex                            | Table             | Name       | BW | Mod   | TCR  | RB  | RB Off set | UE Cat eg | Notes |
|-----------------------------------|-------------------|------------|----|-------|------|-----|------------|-----------|-------|
| <b>Without CSI-RS</b>             |                   |            |    |       |      |     |            |           |       |
| FDD                               | Table A.3.3.3.0-1 | R.70 FDD   | 10 | QPSK  | 0.65 | 50  |            | ≥ 1       |       |
| FDD                               | Table A.3.3.3.0-1 | R.71 FDD   | 10 | 16QAM | 0.6  | 50  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.0-2 | R.80 FDD   | 10 | QPSK  | 1/3  | 6   |            | M1, ≥ 0   |       |
| <b>Two antenna ports (CSI-RS)</b> |                   |            |    |       |      |     |            |           |       |
| FDD                               | Table A.3.3.3.1-1 | R.51 FDD   | 10 | 16QAM | 1/2  | 50  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-1 | R.51-1 FDD | 10 | 16QAM | 0.54 | 50  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-1 | R.51-2 FDD | 5  | 16QAM | 0.54 | 25  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-1 | R.51-3 FDD | 15 | 16QAM | 0.54 | 75  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-1 | R.51-4 FDD | 20 | 16QAM | 0.54 | 100 |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-1 | R.76 FDD   | 10 | QPSK  |      | 50  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-1 FDD | 5  | QPSK  |      | 25  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-2 FDD | 15 | QPSK  |      | 75  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-3 FDD | 20 | QPSK  |      | 100 |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-4 FDD | 5  | QPSK  |      | 25  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-5 FDD | 10 | QPSK  |      | 50  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-6 FDD | 15 | QPSK  |      | 75  |            | ≥ 2       |       |
| FDD                               | Table A.3.3.3.1-3 | R.76-7 FDD | 20 | QPSK  |      | 100 |            | ≥ 2       |       |

|  |                    |             |    |         |          |    |  |                  |                |
|--|--------------------|-------------|----|---------|----------|----|--|------------------|----------------|
| FDD  | Table A.3.3.3.1-1  | R.86 FDD    | 10 | QPSK    | 1/3      | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.1-1  | R.86A FDD   | 10 | QPSK    | 1/3      | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.1-1  | R.94 FDD    | 10 | QPSK    | 2/3      | 24 |  | $\geq 1$         |                |
| <b>Two antenna ports (CSI-RS, non Quasi Co-located)</b>  |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.1-2  | R.52 FDD    | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.1-2  | R.52-1 FDD  | 10 | 16QAM   | 0.54     | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.1-2  | R.53 FDD    | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.1-2  | R.54 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.1-2  | R.97 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| <b>Four antenna ports (CSI-RS)</b>                       |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.2-1  | R.43 FDD    | 10 | QPSK    | 1/3      | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-1  | R.50 FDD    | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-2  | R.50A-1 FDD | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-2  | R.44 FDD    | 10 | QPSK    | 1/3      | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-2  | R.45 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-2  | R.45-1 FDD  | 10 | 16QAM   | 1/2      | 39 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-1  | R.45A-1 FDD | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-2  | R.45A-2 FDD | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-1  | R.48 FDD    | 10 | QPSK    |          | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-2  | R.60 FDD    | 10 | QPSK    | 1/2      | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-3  | R.64 FDD    | 10 | QPSK    | 1/3      | 6  |  | 0                |                |
| FDD  | Table A.3.3.3.2-1  | R.66 FDD    | 10 | 256QAM  | 0.77     | 50 |  | 11-15            |                |
| FDD  | Table A.3.3.3.2-4  | R.69 FDD    | 10 | QPSK    | 0.74-0.8 | 50 |  | $\geq 1$         |                |
| FDD  | Table A.3.3.3.2-1  | R.75 FDD    | 10 | 16QAM   | 0.57     | 50 |  | $\geq 5$         |                |
| FDD  | Table A.3.3.3.2-1  | R.75A FDD   | 10 | 16QAM   | 0.51     | 50 |  | $\geq 5$         |                |
| FDD  | Table A.3.3.3.2-1  | R.cc FDD    | 10 | 16QAM   | 0.64     | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-1  | R.xx2 FDD   | 10 | 1024QAM |          | 50 |  | 20,<br>$\geq 22$ | UE DL Category |
| <b>Four antenna ports (CSI-RS, non Quasi Co-located)</b> |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.2-5  | R.98 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-5  | R.99 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2-6  | R.100 FDD   | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| <b>Eight antenna ports (CSI-RS)</b>                      |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.2A-1 | R.50A-2 FDD | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2A-1 | R.50A-3 FDD | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.2A-2 | R.108 FDD   | 10 | QPSK    | 1/2      | 4  |  | $\geq 1$         |                |
| <b>Twelve antenna ports (CSI-RS)</b>                     |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.3-1  | R.77 FDD    | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| <b>Sixteen antenna ports (CSI-RS)</b>                    |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.4-1  | R.78 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| <b>Twenty-four antenna ports (CSI-RS)</b>                |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.5-1  | R.88 FDD    | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| FDD  | Table A.3.3.3.5-1  | R.88A FDD   | 10 | 16QAM   | 1/2      | 50 |  | $\geq 2$         |                |
| <b>Thirty-two antenna ports (CSI-RS)</b>                 |                    |             |    |         |          |    |  |                  |                |
| FDD  | Table A.3.3.3.6-1  | R.89 FDD    | 10 | 64QAM   | 1/2      | 50 |  | $\geq 2$         |                |



**Table A.3.1.1-1H: Overview of DL reference measurement channels (TDD, PDSCH Performance, Single-antenna transmission (CRS))**

| Duplex                                  | Table            | Name       | BW        | Mod   | TCR  | RB  | RB Off set | UE Cat eg | Notes |
|---|------------------|------------|-----------|-------|------|-----|------------|-----------|-------|
| TDD                                     | Table A.3.4.1-1  | R.4 TDD    | 1.4       | QPSK  | 1/3  | 6   |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.42 TDD   | 20        | QPSK  | 1/3  | 100 |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.2 TDD    | 10        | QPSK  | 1/3  | 50  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.2A TDD   | 10        | QPSK  | 1/3  | 50  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.42-1 TDD | 3         | QPSK  | 1/3  | 15  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.42-2 TDD | 5         | QPSK  | 1/3  | 25  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-1  | R.42-3 TDD | 15        | QPSK  | 1/3  | 75  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-2  | R.3-1 TDD  | 5         | 16QAM | 1/2  | 25  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-2  | R.3 TDD    | 10        | 16QAM | 1/2  | 50  |            | ≥ 2       |       |
| TDD                                     | Table A.3.4.1-3  | R.5 TDD    | 3         | 64QAM | 3/4  | 15  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-3  | R.6 TDD    | 5         | 64QAM | 3/4  | 25  |            | ≥ 2       |       |
| TDD                                     | Table A.3.4.1-3  | R.7 TDD    | 10        | 64QAM | 3/4  | 50  |            | ≥ 2       |       |
| TDD                                     | Table A.3.4.1-3  | R.8 TDD    | 15        | 64QAM | 3/4  | 75  |            | ≥ 2       |       |
| TDD                                     | Table A.3.4.1-3  | R.9 TDD    | 20        | 64QAM | 3/4  | 100 |            | ≥ 3       |       |
| TDD                                     | Table A.3.4.1-3a | R.6-1 TDD  | 5         | 64QAM | 3/4  | 18  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-3a | R.7-1 TDD  | 10        | 64QAM | 3/4  | 17  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-3a | R.8-1 TDD  | 15        | 64QAM | 3/4  | 17  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-3a | R.9-1 TDD  | 20        | 64QAM | 3/4  | 17  |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-3a | R.9-2 TDD  | 20        | 64QAM | 3/4  | 83  |            | ≥ 2       |       |
| TDD                                     | Table A.3.4.1-6  | R.41 TDD   | 10        | QPSK  | 1/10 | 50  |            | ≥ 1       |       |
| <b>Single PRB (Channel edge)</b>        |                  |            |           |       |      |     |            |           |       |
| TDD                                     | Table A.3.4.1-4  | R.0 TDD    | 3         | 16QAM | 1/2  | 1   |            | ≥ 1       |       |
| TDD                                     | Table A.3.4.1-4  | R.1 TDD    | 10/<br>20 | 16QAM | 1/2  | 1   |            | ≥ 1       |       |
| <b>Single PRB (MBSFN Configuration)</b> |                  |            |           |       |      |     |            |           |       |
| TDD                                     | Table A.3.4.1-5  | R.29 TDD   | 10        | 16QAM | 1/2  | 1   |            | ≥ 1       |       |

**Table A.3.1.1-1I: Overview of DL reference measurement channels (TDD, PDSCH Performance, Multi-antenna transmission (CRS))**

| Duplex                   | Table              | Name        | BW | Mod   | TCR  | RB  | RB Off set | UE Cat eg | Notes |
|--------------------------|--------------------|-------------|----|-------|------|-----|------------|-----------|-------|
| <b>Two antenna ports</b> |                    |             |    |       |      |     |            |           |       |
| TDD                      | Table A.3.4.2.1-1  | R.10 TDD    | 10 | QPSK  | 1/3  | 50  |            | ≥ 1       |       |
| TDD                      | Table A.3.4.2.1-1  | R.11 TDD    | 10 | 16QAM | 1/2  | 50  |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.11-1 TDD  | 10 | 16QAM | 1/2  | 50  |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.11-2 TDD  | 5  | 16QAM | 1/2  | 25  |            | ≥ 1       |       |
| TDD                      | Table A.3.4.2.1-1  | R.11-3 TDD  | 10 | 16QAM | 1/2  | 40  |            | ≥ 1       |       |
| TDD                      | Table A.3.4.2.1-1  | R.11-4 TDD  | 10 | QPSK  | 1/2  | 50  |            | ≥ 1       |       |
| TDD                      | Table A.3.4.2.1-11 | R.11-13 TDD | 10 | 16QAM | 1/2  | 50  |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.30 TDD    | 20 | 16QAM | 1/2  | 100 |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.30-1 TDD  | 20 | 16QAM | 1/2  | 100 |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.30-2 TDD  | 20 | 16QAM | 1/2  | 100 |            | 3         |       |
| TDD                      | Table A.3.4.2.1-1  | R.35 TDD    | 10 | 64QAM | 1/2  | 50  |            | ≥ 2       |       |
| TDD                      | Table A.3.4.2.1-1  | R.35-1 TDD  | 20 | 64QAM | 0.39 | 100 |            | 4         |       |

|                           |                    |             |     |        |           |     |  |                  |  |
|---------------------------|--------------------|-------------|-----|--------|-----------|-----|--|------------------|--|
| TDD                       | Table A.3.4.2.1-2  | R.35-2 TDD  | 10  | 64QAM  | 0.47      | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.46 TDD    | 10  | QPSK   |           | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.47 TDD    | 10  | 16QAM  |           | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-9  | R.47-1 TDD  | 5   | 16QAM  |           | 25  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-9  | R.47-2 TDD  | 15  | 16QAM  |           | 75  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-9  | R.47-3 TDD  | 20  | 16QAM  |           | 100 |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-5 TDD  | 1.4 | 16QAM  | 1/2       | 6   |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-6 TDD  | 3   | 16QAM  | 1/2       | 15  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-7 TDD  | 5   | 16QAM  | 1/2       | 25  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-8 TDD  | 10  | 16QAM  | 1/2       | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-9 TDD  | 15  | 16QAM  | 1/2       | 75  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-10 TDD | 10  | QPSK   | 3/5       | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-11 TDD | 10  | QPSK   | 0.48-0.58 | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.11-12 TDD | 10  | QPSK   | 0.54-0.66 | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-2  | R.10-3 TDD  | 10  | 16QAM  | 0.57-0.58 | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-3  | R.62 TDD    | 10  | 16QAM  | 1/2       | 3   |  | 0                |  |
| TDD                       | Table A.3.4.2.1-3  | R.63 TDD    | 10  | 64QAM  | 1/2       | 1   |  | 0                |  |
| TDD                       | Table A.3.4.2.1-4  | R.65 TDD    | 20  | 256QAM | 0.6       | 100 |  | 11-15            |  |
| TDD                       | Table A.3.4.2.1-5  | R.67 TDD    | 10  | 16QAM  | 0.4       | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-6  | R.79 TDD    | 10  | 16QAM  | 1/2       | 3   |  | M1, M2, $\geq 0$ |  |
| TDD                       | Table A.3.4.2.1-7  | R.81 TDD    | 10  | QPSK   | 1/10      | 6   |  | M1, $\geq 0$     |  |
| TDD                       | Table A.3.4.2.1-4  | R.84 TDD    | 10  | 16QAM  | 1/2       | 39  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.aa TDD    | 10  | QPSK   | 0.54-0.64 | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.bb TDD    | 10  | 16QAM  | 0.27-0.32 | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.87 TDD    | 10  | 64QAM  | 0.39      | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.87-1 TDD  | 10  | 16QAM  | 0.44      | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.87-2 TDD  | 5   | 64QAM  | 0.39      | 25  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.87-3 TDD  | 15  | 64QAM  | 0.39      | 75  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-8  | R.87-4 TDD  | 20  | 64QAM  | 0.39      | 100 |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-10 | R.90 TDD    | 10  | QPSK   | 1/3       | 18  |  | M2               |  |
| TDD                       | Table A.3.4.2.1-10 | R.91 TDD    | 10  | QPSK   | 1/10      | 18  |  | M2               |  |
| TDD                       | Table A.3.4.2.1-10 | R.92-1 TDD  | 10  | QPSK   | 1/2       | 36  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-10 | R.92-2 TDD  | 10  | QPSK   | 1/2       | 36  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.1-6  | R.103 TDD   | 10  | QPSK   | 1/3       | 3   |  | M1, M2           |  |
| TDD                       | Table A.3.4.2.1-6  | R.104 TDD   | 10  | 64QAM  | 0.4       | 3   |  | M1, M2           |  |
| <b>Four antenna ports</b> |                    |             |     |        |           |     |  |                  |  |
| TDD                       | Table A.3.4.2.2-1  | R.12 TDD    | 1.4 | QPSK   | 1/3       | 6   |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.13 TDD    | 10  | QPSK   | 1/3       | 50  |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.14 TDD    | 10  | 16QAM  | 1/2       | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.14-1 TDD  | 10  | 16QAM  | 1/2       | 6   |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.14-2 TDD  | 10  | 16QAM  | 1/2       | 3   |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.43 TDD    | 20  | 16QAM  | 1/2       | 100 |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.36 TDD    | 10  | 64QAM  | 1/2       | 50  |  | $\geq 2$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.43-1 TDD  | 1.4 | 16QAM  | 1/2       | 6   |  | $\geq 1$         |  |
| TDD                       | Table A.3.4.2.2-1  | R.43-2 TDD  | 3   | 16QAM  | 1/2       | 15  |  | $\geq 1$         |  |

|     |                   |            |    |        |      |     |  |      |  |
|-----|-------------------|------------|----|--------|------|-----|--|------|--|
| TDD | Table A.3.4.2.2-1 | R.43-3 TDD | 5  | 16QAM  | 1/2  | 25  |  | ≥ 1  |  |
| TDD | Table A.3.4.2.2-1 | R.43-4 TDD | 10 | 16QAM  | 1/2  | 50  |  | ≥ 2  |  |
| TDD | Table A.3.4.2.2-1 | R.43-5 TDD | 15 | 16QAM  | 1/2  | 75  |  | ≥ 2  |  |
| TDD | Table A.3.4.2.2-2 | R.72 TDD   | 10 | 256QAM | 0.62 | 50  |  | ≥ 11 |  |
| TDD | Table A.3.4.2.2-2 | R.72-1 TDD | 5  | 256QAM | 0.62 | 25  |  | ≥ 11 |  |
| TDD | Table A.3.4.2.2-2 | R.72-2 TDD | 15 | 256QAM | 0.62 | 75  |  | ≥ 11 |  |
| TDD | Table A.3.4.2.2-2 | R.72-3 TDD | 20 | 256QAM | 0.62 | 100 |  | ≥ 11 |  |
| TDD | Table A.3.4.2.2-2 | R.73 TDD   | 10 | 64QAM  | 0.44 | 50  |  | ≥ 5  |  |
| TDD | Table A.3.4.2.2-2 | R.74 TDD   | 10 | 16QAM  | 1/2  | 50  |  | ≥ 5  |  |
| TDD | Table A.3.4.2.2-3 | R.74-1 TDD | 5  | 16QAM  | 1/2  | 25  |  | ≥ 5  |  |
| TDD | Table A.3.4.2.2-3 | R.74-2 TDD | 15 | 16QAM  | 1/2  | 75  |  | ≥ 5  |  |
| TDD | Table A.3.4.2.2-3 | R.74-3 TDD | 20 | 16QAM  | 1/2  | 100 |  | ≥ 5  |  |
| TDD | Table A.3.4.2.2-2 | R.85 TDD   | 10 | 64QAM  | 1/2  | 24  |  | ≥ 1  |  |
| TDD | Table A.3.4.2.2-2 | R.93 TDD   | 10 | 64QAM  | 0.50 | 24  |  | ≥ 1  |  |
| TDD | Table A.3.4.2.2-4 | R.95 TDD   | 10 | 16QAM  | 1/2  | 3   |  | M2   |  |

**Table A.3.1.1-1J: Overview of DL reference measurement channels (TDD, PDSCH Performance (DRS))**

| Duplex                     | Table             | Name       | BW | Mod   | TCR       | RB   | RB Off set | UE Cat eg | Notes |
|----------------------------|-------------------|------------|----|-------|-----------|------|------------|-----------|-------|
| <b>Single antenna port</b> |                   |            |    |       |           |      |            |           |       |
| TDD                        | Table A.3.4.3.1-1 | R.25 TDD   | 10 | QPSK  | 1/3       | 50   |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.1-1 | R.26 TDD   | 10 | 16QAM | 1/2       | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.1-1 | R.26-1 TDD | 5  | 16QAM | 1/2       | 25   |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.1-1 | R.27 TDD   | 10 | 64QAM | 3/4       | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.1-1 | R.27-1 TDD | 10 | 64QAM | 3/4       | 18   |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.1-1 | R.28 TDD   | 10 | 16QAM | 1/2       | 1    |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.1-2 | R.80 TDD   | 10 | QPSK  | 1/10      | 6    |            | M1, ≥ 0   |       |
| <b>Two antenna ports</b>   |                   |            |    |       |           |      |            |           |       |
| TDD                        | Table A.3.4.3.2-1 | R.31 TDD   | 10 | QPSK  | 1/3       | 50   |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.2-1 | R.32 TDD   | 10 | 16QAM | 1/2       | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.2-1 | R.32-1 TDD | 5  | 16QAM | 1/2       | [25] |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.2-1 | R.33 TDD   | 10 | 64QAM | 3/4       | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.2-1 | R.33-1 TDD | 10 | 64QAM | 3/4       | [18] |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.2-1 | R.34 TDD   | 10 | 64QAM | 1/2       | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.2   | R.70 TDD   | 10 | QPSK  | 0.54-0.65 | 50   |            | ≥ 1       |       |
| TDD                        | Table A.3.4.3.2   | R.71 TDD   | 10 | 16QAM | 0.5-0.6   | 50   |            | ≥ 2       |       |
| TDD                        | Table A.3.4.3.2-1 | R.86 TDD   | 10 | QPSK  | 1/3       | 50   |            | ≥ 1       |       |

**Table A.3.1.1-1K: Overview of DL reference measurement channels (TDD, PDSCH Performance (UE specific RS))**

| Duplex                            | Table             | Name       | BW | Mod   | TCR  | RB | RB Off set | UE Cat eg | Notes |
|-----------------------------------|-------------------|------------|----|-------|------|----|------------|-----------|-------|
| <b>Two antenna ports (CSI-RS)</b> |                   |            |    |       |      |    |            |           |       |
| TDD                               | Table A.3.4.3.3-1 | R.51 TDD   | 10 | 16QAM | 1/2  | 50 |            | ≥ 2       |       |
| TDD                               | Table A.3.4.3.3-1 | R.51-1 TDD | 10 | 16QAM | 0.57 | 50 |            | ≥ 2       |       |

|  |                   |             |    |        |          |     |  |       |  |
|--|-------------------|-------------|----|--------|----------|-----|--|-------|--|
| TDD  | Table A.3.4.3.3-1 | R.51-2 TDD  | 5  | 16QAM  | 0.57     | 25  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-1 | R.51-3 TDD  | 15 | 16QAM  | 0.57     | 75  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-1 | R.51-4 TDD  | 20 | 16QAM  | 0.57     | 100 |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-1 | R.76 FDD    | 10 | QPSK   |          | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-1 FDD  | 5  | QPSK   |          | 25  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-2 FDD  | 15 | QPSK   |          | 75  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-3 FDD  | 20 | QPSK   |          | 100 |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-4 FDD  | 5  | QPSK   |          | 25  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-5 FDD  | 10 | QPSK   |          | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-6 FDD  | 15 | QPSK   |          | 75  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-3 | R.76-7 FDD  | 20 | QPSK   |          | 100 |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.1-2 | R.76A TDD   | 10 | QPSK   | 1/3      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.1-2 | R.94 TDD    | 10 | QPSK   | 2/3      | 24  |  | ≥ 1   |  |
| <b>Two antenna ports (CSI-RS, non Quasi Co-located)</b>  |                   |             |    |        |          |     |  |       |  |
| TDD  | Table A.3.4.3.3-2 | R.52 TDD    | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-2 | R.52-1 TDD  | 10 | 16QAM  | 0.57     | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-2 | R.53 TDD    | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-2 | R.54 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.3-2 | R.97 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| <b>Four antenna ports (CSI-RS)</b>                       |                   |             |    |        |          |     |  |       |  |
| TDD  | Table A.3.4.3.4-1 | R.44 TDD    | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-5 | R.44A-1 TDD | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-1 | R.48 TDD    | 10 | QPSK   |          | 50  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.4-2 | R.60 TDD    | 10 | QPSK   | 1/2      | 50  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.4-2 | R.61 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-2 | R.61-1 TDD  | 10 | 16QAM  | 1/2      | 39  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.4-1 | R.61A TDD   | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-3 | R.64 TDD    | 10 | QPSK   | 1/3      | 6   |  | 0     |  |
| TDD  | Table A.3.4.3.4-1 | R.66 TDD    | 20 | 256QAM |          | 100 |  | 11-15 |  |
| TDD  | Table A.3.4.3.4-4 | R.69 TDD    | 10 | QPSK   | 0.61-0.8 | 50  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.4-1 | R.75 TDD    | 10 | 16QAM  | 0.57     | 50  |  | ≥ 5   |  |
| TDD  | Table A.3.4.3.4-1 | R.75A TDD   | 10 | 16QAM  | 0.51     | 50  |  | ≥ 5   |  |
| TDD  | Table A.3.4.3.4-1 | R.cc TDD    | 10 | 16QAM  |          | 50  |  | ≥ 2   |  |
| <b>Four antenna ports (CSI-RS, non Quasi Co-located)</b> |                   |             |    |        |          |     |  |       |  |
| TDD  | Table A.3.4.3.4-6 | R.98 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-6 | R.99 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.4-7 | R.100 TDD   | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| <b>Eight antenna ports (CSI-RS)</b>                      |                   |             |    |        |          |     |  |       |  |
| TDD  | Table A.3.4.3.5-1 | R.50 TDD    | 10 | QPSK   | 1/3      | 50  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.5-2 | R.45 TDD    | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.5-2 | R.45-1 TDD  | 10 | 16QAM  | 1/2      | 39  |  | ≥ 1   |  |
| TDD  | Table A.3.4.3.5-2 | R.45A TDD   | 10 | 16QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.5-2 | R.45-2 TDD  | 10 | 64QAM  |          | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.5-3 | R.44A-2 TDD | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.5-3 | R.44A-3 TDD | 10 | 64QAM  | 1/2      | 50  |  | ≥ 2   |  |
| TDD  | Table A.3.4.3.5-1 | R.50-3 TDD  | 5  | 16QAM  | 1/2      | 25  |  | 8     |  |
| TDD  | Table A.3.4.3.5-1 | R.50-4 TDD  | 10 | 16QAM  | 1/2      | 50  |  | 8     |  |
| TDD  | Table A.3.4.3.5-1 | R.50-5 TDD  | 15 | 16QAM  | 1/2      | 75  |  | 8     |  |

|   |                   |            |    |       |     |     |  |     |  |
|---|-------------------|------------|----|-------|-----|-----|--|-----|--|
| TDD                                       | Table A.3.4.3.5-1 | R.50-6 TDD | 20 | 16QAM | 1/2 | 100 |  | 8   |  |
| TDD                                       | Table A.3.4.3.5-4 | R.108 TDD  | 10 | QPSK  | 1/2 | 4   |  | ≥ 1 |  |
| <b>Twelve antenna ports (CSI-RS)</b>      |                   |            |    |       |     |     |  |     |  |
| TDD                                       | Table A.3.4.3.6-1 | R.77 TDD   | 10 | 64QAM | 1/2 | 50  |  | ≥ 2 |  |
| <b>Sixteen antenna ports (CSI-RS)</b>     |                   |            |    |       |     |     |  |     |  |
| TDD                                       | Table A.3.4.3.7-1 | R.78 TDD   | 10 | 16QAM | 1/2 | 50  |  | ≥ 2 |  |
| <b>Twenty-four antenna ports (CSI-RS)</b> |                   |            |    |       |     |     |  |     |  |
| TDD                                       | Table A.3.4.3.8-1 | R.88 TDD   | 10 | 16QAM | 1/2 | 50  |  | ≥ 2 |  |
| TDD                                       | Table A.3.4.3.8-1 | R.88A TDD  | 10 | 16QAM | 1/2 | 50  |  | ≥ 2 |  |
| <b>Thirty-two antenna ports (CSI-RS)</b>  |                   |            |    |       |     |     |  |     |  |
| TDD                                       | Table A.3.4.3.9-1 | R.89 TDD   | 10 | 64QAM | 1/2 | 50  |  | ≥ 2 |  |

**Table A.3.1.1-1L: Overview of DL reference measurement channels (PDCCH / PCFICH Performance)**

| Duplex     | Table           | Name       | BW | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|-----------------|------------|----|-------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                 |            |    |       |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.15 FDD   | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.15-1 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.15-2 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.16 FDD   | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.16-1 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.16-2 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.16-3 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.16-4 FDD | 10 | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.17 FDD   | 5  | PDCCH |     |    |            |           |       |
| FDD        | Table A.3.5.1-1 | R.17-3 FDD | 10 | PDCCH |     |    |            |           |       |
| <b>TDD</b> |                 |            |    |       |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.15 TDD   | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.15-1 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.15-2 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.16 TDD   | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.16-1 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.16-2 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.16-3 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.16-4 TDD | 10 | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.17 TDD   | 5  | PDCCH |     |    |            |           |       |
| TDD        | Table A.3.5.2-1 | R.17-3 TDD | 10 | PDCCH |     |    |            |           |       |
| <b>FS3</b> |                 |            |    |       |     |    |            |           |       |
| FS3        | Table A.3.5.3-1 | R.3 FS3    | 20 | PDCCH |     |    |            |           |       |
| FS3        | Table A.3.5.3-2 | R.4 FS3    | 20 | PDCCH |     |    |            |           |       |

**Table A.3.1.1-1M: Overview of DL reference measurement channels (PHICH Performance)**

| Duplex    | Table         | Name | BW | Mod   | TCR | RB | RB Off set | UE Cat eg | Notes |
|-----------|---------------|------|----|-------|-----|----|------------|-----------|-------|
| FDD / TDD | Table A.3.6-1 | R.18 | 10 | PHICH |     |    |            |           |       |

|           |               |        |    |       |  |  |  |  |  |
|-----------|---------------|--------|----|-------|--|--|--|--|--|
| FDD / TDD | Table A.3.6-1 | R.19   | 10 | PHICH |  |  |  |  |  |
| FDD       | Table A.3.6-1 | R.19-1 | 5  | PHICH |  |  |  |  |  |
| FDD / TDD | Table A.3.6-1 | R.20   | 5  | PHICH |  |  |  |  |  |
| FDD / TDD | Table A.3.6-1 | R.24   | 10 | PHICH |  |  |  |  |  |

**Table A.3.1.1-1N: Overview of DL reference measurement channels (PBCH Performance)**

| Duplex    | Table         | Name   | BW  | Mod  | TCR     | RB | RB Off set | UE Cat eg | Notes |
|-----------|---------------|--------|-----|------|---------|----|------------|-----------|-------|
| FDD / TDD | Table A.3.7-1 | R.21   | 1.4 | QPSK | 40/1920 |    |            |           |       |
| FDD / TDD | Table A.3.7-1 | R.22   | 1.4 | QPSK | 40/1920 |    |            |           |       |
| FDD / TDD | Table A.3.7-1 | R.23   | 1.4 | QPSK | 40/1920 |    |            |           |       |
| FDD / TDD | Table A.3.7-1 | R.23-1 | 1.4 | QPSK | 40/4416 |    |            |           |       |

**Table A.3.1.1-1O: Overview of DL reference measurement channels (PMCH Performance)**

| Duplex     | Table            | Name        | BW  | Mod   | TCR  | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|-------------|-----|-------|------|----|------------|-----------|-------|
| <b>FDD</b> |                  |             |     |       |      |    |            |           |       |
| FDD        | Table A.3.8.1-1  | R.40 FDD    | 1.4 | QPSK  | 1/3  | 6  |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-1  | R.37 FDD    | 10  | QPSK  | 1/3  | 50 |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-2  | R.38 FDD    | 10  | 16QAM | 1/2  | 50 |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-3  | R.39-1 FDD  | 5   | 64QAM | 2/3  | 25 |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-3  | R.39 FDD    | 10  | 64QAM | 2/3  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-4  | R.81-1 FDD  | 10  | 16QAM | 1/2  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-4  | R.81-2 FDD  | 10  | 64QAM | 2/3  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-5  | R.82-1 FDD  | 10  | 16QAM | 1/2  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-6  | R.83-1 FDD  | 10  | 16QAM | 1/2  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-6  | R.83-2 FDD  | 10  | 64QAM | 2/3  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-7  | R.84-1 FDD  | 10  | 16QAM | 1/2  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-8  | R.85-1 FDD  | 3   | QPSK  | 1/3  | 15 |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-8  | R.85-2 FDD  | 5   | 16QAM | 1/2  | 25 |            | ≥ 1       |       |
| FDD        | Table A.3.8.1-8  | R.85-3 FDD  | 10  | 64QAM | 2/3  | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-9  | R.106-1 FDD | 10  | 64QAM | 0.48 | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-9  | R.106-2 FDD | 10  | 64QAM | 0.52 | 50 |            | ≥ 2       |       |
| FDD        | Table A.3.8.1-10 | R.107 FDD   | 10  | 16QAM | 0.46 | 50 |            | ≥ 2       |       |
| <b>TDD</b> |                  |             |     |       |      |    |            |           |       |
| TDD        | Table A.3.8.2-1  | R.40 TDD    | 1.4 | QPSK  | 1/3  | 6  |            | ≥ 1       |       |
| TDD        | Table A.3.8.2-1  | R.37 TDD    | 10  | QPSK  | 1/3  | 50 |            | ≥ 1       |       |
| TDD        | Table A.3.8.2-2  | R.38 TDD    | 10  | 16QAM | 1/2  | 50 |            | ≥ 1       |       |
| TDD        | Table A.3.8.2-3  | R.39-1 TDD  | 5   | 64QAM | 2/3  | 25 |            | ≥ 1       |       |
| TDD        | Table A.3.8.2-3  | R.39 TDD    | 10  | 64QAM | 2/3  | 50 |            | ≥ 2       |       |

Table A.3.1.1-1P: Overview of DL reference measurement channels (Sustained data rate)

| Duplex     | Table            | Name        | BW | Mod    | TCR       | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|-------------|----|--------|-----------|----|------------|-----------|-------|
| <b>FDD</b> |                  |             |    |        |           |    |            |           |       |
| FDD        | Table A.3.9.1-1  | R.31-1 FDD  | 10 | 64QAM  | 0.40      |    |            | ≥ 1       |       |
| FDD        | Table A.3.9.1-2  | R.31-1A FDD | 20 | 64QAM  | 0.41      |    |            | ≥ 1       |       |
| FDD        | Table A.3.9.1-1  | R.31-2 FDD  | 10 | 64QAM  | 0.59-0.64 |    |            | ≥ 2       |       |
| FDD        | Table A.3.9.1-1  | R.31-3 FDD  | 20 | 64QAM  | 0.59-0.62 |    |            | ≥ 2       |       |
| FDD        | Table A.3.9.1-1  | R.31-3A FDD | 10 | 64QAM  | 0.85-0.90 |    |            | ≥ 2       |       |
| FDD        | Table A.3.9.1-1  | R.31-3C FDD | 15 | 64QAM  | 0.87-0.91 |    |            | ≥ 3       |       |
| FDD        | Table A.3.9.1-1  | R.31-4 FDD  | 20 | 64QAM  | 0.87-0.90 |    |            | ≥ 3       |       |
| FDD        | Table A.3.9.1-1  | R.31-4B FDD | 15 | 64QAM  | 0.85-0.88 |    |            | ≥ 4       |       |
| FDD        | Table A.3.9.1-1  | R.31-5 FDD  | 15 | 64QAM  | 0.85-0.91 |    |            | ≥ 3       |       |
| FDD        | Table A.3.9.1-2  | R.31-6 FDD  | 5  | 64QAM  | 0.83-0.85 |    |            | ≥ 2       |       |
| FDD        | Table A.3.9.1-2  | R.31-7 FDD  | 10 | 64QAM  | 0.78-0.83 |    |            | ≥ 6       |       |
| FDD        | Table A.3.9.1-2  | R.31-8 FDD  | 15 | 64QAM  | 0.77-0.80 |    |            | ≥ 6       |       |
| FDD        | Table A.3.9.1-2  | R.31-9 FDD  | 20 | 64QAM  | 0.79-0.81 |    |            | ≥ 6       |       |
| FDD        | Table A.3.9.1-2  | R.31-10 FDD | 5  | 64QAM  | 0.78-0.85 |    |            | ≥ 6       |       |
| FDD        | Table A.3.9.1-3  | R.68 FDD    | 20 | 256QAM | 0.74-0.85 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-1 FDD  | 15 | 256QAM | 0.74-0.88 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-2 FDD  | 10 | 256QAM | 0.74-0.85 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-3 FDD  | 5  | 256QAM | 0.77-0.85 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-4 FDD  | 10 | 256QAM | 0.78-0.83 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-5 FDD  | 15 | 256QAM | 0.79-0.82 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-6 FDD  | 20 | 256QAM | 0.78-0.80 |    |            | 11-12     |       |
| FDD        | Table A.3.9.1-3  | R.68-7 FDD  | 5  | 256QAM | 0.77-0.85 |    |            | 11-12     |       |
| <b>TDD</b> |                  |             |    |        |           |    |            |           |       |
| TDD        | Table A.3.9.2-1  | R.31-1 TDD  | 10 | 64QAM  | 0.40      |    |            | ≥ 1       |       |
| TDD        | Table A.3.9.2-1  | R.31-1A TDD | 20 | 64QAM  | 0.41      |    |            | ≥ 1       |       |
| TDD        | Table A.3.9.2-1  | R.31-2 TDD  | 10 | 64QAM  | 0.59-0.64 |    |            | ≥ 2       |       |
| TDD        | Table A.3.9.2-1  | R.31-3 TDD  | 20 | 64QAM  | 0.59-0.62 |    |            | ≥ 2       |       |
| TDD        | Table A.3.9.2-1  | R.31-3A TDD | 15 | 64QAM  | 0.87-0.90 |    |            | ≥ 2       |       |
| TDD        | Table A.3.9.2-1  | R.31-4 TDD  | 20 | 64QAM  | 0.87-0.90 |    |            | ≥ 3       |       |
| TDD        | Table A.3.9.2-1  | R.31-4A TDD | 20 | 64QAM  | 0.87-0.90 |    |            | ≥ 3       |       |
| TDD        | Table A.3.9.2-1  | R.31-5 TDD  | 15 | 64QAM  | 0.85-0.88 |    |            | ≥ 3       |       |
| TDD        | Table A.3.9.2-1  | R.31-5A TDD | 15 | 64QAM  | 0.85-0.88 |    |            | ≥ 3       |       |
| TDD        | Table A.3.9.2-1  | R.31-6 TDD  | 10 | 64QAM  | 0.85-0.88 |    |            | ≥ 2       |       |
| TDD        | Table A.3.9.2-1A | R.31-7 TDD  | 10 | 64QAM  | 0.78-0.82 |    |            | ≥ 6       |       |
| TDD        | Table A.3.9.2-1A | R.31-8 TDD  | 15 | 64QAM  | 0.77-0.79 |    |            | ≥ 6       |       |

|                               |                  |              |    |        |           |  |  |       |  |
|-------------------------------|------------------|--------------|----|--------|-----------|--|--|-------|--|
| TDD                           | Table A.3.9.2-1A | R.31-9 TDD   | 20 | 64QAM  | 0.79-0.81 |  |  | ≥ 6   |  |
| TDD                           | Table A.3.9.2-1A | R.31-7 TDD   | 10 | 64QAM  | 0.75-0.85 |  |  | 8     |  |
| TDD                           | Table A.3.9.2-1A | R.31-8 TDD   | 15 | 64QAM  | 0.76-0.84 |  |  | 8     |  |
| TDD                           | Table A.3.9.2-1A | R.31-9 TDD   | 20 | 64QAM  | 0.74-0.85 |  |  | 8     |  |
| TDD                           | Table A.3.9.2-2  | R.68 TDD     | 20 | 256QAM |           |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-2  | R.68-1 TDD   | 15 | 256QAM |           |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-2  | R.68-2 TDD   | 10 | 256QAM |           |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-2  | R.68-3 TDD   | 20 | 256QAM |           |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-2  | R.68-4 TDD   | 15 | 256QAM |           |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-3  | R.68-5 TDD   | 10 | 256QAM | 0.78-0.82 |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-3  | R.68-6 TDD   | 15 | 256QAM | 0.79-0.82 |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-3  | R.68-7 TDD   | 20 | 256QAM | 0.78-0.80 |  |  | 11-12 |  |
| TDD                           | Table A.3.9.2-3  | R.68-8 TDD   | 10 | 256QAM | 0.70-0.77 |  |  | 8     |  |
| TDD                           | Table A.3.9.2-3  | R.68-9 TDD   | 15 | 256QAM | 0.70-0.76 |  |  | 8     |  |
| TDD                           | Table A.3.9.2-3  | R.68-10 TDD  | 20 | 256QAM | 0.69-0.77 |  |  | 8     |  |
| <b>FDD, EPDCCH scheduling</b> |                  |              |    |        |           |  |  |       |  |
| FDD                           | Table A.3.9.3-1  | R.31E-1 FDD  | 10 | 64QAM  | 0.40-0    |  |  | ≥ 1   |  |
| FDD                           | Table A.3.9.3-1  | R.31E-2 FDD  | 10 | 64QAM  | 0.59-0.66 |  |  | ≥ 2   |  |
| FDD                           | Table A.3.9.3-1  | R.31E-3 FDD  | 20 | 64QAM  | 0.59-0.63 |  |  | ≥ 2   |  |
| FDD                           | Table A.3.9.1-1  | R.31E-3C FDD | 15 | 64QAM  | 0.87-0.92 |  |  | ≥ 3   |  |
| FDD                           | Table A.3.9.3-1  | R.31E-3A FDD | 10 | 64QAM  | 0.85-0.92 |  |  | ≥ 2   |  |
| FDD                           | Table A.3.9.3-1  | R.31E-4 FDD  | 20 | 64QAM  | 0.87-0.91 |  |  | ≥ 3   |  |
| FDD                           | Table A.3.9.1-1  | R.31E-4B FDD | 15 | 64QAM  | 0.87-0.90 |  |  | ≥ 4   |  |
| <b>TDD, EPDCCH scheduling</b> |                  |              |    |        |           |  |  |       |  |
| TDD                           | Table A.3.9.4-1  | R.31E-1 TDD  | 10 | 64QAM  | 0.40-0.41 |  |  | ≥ 1   |  |
| TDD                           | Table A.3.9.4-1  | R.31E-2 TDD  | 10 | 64QAM  | 0.59-0.65 |  |  | ≥ 2   |  |
| TDD                           | Table A.3.9.4-1  | R.31E-3 TDD  | 20 | 64QAM  | 0.59-0.63 |  |  | ≥ 2   |  |
| TDD                           | Table A.3.9.4-1  | R.31E-3A TDD | 15 | 64QAM  | 0.87-0.92 |  |  | ≥ 2   |  |
| TDD                           | Table A.3.9.4-1  | R.31E-4 TDD  | 20 | 64QAM  | 0.87-0.90 |  |  | ≥ 3   |  |

**Table A.3.1.1-1Q: Overview of DL reference measurement channels (EPDCCH)**

| Duplex     | Table            | Name       | BW | Mod     | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|------------|----|---------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                  |            |    |         |     |    |            |           |       |
| FDD        | Table A.3.10.1-1 | R.55 FDD   | 10 | EPDCC H |     |    |            |           |       |
| FDD        | Table A.3.10.1-1 | R.55-1 FDD | 10 | EPDCC H |     |    |            |           |       |
| FDD        | Table A.3.10.1-1 | R.56 FDD   | 10 | EPDCC H |     |    |            |           |       |
| FDD        | Table A.3.10.1-1 | R.57 FDD   | 10 | EPDCC H |     |    |            |           |       |



|            |                  |            |    |            |  |  |  |  |  |
|------------|------------------|------------|----|------------|--|--|--|--|--|
| FDD        | Table A.3.10.1-1 | R.58 FDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| FDD        | Table A.3.10.1-1 | R.59 FDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| <b>TDD</b> |                  |            |    |            |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.55 TDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.55-1 TDD | 10 | EPDCC<br>H |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.56 TDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.57 TDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.58 TDD   | 10 | EPDCC<br>H |  |  |  |  |  |
| TDD        | Table A.3.10.2-1 | R.59 TDD   | 10 | EPDCC<br>H |  |  |  |  |  |

**Table A.3.1.1-1R: Overview of DL reference measurement channels (MPDCCH)**

| Duplex     | Table            | Name     | BW | Mod        | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|----------|----|------------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                  |          |    |            |     |    |            |           |       |
| FDD        | Table A.3.11.1-1 | R.82 FDD | 10 | MPDCC<br>H |     |    |            |           |       |
| FDD        | Table A.3.11.1-1 | R.83 FDD | 10 | MPDCC<br>H |     |    |            |           |       |
| FDD        | Table A.3.11.1-1 | R.96 FDD | 10 | MPDCC<br>H |     |    |            |           |       |
| <b>TDD</b> |                  |          |    |            |     |    |            |           |       |
| TDD        | Table A.3.11.2-1 | R.82 TDD | 10 | MPDCC<br>H |     |    |            |           |       |
| TDD        | Table A.3.11.2-1 | R.83 TDD | 10 | MPDCC<br>H |     |    |            |           |       |
| TDD        | Table A.3.11.2-1 | R.96 TDD | 10 | MPDCC<br>H |     |    |            |           |       |

**Table A.3.1.1-1S: Overview of DL reference measurement channels (NPDSCH)**

| Duplex     | Table              | Name         | BW(KHz) | Mod  | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|--------------------|--------------|---------|------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                    |              |         |      |     |    |            |           |       |
| HD-FDD     | Table A.3.12.1.2-1 | R.NB.5 FDD   | 200     | QPSK | 1/3 |    |            | NB1       |       |
| HD-FDD     | Table A.3.12.1.2-1 | R.NB.5-1 FDD | 200     | QPSK | 1/3 |    |            | NB1       |       |
| HD-FDD     | Table A.3.12.2.1-1 | R.NB.6 FDD   | 200     | QPSK | 1/2 |    |            | NB1       |       |
| HD-FDD     | Table A.3.12.2.1-1 | R.NB.6-1 FDD | 200     | QPSK | 1/3 |    |            | NB1       |       |

**Table A.3.1.1-1T: Overview of DL reference measurement channels (NPDCCH)**

| Duplex     | Table            | Name       | BW(KHz) | Mod  | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|------------|---------|------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                  |            |         |      |     |    |            |           |       |
| HD-FDD     | Table A.3.13.1-1 | R.NB.3 FDD | 200     | QPSK |     |    |            | NB1       |       |
| HD-FDD     | Table A.3.13.1-1 | R.NB.4 FDD | 200     | QPSK |     |    |            | NB1       |       |

Table A.3.1.1-1U: Overview of DL reference measurement channels (NPBCH)

| Duplex     | Table          | Name       | BW(KHz) | Mod  | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|----------------|------------|---------|------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                |            |         |      |     |    |            |           |       |
| HD-FDD     | Table A.3.14-1 | R.NB.1 FDD | 200     | QPSK |     |    |            | NB1       |       |
| HD-FDD     | Table A.3.14-1 | R.NB.2 FDD | 200     | QPSK |     |    |            | NB1       |       |

Table A.3.1.1-1V: Overview of DL reference measurement channels (FS3)

| Duplex     | Table              | Name     | BW | Mod    | TCR       | RB  | RB Off set | UE Cat eg | Notes   |
|------------|--------------------|----------|----|--------|-----------|-----|------------|-----------|---|
| <b>FS3</b> |                    |          |    |        |           |     |            |           |   |
| FS3        | Table A.3.5.1.1-2  | R.1 FS3  | 20 | 64QAM  | 0.6       | 100 |            | ≥ 5       |   |
| FS3        | Table A.3.15.2.1-1 | R.2 FS3  | 20 | 16QAM  | 1/2       | 100 |            | ≥ 5       |   |
| FS3        | Table A.3.9.5-1    | R.5 FS3  | 20 | 64QAM  | 0.88-0.89 | 100 |            | ≥ 5       | not supporting both initial and end partial SF                  |
| FS3        | Table A.3.9.5-1    | R.6 FS3  | 20 | 64QAM  | 0.77-0.89 | 100 |            | ≥ 5       | supporting end partial SF                                       |
| FS3        | Table A.3.9.5-1    | R.7 FS3  | 20 | 64QAM  | 0.88-0.90 | 100 |            | ≥ 5       | supporting initial partial SF but not supporting end partial SF |
| FS3        | Table A.3.9.5-1    | R.8 FS3  | 20 | 64QAM  | 0.79-0.80 | 100 |            | ≥ 5       | not supporting both initial and end partial SF                  |
| FS3        | Table A.3.9.5-1    | R.9 FS3  | 20 | 64QAM  | 0.79-0.82 | 100 |            | ≥ 5       | supporting end partial SF                                       |
| FS3        | Table A.3.9.5-1    | R.10 FS3 | 20 | 64QAM  | 0.79-0.81 | 100 |            | ≥ 5       | supporting initial partial SF but not supporting end partial SF |
| FS3        | Table A.3.9.5-2    | R.11 FS3 | 20 | 256QAM | 0.75-0.85 | 100 |            | ≥ 11      | not supporting both initial and end partial SF                  |
| FS3        | Table A.3.9.5-2    | R.12 FS3 | 20 | 256QAM | 0.74-0.85 | 100 |            | ≥ 11      | supporting end partial SF                                       |
| FS3        | Table A.3.9.5-2    | R.13 FS3 | 20 | 256QAM | 0.74-0.85 | 100 |            | ≥ 11      | supporting initial partial SF but not supporting end partial SF |
| FS3        | Table A.3.9.5-2    | R.14 FS3 | 20 | 256QAM | 0.78-0.79 | 100 |            | ≥ 11      | not supporting both initial and end partial SF                  |
| FS3        | Table A.3.9.5-2    | R.15 FS3 | 20 | 256QAM | 0.74-0.79 | 100 |            | ≥ 11      | supporting end partial SF                                       |
| FS3        | Table A.3.9.5-2    | R.16 FS3 | 20 | 256QAM | 0.77-0.79 | 100 |            | ≥ 11      | supporting initial partial SF but not supporting end partial SF |

Table A.3.1.1-1W: Overview of DL reference measurement channels (Slot-PDSCH/Subslot-PDSCH)

| Duplex     | Table            | Name         | BW | Mod   | TCR  | RB | RB Off set | UE Cat eg | Notes         |
|------------|------------------|--------------|----|-------|------|----|------------|-----------|---------------|
| <b>FDD</b> |                  |              |    |       |      |    |            |           |               |
| FDD        | Table A.3.16.1-1 | R.sTTI.1 FDD | 10 | 16QAM | 1/2  | 50 |            | ≥2        | Slot-PDSCH    |
| FDD        | Table A.3.16.1-2 | R.sTTI.2 FDD | 10 | 16QAM | 0.45 | 50 |            | ≥2        | Subslot-PDSCH |
| FDD        | Table A.3.16.1-3 | R.sTTI.3 FDD | 10 | QPSK  | 1/3  | 50 |            | ≥2        | Slot-PDSCH    |
| FDD        | Table A.3.16.1-4 | R.sTTI.4 FDD | 10 | QPSK  | 1/3  | 50 |            | ≥2        | Subslot-PDSCH |
| <b>TDD</b> |                  |              |    |       |      |    |            |           |               |
| TDD        | Table A.3.16.2-1 | R.sTTI.1 TDD | 10 | 16QAM | 1/2  | 50 |            | ≥2        | Slot-PDSCH    |

|     |                  |              |    |      |     |    |  |    |            |
|-----|------------------|--------------|----|------|-----|----|--|----|------------|
| TDD | Table A.3.16.2-1 | R.sTTI.2 TDD | 10 | QPSK | 1/3 | 50 |  | ≥2 | Slot-PDSCH |
|-----|------------------|--------------|----|------|-----|----|--|----|------------|

**Table A.3.1.1-1X: Overview of DL reference measurement channels (SPDCCH)**

| Duplex     | Table            | Name          | BW | Mod     | TCR | RB | RB Off set | UE Cat eg | Notes |
|------------|------------------|---------------|----|---------|-----|----|------------|-----------|-------|
| <b>FDD</b> |                  |               |    |         |     |    |            |           |       |
| FDD        | Table A.3.17.1-1 | R.sTTI.10 FDD | 10 | SPDCC H |     |    |            |           |       |
| FDD        | Table A.3.17.1-1 | R.sTTI.11 FDD | 10 | SPDCC H |     |    |            |           |       |
| <b>TDD</b> |                  |               |    |         |     |    |            |           |       |
| TDD        | Table A.3.17.2-1 | R.sTTI.10 TDD | 10 | SPDCC H |     |    |            |           |       |
| TDD        | Table A.3.17.2-1 | R.sTTI.11 TDD | 10 | SPDCC H |     |    |            |           |       |

## A.3.2 Reference measurement channel for receiver characteristics

Unless otherwise stated, Tables A.3.2-1, A.3.2-1a, A.3.2-1b, A.3.2-2, A.3.2-2a and A.3.2-2b are applicable for measurements on the Receiver Characteristics (clause 7) with the exception of subclause 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2-3, A.3.2-3a, A.3.2-3b, A.3.2-4, A.3.2-4a and A.3.2-4b are applicable for subclause 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2-1, A.3.2-1a, A.3.2-1b, A.3.2-2, A.3.2-2a and A.3.2-2b also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

For transmissions in TDD Band 46, Table A.3.2-2c is applicable for measurements of Receiver Characteristics (clause 7) except for the Maximum Input Level (clause 7.4A) for which Table A.3.2-4d and Table A.3.2-7 apply. For these measurements, the discovery signals measurement timing configuration (DMTC) periodicity shall be set at *dmtc-Periodicity* = 40 ms with an offset *dmtc-Offset* = 0 for the channel and the DRS shall be transmitted in the first subframe of each DMTC occasion. Furthermore, no PBCH is transmitted and the PDSCH is also scheduled in subframe #5.

**Table A.3.2-1 Fixed Reference Channel for Receiver Requirements (FDD)**

| Parameter                                    | Unit      | Value |      |      |       |       |       |
|--|-----------|-------|------|------|-------|-------|-------|
|  |           | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Channel bandwidth                            | MHz       | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Allocated resource blocks                    |           | 6     | 15   | 25   | 50    | 75    | 100   |
| Subcarriers per resource block               |           | 12    | 12   | 12   | 12    | 12    | 12    |
| Allocated subframes per Radio Frame          |           | 9     | 9    | 9    | 9     | 9     | 9     |
| Modulation                                   |           | QPSK  | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding Rate                           |           | 1/3   | 1/3  | 1/3  | 1/3   | 1/3   | 1/3   |
| Number of HARQ Processes                     | Processes | 8     | 8    | 8    | 8     | 8     | 8     |
| Maximum number of HARQ transmissions         |           | 1     | 1    | 1    | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame        |           |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits      | 408   | 1320 | 2216 | 4392  | 6712  | 8760  |
| For Sub-Frame 5                              | Bits      | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits      | 152   | 872  | 1800 | 4392  | 6712  | 8760  |
| Transport block CRC                          | Bits      | 24    | 24   | 24   | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 3) |           |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits      | 1     | 1    | 1    | 1     | 2     | 2     |
| For Sub-Frame 5                              | Bits      | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits      | 1     | 1    | 1    | 1     | 2     | 2     |
| Binary Channel Bits Per Sub-Frame            |           |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits      | 1368  | 3780 | 6300 | 13800 | 20700 | 27600 |
| For Sub-Frame 5                              | Bits      | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits      | 528   | 2940 | 5460 | 12960 | 19860 | 26760 |

|                                       |  |       |        |        |        |        |      |
|---------------------------------------|--|-------|--------|--------|--------|--------|------|
| Max. Throughput averaged over 1 frame | kbps   | 341.6 | 1143.2 | 1952.8 | 3952.8 | 6040.8 | 7884 |
| UE Category                           |  | ≥ 1   | ≥ 1    | ≥ 1    | ≥ 1    | ≥ 1    | ≥ 1  |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz |       |        |        |        |        |      |
| Note 2:                               | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]  |       |        |        |        |        |      |
| Note 3:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)                           |       |        |        |        |        |      |

**Table A.3.2-1a Fixed Reference Channel for Receiver Requirements (FDD)**

| Parameter                             | Unit   | Value |      |      |       |       |       |
|---------------------------------------|--|-------|------|------|-------|-------|-------|
|                                       |  | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Channel bandwidth                     | MHz  | 1.4   | 3    | 5    | 10    | 15    | 20    |
| Allocated resource blocks             |  | 6     | 14   | 14   | 14    | 14    | 14    |
| Subcarriers per resource block        |  | 12    | 12   | 12   | 12    | 12    | 12    |
| Allocated subframes per Radio Frame   |  | 9     | 9    | 9    | 9     | 9     | 9     |
| Modulation                            |  | QPSK  | QPSK | QPSK | QPSK  | QPSK  | QPSK  |
| Target Coding Rate                    |  | 1/3   | 1/3  | 1/3  | 1/3   | 1/3   | 1/3   |
| Number of HARQ Processes              | Processes  | 8     | 8    | 8    | 8     | 8     | 8     |
| Maximum number of HARQ transmissions  |  | 1     | 1    | 1    | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame |  |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9        | Bits   | 408   | 1000 | 1000 | 1000  | 1000  | 1000  |
| For Sub-Frame 5                       | Bits   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0 (Note 3)              | Bits   | 152   | 840  | 840  | 904   | 904   | 904   |
| Transport block CRC                   | Bits   | 24    | 24   | 24   | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame   |  |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9        | Bits   | 1     | 1    | 1    | 1     | 1     | 1     |
| For Sub-Frame 5                       | Bits   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0                       | Bits   | 1     | 1    | 1    | 1     | 1     | 1     |
| Binary Channel Bits Per Sub-Frame     |  |       |      |      |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9        | Bits   | 1368  | 3528 | 3528 | 3864  | 3864  | 3864  |
| For Sub-Frame 5                       | Bits   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A   |
| For Sub-Frame 0 (Note 3)              | Bits   | 528   | 2688 | 2688 | 3024  | 3024  | 3024  |
| Max. Throughput averaged over 1 frame | kbps   | 341.6 | 884  | 884  | 890.4 | 890.4 | 890.4 |
| UE DL Category                        |  | 0     | 0    | 0    | 0     | 0     | 0     |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz   |       |      |      |       |       |       |
| Note 2:                               | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.   |       |      |      |       |       |       |
| Note 3:                               | For Sub-Frame 0, it is assumed the 6PRBs are allocated in the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.  |       |      |      |       |       |       |
| Note 4:                               | For HD-FDD UE, the downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled. |       |      |      |       |       |       |

**Table A.3.2-1b Fixed Reference Channel for Receiver Requirements (FDD and HD-FDD) – for CAT-M1**

| Parameter                                    | Unit      | Value |      |      |      |      |      |
|--|-----------|-------|------|------|------|------|------|
|  |           | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Channel bandwidth                            | MHz       | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks                    |           | 4     | 4    | 4    | 4    | 4    | 4    |
| Subcarriers per resource block               |           | 12    | 12   | 12   | 12   | 12   | 12   |
| Allocated subframes per Radio Frame (Note 6) |           | 2     | 2    | 8    | 8    | 8    | 8    |
| Modulation                                   |           | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate                           |           | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Number of HARQ Processes                     | Processes | 8     | 8    | 8    | 8    | 8    | 8    |
| Maximum number of HARQ transmissions         |           | 1     | 1    | 1    | 1    | 1    | 1    |
| Information Bit Payload per Sub-Frame        |           |       |      |      |      |      |      |
| For Sub-Frames 3,8                           | Bits      | 256   | 256  | 256  | 328  | 328  | 328  |
| For Sub-Frames 0,1,2,5,7,9                   | Bits      | N/A   | N/A  | 256  | 328  | 328  | 328  |
| For Sub-Frame 4                              | Bits      | N/A   | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 6                              | Bits      | N/A   | N/A  | N/A  | N/A  | N/A  | N/A  |
| Transport block CRC                          | Bits      | 24    | 24   | 24   | 24   | 24   | 24   |
| Number of Code Blocks per Sub-Frame          |           |       |      |      |      |      |      |

|   |   |      |      |       |       |       |       |
|---|---|------|------|-------|-------|-------|-------|
| For Sub-Frames 3,8                                | Bits  | 1    | 1    | 1     | 1     | 1     | 1     |
| For Sub-Frames 0,1,2,5,7,9                        | Bits  | N/A  | N/A  | 1     | 1     | 1     | 1     |
| For Sub-Frame 4                                   | Bits  | N/A  | N/A  | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 6                                   | Bits  | N/A  | N/A  | N/A   | N/A   | N/A   | N/A   |
| Binary Channel Bits Per Sub-Frame                 |   |      |      |       |       |       |       |
| For Sub-Frames 3,8                                | Bits  | 912  | 1008 | 1008  | 1104  | 1104  | 1104  |
| For Sub-Frames 0,1,2,5,7,9                        | Bits  | N/A  | N/A  | 1008  | 1104  | 1104  | 1104  |
| For Sub-Frame 4                                   | Bits  | N/A  | N/A  | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 6                                   | Bits  | N/A  | N/A  | N/A   | N/A   | N/A   | N/A   |
| Max. Throughput averaged over 1 frame for FDD     | kbps  | 51.2 | 51.2 | 204.8 | 262.4 | 262.4 | 262.4 |
| Max. Throughput averaged over 1 frames for HD-FDD | kbps  | 25.6 | 25.6 | 76.8  | 98.4  | 98.4  | 98.4  |
| UE DL Category                                    |   | M1   | M1   | M1    | M1    | M1    | M1    |
| Note 1:   | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz  |      |      |       |       |       |       |
| Note 2:   | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.  |      |      |       |       |       |       |
| Note 3:   | The scheduled narrowband other than 1.4MHz and 3MHz channel bandwidth avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.  |      |      |       |       |       |       |
| Note 4:   | For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz and 3MHz channel bandwidth. For other channel bandwidth, PDSCH are scheduled at the 0th, 1st and 2nd subframes every 1 radio frame. Information bit payload is available if downlink subframe is scheduled. The corresponding M-PDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. |      |      |       |       |       |       |
| Note 5:   | 2 resource blocks allocated to M-PDCCH  |      |      |       |       |       |       |

**Table A.3.2-1c Fixed Reference Channel for Receiver Requirements (HD-FDD) without repetition – for CAT-NB1**

| Parameter                                | Unit   | Value |
|--|--|-------|
| Channel bandwidth                        | MHz  | 0.2   |
| Number of subcarriers                    |  | 12    |
| Modulation                               |  | QPSK  |
| Target Coding Rate                       |  | 1/3   |
| Number of HARQ Processes                 | Processes  | 1     |
| Maximum number of HARQ transmissions     |  | 1     |
| Transport block size                     | Bits   | 88    |
| Number of Sub-Frames per transport block |  | 1     |
| Transport block CRC                      | Bits   | 24    |
| Binary Channel Bits Per Sub-Frame        | Bits   | 320   |
| LTE CRS port                             |  | N/A   |
| Number of NRS ports                      |  | 1     |
| Number of NPDSCH repetitions (Note 7)    |  | 0     |
| UE DL Category                           |  | NB1   |
| Note 1:                                  | Category NB1 in stand-alone mode has been considered here.   |       |
| Note 2:                                  | Reference signal, Synchronization signals and NPBCH allocated as per TS 36.211.  |       |
| Note 3:                                  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |       |
| Note 4:                                  | Parameters related to NPDSCH scheduling are defined in Table A.3.2-1e to Table A.3.2-1g.   |       |
| Note 5:                                  | NPDCCH and information bit payload are not transmitted in the subframes used for transmission of SI messages.  |       |
| Note 6:                                  | SI messages transmission should be prioritized over NPDCCH transmission in case of collision. NPDCCH transmission is postponed until the next NB-IoT downlink subframe in case NPDCCH transmission occurs in a non NB-IoT downlink subframe, where an NB-IoT downlink subframe is a subframe that does not contain NPSS/NSSS/NPBCH/SIB1-NB transmission. |       |
| Note 7:                                  | Number of repetition $N_{Rep}$ as defined in table 16.4.1.3-2 in TS 36.213 [6].  |       |

Table A.3.2-1d: Void

Table A.3.2-1e: General configuration for CAT-NB1

| Parameter  | Unit | Value          |
|--|------|----------------|
| NB-IoT downlink subframe bitmap for anchor carrier<br>( <i>downlinkBitmap</i> )              |      | Not configured |
| NB-IoT downlink subframe bitmap for non-anchor carrier<br>( <i>downlinkBitmapNonAnchor</i> ) |      | Not configured |
| Downlink gap configuration for anchor carrier<br>( <i>dl-Gap</i> )                           |      | Not configured |
| Downlink gap configuration for non-anchor carrier<br>( <i>dl-GapNonAnchor</i> )              |      | Not configured |

Table A.3.2-1f: NPDCCH configuration for NPDSCH scheduling

| Parameter  | Unit | Value         |
|--|------|---------------|
| DCI format   |      | DCI format N1 |
| NPDCCH format  |      | 1             |
| Scheduling delay ( $I_{\text{Delay}}$ )                  |      | 0             |
| DCI subframe repetition number                           |      | 00            |
| $R_{\text{max}}$<br>( <i>npdcch-NumRepetitions</i> )     |      | 1             |
| $G$<br>( <i>NPDCCH-startSF-USS</i> )                     |      | 8             |
| $\alpha_{\text{offset}}$<br>( <i>npdcch-Offset-USS</i> ) |      | 1/4           |

Table A.3.2-1g: NPUSCH format 2 configurations for NPDSCH scheduling

| Parameter   | Unit | Value |
|---|------|-------|
| Scheduling delay<br>( $I_{\text{Delay}}$ )                      |      | 0     |
| $N_{\text{Rep}}^{\text{AN}}$ ( <i>ack-NACK-NumRepetitions</i> ) |      | 1     |
| ACK/NACK resource field   |      | 0     |

Table A.3.2-1h: Fixed Reference Channel for Receiver Requirements (FDD and HD-FDD) – for CAT-M2

| Parameter                                    | Unit      | Value |      |      |      |      |      |
|--|-----------|-------|------|------|------|------|------|
| Channel bandwidth                            | MHz       | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks (Note 6)           |           | 4     | 8    | 16   | 16   | 16   | 16   |
| Subcarriers per resource block               |           | 12    | 12   | 12   | 12   | 12   | 12   |
| Allocated subframes per Radio Frame (Note 4) |           | 2     | 2    | 8    | 8    | 8    | 8    |
| Modulation                                   |           | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate                           |           | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Number of HARQ Processes                     | Processes | 8     | 8    | 8    | 8    | 8    | 8    |
| Maximum number of HARQ transmissions         |           | 1     | 1    | 1    | 1    | 1    | 1    |
| Information Bit Payload per Sub-Frame        |           |       |      |      |      |      |      |
| For Sub-Frames 3,8                           | Bits      | 256   | 680  | 1384 | 1384 | 1384 | 1384 |

|   |   |      |       |       |       |        |        |
|---|---|------|-------|-------|-------|--------|--------|
| For Sub-Frames 0,1,2,5,7,9                        | Bits  | N/A  | N/A   | N/A   | N/A   | 1384   | 1384   |
| For Sub-Frame 4                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| Transport block CRC                               | Bits  | 24   | 24    | 24    | 24    | 24     | 24     |
| Number of Code Blocks per Sub-Frame               |   |      |       |       |       |        |        |
| For Sub-Frames 3,8                                | Bits  | 1    | 1     | 1     | 1     | 1      | 1      |
| For Sub-Frames 0,1,2,5,7,9                        | Bits  | N/A  | N/A   | 1     | 1     | 1      | 1      |
| For Sub-Frame 4                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| Binary Channel Bits Per Sub-Frame                 |   |      |       |       |       |        |        |
| For Sub-Frames 3,8                                | Bits  | 912  | 2016  | 4032  | 4416  | 4416   | 4416   |
| For Sub-Frames 0,1,2,5,7,9                        | Bits  | N/A  | N/A   | N/A   | N/A   | 4416   | 4416   |
| For Sub-Frame 4                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                   | Bits  | N/A  | N/A   | N/A   | N/A   | N/A    | N/A    |
| Max. Throughput averaged over 1 frame for FDD     | kbps  | 51.2 | 136.0 | 276.8 | 276.8 | 1107.2 | 1107.2 |
| Max. Throughput averaged over 1 frames for HD-FDD | kbps  | 25.6 | 68.0  | 138.4 | 138.4 | 415.2  | 415.2  |
| UE DL Category                                    |   | M2   | M2    | M2    | M2    | M2     | M2     |
| Note 1:   | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz  |      |       |       |       |        |        |
| Note 2:   | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.  |      |       |       |       |        |        |
| Note 3:   | The scheduled wideband other than 1.4MHz/3MHz/5MHz/15MHz channel bandwidth avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.   |      |       |       |       |        |        |
| Note 4:   | For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz/3MHz/5MHz/10MHz channel bandwidth. For other channel bandwidth, PDSCH are scheduled at the 0th, 1st and 2nd subframes every 1 radio frame. Information bit payload is available if downlink subframe is scheduled. The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. |      |       |       |       |        |        |
| Note 5:   | 2 resource blocks allocated to MPDCCH.  |      |       |       |       |        |        |
| Note 6:   | 4 resource blocks in each narrowband allocated to PDSCH.  |      |       |       |       |        |        |

**Table A.3.2-2 Fixed Reference Channel for Receiver Requirements (TDD)**

| Parameter                                    | Unit      | Value |      |      |        |        |        |
|--|-----------|-------|------|------|--------|--------|--------|
|  |           | 1.4   | 3    | 5    | 10     | 15     | 20     |
| Channel Bandwidth                            | MHz       | 1.4   | 3    | 5    | 10     | 15     | 20     |
| Allocated resource blocks                    |           | 6     | 15   | 25   | 50     | 75     | 100    |
| Uplink-Downlink Configuration (Note 5)       |           | 1     | 1    | 1    | 1      | 1      | 1      |
| Allocated subframes per Radio Frame (D+S)    |           | 3     | 3+2  | 3+2  | 3+2    | 3+2    | 3+2    |
| Number of HARQ Processes                     | Processes | 7     | 7    | 7    | 7      | 7      | 7      |
| Maximum number of HARQ transmission          |           | 1     | 1    | 1    | 1      | 1      | 1      |
| Modulation                                   |           | QPSK  | QPSK | QPSK | QPSK   | QPSK   | QPSK   |
| Target coding rate                           |           | 1/3   | 1/3  | 1/3  | 1/3    | 1/3    | 1/3    |
| Information Bit Payload per Sub-Frame        | Bits      |       |      |      |        |        |        |
| For Sub-Frame 4, 9                           |           | 408   | 1320 | 2216 | 4392   | 6712   | 8760   |
| For Sub-Frame 1, 6                           |           | N/A   | 968  | 1544 | 3240   | 4968   | 6712   |
| For Sub-Frame 5                              |           | N/A   | N/A  | N/A  | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              |           | 208   | 1064 | 1800 | 4392   | 6712   | 8760   |
| Transport block CRC                          | Bits      | 24    | 24   | 24   | 24     | 24     | 24     |
| Number of Code Blocks per Sub-Frame (Note 4) |           |       |      |      |        |        |        |
| For Sub-Frame 4, 9                           |           | 1     | 1    | 1    | 1      | 2      | 2      |
| For Sub-Frame 1, 6                           |           | N/A   | 1    | 1    | 1      | 1      | 2      |
| For Sub-Frame 5                              |           | N/A   | N/A  | N/A  | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              |           | 1     | 1    | 1    | 1      | 2      | 2      |
| Binary Channel Bits Per Sub-Frame            | Bits      |       |      |      |        |        |        |
| For Sub-Frame 4, 9                           |           | 1368  | 3780 | 6300 | 13800  | 20700  | 27600  |
| For Sub-Frame 1, 6                           |           | N/A   | 3276 | 5556 | 11256  | 16956  | 22656  |
| For Sub-Frame 5                              |           | N/A   | N/A  | N/A  | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              |           | 672   | 3084 | 5604 | 13104  | 20004  | 26904  |
| Max. Throughput averaged over 1 frame        | kbps      | 102.4 | 564  | 932  | 1965.6 | 3007.2 | 3970.4 |
| UE Category                                  |           | ≥ 1   | ≥ 1  | ≥ 1  | ≥ 1    | ≥ 1    | ≥ 1    |

|         |   |
|---------|---|
| Note 1: | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |
| Note 2: | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance  |
| Note 3: | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]   |
| Note 4: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |
| Note 5: | As per Table 4.2-2 in TS 36.211 [4]   |

**Table A.3.2-2a Fixed Reference Channel for Receiver Requirements (TDD)**

| Parameter                                    | Unit  | Value |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|
|  |   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel Bandwidth                            | MHz   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks                    |   | 6     | 14    | 14    | 14    | 14    | 14    |
| Uplink-Downlink Configuration (Note 5)       |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame (D+S)    |   | 3     | 3+2   | 3+2   | 3+2   | 3+2   | 3+2   |
| Number of HARQ Processes                     | Processes   | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmission          |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Modulation                                   |   | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  |
| Target coding rate                           |   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Information Bit Payload per Sub-Frame        | Bits  |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 408   | 1000  | 1000  | 1000  | 1000  | 1000  |
| For Sub-Frame 1, 6                           |   | N/A   | 872   | 872   | 872   | 872   | 872   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 208   | 1000  | 1000  | 1000  | 1000  | 1000  |
| Transport block CRC                          | Bits  | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frame 1, 6                           |   | N/A   | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Binary Channel Bits Per Sub-Frame            | Bits  |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 1368  | 3528  | 3528  | 3864  | 3864  | 3864  |
| For Sub-Frame 1, 6                           |   | N/A   | 3048  | 3048  | 3048  | 3048  | 3048  |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 672   | 2832  | 2832  | 3168  | 3168  | 3168  |
| Max. Throughput averaged over 1 frame        | kbps  | 102.4 | 474.4 | 474.4 | 474.4 | 474.4 | 474.4 |
| UE DL Category                               |   | 0     | 0     | 0     | 0     | 0     | 0     |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |       |       |       |       |       |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance  |       |       |       |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]   |       |       |       |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |       |       |       |       |       |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4]   |       |       |       |       |       |       |

**Table A.3.2-2b Fixed Reference Channel for Receiver Requirements (TDD) – for CAT-M1**

| Parameter                               | Unit      | Value |      |      |      |      |      |
|---|-----------|-------|------|------|------|------|------|
|   |           | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Channel Bandwidth                       | MHz       | 1.4   | 3    | 5    | 10   | 15   | 20   |
| Allocated resource blocks               |           | 4     | 4    | 4    | 4    | 4    | 4    |
| Uplink-Downlink Configuration (Note 5)  |           | 1     | 1    | 1    | 1    | 1    | 1    |
| Allocated subframes per Radio Frame (D) |           | 3     | 3    | 3    | 3    | 3    | 3    |
| Number of HARQ Processes                | Processes | 7     | 7    | 7    | 7    | 7    | 7    |
| Maximum number of HARQ transmission     |           | 1     | 1    | 1    | 1    | 1    | 1    |
| Modulation                              |           | QPSK  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target coding rate                      |           | 1/3   | 1/3  | 1/3  | 1/3  | 1/3  | 1/3  |
| Information Bit Payload per Sub-Frame   | Bits      |       |      |      |      |      |      |
| For Sub-Frame 4, 9                      |           | 256   | 256  | 256  | 328  | 328  | 328  |



|  |   |      |      |      |      |      |      |
|--|---|------|------|------|------|------|------|
| For Sub-Frame 1, 6                           |   | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 5                              |   | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0                              |   | 256  | 256  | 256  | 328  | 328  | 328  |
| Transport block CRC                          | Bits  | 24   | 24   | 24   | 24   | 24   | 24   |
| Number of Code Blocks per Sub-Frame (Note 4) |   |      |      |      |      |      |      |
| For Sub-Frame 4, 9                           |   | 1    | 1    | 1    | 1    | 1    | 1    |
| For Sub-Frame 1, 6                           |   | N/A  | 1    | 1    | 1    | 1    | 1    |
| For Sub-Frame 5                              |   | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0                              |   | 1    | 1    | 1    | 1    | 1    | 1    |
| Binary Channel Bits Per Sub-Frame            | Bits  |      |      |      |      |      |      |
| For Sub-Frame 4, 9                           |   | 912  | 1008 | 1008 | 1104 | 1104 | 1104 |
| For Sub-Frame 1, 6                           |   | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 5                              |   | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0                              |   | 912  | 1008 | 1008 | 1104 | 1104 | 1104 |
| Max. Throughput averaged over 1 frame        | kbps  | 76.8 | 76.8 | 76.8 | 98.4 | 98.4 | 98.4 |
| UE DL Category                               |   | M1   | M1   | M1   | M1   | M1   | M1   |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |      |      |      |      |      |      |
| Note 2:                                      | No data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance  |      |      |      |      |      |      |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]   |      |      |      |      |      |      |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |      |      |      |      |      |      |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4]   |      |      |      |      |      |      |
| Note 6:                                      | For Sub-Frame 0, the scheduled narrowband avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.  |      |      |      |      |      |      |
| Note 7:                                      | 2 resource blocks allocated to MPDCCH   |      |      |      |      |      |      |

Table A.3.2-2c Fixed Reference Channel for Receiver Requirements (TDD Band 46)

| Parameter                                    | Unit  | Value  | Value |
|--|---|--------|-------|
| Channel bandwidth                            | MHz   | 10     | 20    |
| Allocated resource blocks                    |   | 50     | 100   |
| Uplink-Downlink Configuration                |   | N/A    | N/A   |
| Subcarriers per resource block               |   | 12     | 12    |
| Allocated subframes per Radio Frame (D)      |   | 8      | 8     |
| Modulation                                   |   | QPSK   | QPSK  |
| Target Coding Rate                           |   | 1/3    | 1/3   |
| Number of HARQ Processes                     | Processes   | N/A    | N/A   |
| Maximum number of HARQ transmissions         |   | N/A    | N/A   |
| Information Bit Payload per Sub-Frame        |   |        |       |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 4392   | 8760  |
| For Sub-Frame 1,2                            | Bits  | N/A    | N/A   |
| For Sub-Frame 0,5                            | Bits  | 4392   | 8760  |
| Transport block CRC                          | Bits  | 24     | 24    |
| Number of Code Blocks per Sub-Frame (Note 3) |   |        |       |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 1      | 2     |
| For Sub-Frame 1,2                            | Bits  | N/A    | N/A   |
| For Sub-Frame 0,5                            | Bits  | 1      | 2     |
| Binary Channel Bits Per Sub-Frame            |   |        |       |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 13800  | 27600 |
| For Sub-Frame 1,2                            | Bits  | N/A    | N/A   |
| For Sub-Frame 0,5                            | Bits  | 13512  | 27312 |
| Max. Throughput averaged over 1 frame        | kbps  | 3513.6 | 7008  |
| UE Category                                  |   | ≥ 1    | ≥ 1   |
| Note 1:                                      | 2 symbols allocated to PDCCH.   |        |       |
| Note 2:                                      | Reference signal and Synchronization signals allocated as per TS 36.211 [4].  |        |       |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |        |       |

**Table A.3.2-2d: Fixed Reference Channel for Receiver Requirements (TDD) – for CAT-M2**

| Parameter                                    | Unit  | Value |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|
|  |   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel Bandwidth                            | MHz   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks (Note 8)           |   | 4     | 8     | 16    | 16    | 16    | 16    |
| Uplink-Downlink Configuration (Note 5)       |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame (D)      |   | 3     | 3     | 3     | 3     | 3     | 3     |
| Number of HARQ Processes                     | Processes   | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmission          |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Modulation                                   |   | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  |
| Target coding rate                           |   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Information Bit Payload per Sub-Frame        | Bits  |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 256   | 680   | 1384  | 1384  | 1384  | 1384  |
| For Sub-Frame 1, 6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 256   | 680   | 1384  | 1384  | 1384  | 1384  |
| Transport block CRC                          | Bits  | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frame 1, 6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Binary Channel Bits Per Sub-Frame            | Bits  |       |       |       |       |       |       |
| For Sub-Frame 4, 9                           |   | 912   | 2016  | 4032  | 4416  | 4416  | 4416  |
| For Sub-Frame 1, 6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | 912   | 2016  | 4032  | 4416  | 4416  | 4416  |
| Max. Throughput averaged over 1 frame        | kbps  | 76.8  | 204.0 | 415.2 | 415.2 | 415.2 | 415.2 |
| UE DL Category                               |   | M2    | M2    | M2    | M2    | M2    | M2    |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |       |       |       |       |       |
| Note 2:                                      | No data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance  |       |       |       |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]   |       |       |       |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |       |       |       |       |       |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4]   |       |       |       |       |       |       |
| Note 6:                                      | For Sub-Frame 0, the scheduled narrowband avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.  |       |       |       |       |       |       |
| Note 7:                                      | 2 resource blocks allocated to MPDCCH   |       |       |       |       |       |       |
| Note 8:                                      | 4 resource blocks in each narrowband allocated to PDSCH.  |       |       |       |       |       |       |

**Table A.3.2-2e Fixed Reference Channel for Receiver Requirements (TDD) – for CAT-NB1 and CAT-NB2**

| Parameter                                | Unit      | Value |
|--|-----------|-------|
| Channel bandwidth                        | MHz       | 0.2   |
| Number of subcarriers                    |           | 12    |
| Uplink-Downlink Configuration (Note 7)   |           | 1     |
| Modulation                               |           | QPSK  |
| Target Coding Rate                       |           | 1/3   |
| Number of HARQ Processes                 | Processes | 1     |
| Maximum number of HARQ transmissions     |           | 1     |
| Transport block size                     | Bits      | 88    |
| Number of Sub-Frames per transport block |           | 1     |
| Transport block CRC                      | Bits      | 24    |
| Binary Channel Bits Per Sub-Frame        | Bits      | 320   |
| LTE CRS port                             |           | N/A   |
| Number of NRS ports                      |           | 1     |

|                              |  |            |
|------------------------------|--|------------|
| Number of NPDSCH repetitions |  | 1          |
| UE DL Category               |  | NB1 or NB2 |
| Note 1:                      | Category NB1 or NB2 in stand-alone mode has been considered here.  |            |
| Note 2:                      | Reference signal, Synchronization signals and NPBCH allocated as per TS 36.211.  |            |
| Note 3:                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |            |
| Note 4:                      | Parameters related to NPDSCH scheduling are defined in Table A.3.2-1e to Table A.3.2-1g.   |            |
| Note 5:                      | NPDCCH and information bit payload are not transmitted in the subframes used for transmission of SI messages.  |            |
| Note 6:                      | SI messages transmission should be prioritized over NPDCCH transmission in case of collision. NPDCCH transmission is postponed until the next NB-IoT downlink subframe in case NPDCCH transmission occurs in a non NB-IoT downlink subframe, where an NB-IoT downlink subframe is a subframe that does not contain NPSS/NSSS/NPBCH/SIB1-NB transmission. |            |
| Note 7:                      | As per Table 4.2-2 in TS 36.211 [4]  |            |
| Note 8:                      | Number of repetition $N_{Rep}$ as defined in table 16.4.1.3-2 in TS 36.213 [6].  |            |

**Table A.3.2-3 Fixed Reference Channel for Maximum input level for UE Categories ≥ 3(FDD)**

| Parameter                                    | Unit   | Value  |        |       |       |       |       |
|--|--|--------|--------|-------|-------|-------|-------|
|  |  | 1.4    | 3      | 5     | 10    | 15    | 20    |
| Channel bandwidth                            | MHz  | 1.4    | 3      | 5     | 10    | 15    | 20    |
| Allocated resource blocks                    |  | 6      | 15     | 25    | 50    | 75    | 100   |
| Subcarriers per resource block               |  | 12     | 12     | 12    | 12    | 12    | 12    |
| Allocated subframes per Radio Frame          |  | 8      | 9      | 9     | 9     | 9     | 9     |
| Modulation                                   |  | 64QAM  | 64QAM  | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate                           |  | 3/4    | 3/4    | 3/4   | 3/4   | 3/4   | 3/4   |
| Number of HARQ Processes                     | Processes  | 8      | 8      | 8     | 8     | 8     | 8     |
| Maximum number of HARQ transmissions         |  | 1      | 1      | 1     | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame        |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 2984   | 8504   | 14112 | 30576 | 46888 | 61664 |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits   | N/A    | 6456   | 12576 | 28336 | 45352 | 61664 |
| Transport block CRC                          | Bits   | 24     | 24     | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 3) |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               |  | 1      | 2      | 3     | 5     | 8     | 11    |
| For Sub-Frame 5                              |  | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |  | N/A    | 2      | 3     | 5     | 8     | 11    |
| Binary Channel Bits Per Sub-Frame            |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 4104   | 11340  | 18900 | 41400 | 62100 | 82800 |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits   | N/A    | 8820   | 16380 | 38880 | 59580 | 80280 |
| Max. Throughput averaged over 1 frame        | kbps   | 2387.2 | 7448.8 | 12547 | 27294 | 42046 | 55498 |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz. |        |        |       |       |       |       |
| Note 2:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].   |        |        |       |       |       |       |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |        |        |       |       |       |       |

**Table A.3.2-3a Fixed Reference Channel for Maximum input level for UE Category 1 (FDD)**

| Parameter                           | Unit | Value |       |       |       |       |       |
|-------------------------------------|------|-------|-------|-------|-------|-------|-------|
|                                     |      | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth                   | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks           |      | 6     | 15    | 18    | 17    | 17    | 17    |
| Subcarriers per resource block      |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Allocated subframes per Radio Frame |      | 8     | 9     | 9     | 9     | 9     | 9     |
| Modulation                          |      | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |

|  |  |        |        |        |        |        |        |
|--|--|--------|--------|--------|--------|--------|--------|
| Target Coding Rate                           |  | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    |
| Number of HARQ Processes                     | Processes  | 8      | 8      | 8      | 8      | 8      | 8      |
| Maximum number of HARQ transmissions         |  | 1      | 1      | 1      | 1      | 1      | 1      |
| Information Bit Payload                      |  |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 2984   | 8504   | 10296  | 10296  | 10296  | 10296  |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              | Bits   | N/A    | 6456   | 8248   | 10296  | 10296  | 10296  |
| Transport block CRC                          | Bits   | 24     | 24     | 24     | 24     | 24     | 24     |
| Number of Code Blocks per Sub-Frame (Note 3) |  |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               |  | 1      | 2      | 2      | 2      | 2      | 2      |
| For Sub-Frame 5                              |  | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              |  | N/A    | 2      | 2      | 2      | 2      | 2      |
| Binary Channel Bits Per Sub-Frame            |  |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 4104   | 11340  | 13608  | 14076  | 14076  | 14076  |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              | Bits   | N/A    | 8820   | 11088  | 14076  | 14076  | 14076  |
| Max. Throughput averaged over 1 frame        | kbps   | 2387.2 | 7448.8 | 9079.6 | 9266.4 | 9266.4 | 9266.4 |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz. |        |        |        |        |        |        |
| Note 2:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].   |        |        |        |        |        |        |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |        |        |        |        |        |        |

Table A.3.2-3b Fixed Reference Channel for Maximum input level for UE Category 2 (FDD)

| Parameter                                    | Unit   | Value  |        |       |       |       |       |
|--|--|--------|--------|-------|-------|-------|-------|
| Channel bandwidth                            | MHz  | 1.4    | 3      | 5     | 10    | 15    | 20    |
| Allocated resource blocks                    |  | 6      | 15     | 25    | 50    | 75    | 83    |
| Subcarriers per resource block               |  | 12     | 12     | 12    | 12    | 12    | 12    |
| Allocated subframes per Radio Frame          |  | 8      | 9      | 9     | 9     | 9     | 9     |
| Modulation                                   |  | 64QAM  | 64QAM  | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate                           |  | 3/4    | 3/4    | 3/4   | 3/4   | 3/4   | 3/4   |
| Number of HARQ Processes                     | Processes  | 8      | 8      | 8     | 8     | 8     | 8     |
| Maximum number of HARQ transmissions         |  | 1      | 1      | 1     | 1     | 1     | 1     |
| Information Bit Payload                      |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 2984   | 8504   | 14112 | 30576 | 46888 | 51024 |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits   | N/A    | 6456   | 12576 | 28336 | 45352 | 51024 |
| Transport block CRC                          | Bits   | 24     | 24     | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 3) |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               |  | 1      | 2      | 3     | 5     | 8     | 9     |
| For Sub-Frame 5                              |  | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |  | N/A    | 2      | 3     | 5     | 8     | 9     |
| Binary Channel Bits Per Sub-Frame            |  |        |        |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 4104   | 11340  | 18900 | 41400 | 62100 | 68724 |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits   | N/A    | 8820   | 16380 | 38880 | 59580 | 66204 |
| Max. Throughput averaged over 1 frame        | kbps   | 2387.2 | 7448.8 | 12547 | 27294 | 42046 | 45922 |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz. |        |        |       |       |       |       |
| Note 2:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].   |        |        |       |       |       |       |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |        |        |       |       |       |       |

Table A.3.2-3c Fixed Reference Channel for Maximum input level for UE DL Category 0 (FDD)

| Parameter                           | Unit | Value |       |       |       |       |       |
|-------------------------------------|------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth                   | MHz  | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks           |      | 2     | 2     | 2     | 2     | 2     | 2     |
| Subcarriers per resource block      |      | 12    | 12    | 12    | 12    | 12    | 12    |
| Allocated subframes per Radio Frame |      | 8     | 9     | 9     | 9     | 9     | 9     |
| Modulation                          |      | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |

|   |           |      |      |      |      |      |      |
|---|-----------|------|------|------|------|------|------|
| Target Coding Rate  |           | 3/4  | 3/4  | 3/4  | 3/4  | 3/4  | 3/4  |
| Number of HARQ Processes  | Processes | 8    | 8    | 8    | 8    | 8    | 8    |
| Maximum number of HARQ transmissions  |           | 1    | 1    | 1    | 1    | 1    | 1    |
| Information Bit Payload   |           |      |      |      |      |      |      |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits      | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| For Sub-Frame 5   | Bits      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0 (Note 3)  | Bits      | N/A  | 1000 | 1000 | 1000 | 1000 | 1000 |
| Transport block CRC   | Bits      | 24   | 24   | 24   | 24   | 24   | 24   |
| Number of Code Blocks per Sub-Frame   |           |      |      |      |      |      |      |
| For Sub-Frames 1,2,3,4,6,7,8,9  |           | 1    | 1    | 1    | 1    | 1    | 1    |
| For Sub-Frame 5   |           | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0   |           | N/A  | 1    | 1    | 1    | 1    | 1    |
| Binary Channel Bits Per Sub-Frame   |           |      |      |      |      |      |      |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits      | 1368 | 1512 | 1512 | 1656 | 1656 | 1656 |
| For Sub-Frame 5   | Bits      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  |
| For Sub-Frame 0 (Note 3)  | Bits      | N/A  | 1512 | 1512 | 1656 | 1656 | 1656 |
| Max. Throughput averaged over 1 frame   | kbps      | 800  | 900  | 900  | 900  | 900  | 900  |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz.                    |           |      |      |      |      |      |      |
| Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.  |           |      |      |      |      |      |      |
| Note 3: For Sub-Frame 0, it is assumed that the allocated 2PRBs are scheduled on the RBs other than the center 6PRBs as most of the symbols are occupied by PBCH and synchronization signals. |           |      |      |      |      |      |      |

**Table A.3.2-3d Fixed Reference Channel for Maximum input level for UE DL Category M1 (FDD and HD-FDD)**

| Parameter   | Unit      | Value |       |       |       |       |       |
|---|-----------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth   | MHz       | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks   |           | 2     | 2     | 2     | 2     | 2     | 2     |
| Subcarriers per resource block  |           | 12    | 12    | 12    | 12    | 12    | 12    |
| Allocated subframes per Radio Frame (Note 6)  |           | 2     | 2     | 8     | 8     | 8     | 8     |
| Modulation  |           | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate  |           | 3/5   | 3/5   | 3/5   | 3/5   | 3/5   | 3/5   |
| Number of HARQ Processes  | Processes | 8     | 8     | 8     | 8     | 8     | 8     |
| Maximum number of HARQ transmissions  |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Information Bit Payload   |           |       |       |       |       |       |       |
| For Sub-Frames 3, 8   | Bits      | 552   | 552   | 552   | 552   | 552   | 552   |
| For Sub-Frames 0,1,2,5,7,9  | Bits      | N/A   | N/A   | 552   | 552   | 552   | 552   |
| For Sub-Frame 4   | Bits      | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 6   | Bits      | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Transport block CRC   | Bits      | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame   |           |       |       |       |       |       |       |
| For Sub-Frames 3, 8   |           | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frames 0,1,2,5,7,9  |           | N/A   | N/A   | 1     | 1     | 1     | 1     |
| For Sub-Frame 4   |           | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 6   |           | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Binary Channel Bits Per Sub-Frame   |           |       |       |       |       |       |       |
| For Sub-Frames 3, 8   | Bits      | 912   | 1008  | 1008  | 1008  | 1008  | 1008  |
| For Sub-Frames 0,1,2,5,7,9  |           | N/A   | N/A   | 1008  | 1008  | 1008  | 1008  |
| For Sub-Frame 4   | Bits      | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 6   | Bits      | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Max. Throughput averaged over 1 frame for FDD   | kbps      | 110.4 | 110.4 | 441.6 | 441.6 | 441.6 | 441.6 |
| Max. Throughput averaged over 1 frame for HD-FDD  |           | 55.2  | 55.2  | 165.6 | 165.6 | 165.6 | 165.6 |
| Note 1: 4 symbols allocated to PDCCH for 1.4MHz channel bandwidth. 3 symbols allocated to PDCCH for all other channel bandwidths.   |           |       |       |       |       |       |       |
| Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.  |           |       |       |       |       |       |       |
| Note 3: The scheduled narrowband other than 1.4MHz and 3MHz channel bandwidth avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.  |           |       |       |       |       |       |       |
| Note 4: For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz and 3MHz channel bandwidth. For other channel bandwidth, PDSCH are scheduled at the 0th, 1st, and 2nd subframes every 1 radio frame. Information bit payload is available if downlink subframe is scheduled. The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. |           |       |       |       |       |       |       |

|  |
|--|
| Note 5: 2 resource blocks allocated to MPDCCH. |
|--|

**Table A.3.2-3e: Fixed Reference Channel for Maximum input level for UE DL Category M2 (FDD and HD-FDD)**

| Parameter  | Unit   | Value |       |       |       |        |        |
|--|--|-------|-------|-------|-------|--------|--------|
|  |  | 1.4   | 3     | 5     | 10    | 15     | 20     |
| Channel bandwidth                                | MHz  | 1.4   | 3     | 5     | 10    | 15     | 20     |
| Allocated resource blocks (Note 6)               |  | 2     | 8     | 15    | 15    | 15     | 15     |
| Subcarriers per resource block                   |  | 12    | 12    | 12    | 12    | 12     | 12     |
| Allocated subframes per Radio Frame (Note 4)     |  | 2     | 2     | 8     | 8     | 8      | 8      |
| Modulation                                       |  | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM  | 16QAM  |
| Target Coding Rate                               |  | 3/5   | 3/5   | 1/2   | 1/2   | 1/2    | 1/2    |
| Number of HARQ Processes                         | Processes  | 8     | 8     | 8     | 8     | 8      | 8      |
| Maximum number of HARQ transmissions             |  | 1     | 1     | 1     | 1     | 1      | 1      |
| Information Bit Payload                          |  |       |       |       |       |        |        |
| For Sub-Frames 3, 8                              | Bits   | 552   | 2280  | 4008  | 4008  | 4008   | 4008   |
| For Sub-Frames 0,1,2,5,7,9                       | Bits   | N/A   | N/A   | N/A   | N/A   | 4008   | 4008   |
| For Sub-Frame 4                                  | Bits   | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                  | Bits   | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| Transport block CRC                              | Bits   | 24    | 24    | 24    | 24    | 24     | 24     |
| Number of Code Blocks per Sub-Frame              |  |       |       |       |       |        |        |
| For Sub-Frames 3, 8                              |  | 1     | 1     | 1     | 1     | 1      | 1      |
| For Sub-Frames 0,1,2,5,7,9                       |  | N/A   | N/A   | 1     | 1     | 1      | 1      |
| For Sub-Frame 4                                  |  | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                  |  | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| Binary Channel Bits Per Sub-Frame                |  |       |       |       |       |        |        |
| For Sub-Frames 3, 8                              | Bits   | 912   | 4032  | 7560  | 7560  | 7560   | 7560   |
| For Sub-Frames 0,1,2,5,7,9                       |  | N/A   | N/A   | N/A   | N/A   | 7560   | 7560   |
| For Sub-Frame 4                                  | Bits   | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| For Sub-Frame 6                                  | Bits   | N/A   | N/A   | N/A   | N/A   | N/A    | N/A    |
| Max. Throughput averaged over 1 frame for FDD    | kbps   | 110.4 | 456.0 | 801.6 | 801.6 | 3206.4 | 3206.4 |
| Max. Throughput averaged over 1 frame for HD-FDD |  | 55.2  | 228.0 | 400.8 | 400.8 | 1202.4 | 1202.4 |
| Note 1:  | 4 symbols allocated to PDCCH for 1.4MHz channel bandwidth. 3 symbols allocated to all other channel bandwidths.  |       |       |       |       |        |        |
| Note 2:  | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.   |       |       |       |       |        |        |
| Note 3:  | The scheduled wideband other than 1.4MHz/3MHz/5MHz/10MHz/ channel bandwidth avoids the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.   |       |       |       |       |        |        |
| Note 4:  | For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz/3MHz/5MHz/10MHz channel bandwidth. For other channel bandwidth, PDSCH are scheduled at the 0th, 1st, and 2nd subframes every 1 radio frame. Information bit payload is available if downlink subframe is scheduled. The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. |       |       |       |       |        |        |
| Note 5:  | 2 resource blocks allocated to MPDCCH.   |       |       |       |       |        |        |
| Note 6:  | 2 resource blocks allocated to PDSCH for 1.4MHz channel bandwidth. 2 narrowbands and 4 resource blocks in each narrowband allocated to PDSCH for 3MHz channel bandwidth. For 5MHz/10MHz/15MHz/20MHz channel bandwidth, configure 3 narrowbands and 5 resource blocks in each narrowband allocated to PDSCH.  |       |       |       |       |        |        |

**Table A.3.2-4 Fixed Reference Channel for Maximum input level for UE Categories  $\geq 3$  (TDD)**

| Parameter                              | Unit      | Value |       |       |       |       |       |
|--|-----------|-------|-------|-------|-------|-------|-------|
|  |           | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth                      | MHz       | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks              |           | 6     | 15    | 25    | 50    | 75    | 100   |
| Subcarriers per resource block         |           | 12    | 12    | 12    | 12    | 12    | 12    |
| Uplink-Downlink Configuration (Note 5) |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame    |           | 2     | 3+2   | 3+2   | 3+2   | 3+2   | 3+2   |
| Modulation                             |           | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate                     |           | 3/4   | 3/4   | 3/4   | 3/4   | 3/4   | 3/4   |
| Number of HARQ Processes               | Processes | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmissions   |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame  |           |       |       |       |       |       |       |
| For Sub-Frames 4,9                     | Bits      | 2984  | 8504  | 14112 | 30576 | 46888 | 61664 |

|  |   |       |        |        |       |       |       |
|--|---|-------|--------|--------|-------|-------|-------|
| For Sub-Frames 1,6                           | Bits  | N/A   | 6968   | 11448  | 23688 | 35160 | 46888 |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | 6968   | 12576  | 30576 | 45352 | 61664 |
| Transport block CRC                          | Bits  | 24    | 24     | 24     | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           |   | 1     | 2      | 3      | 5     | 8     | 11    |
| For Sub-Frames 1,6                           |   | N/A   | 2      | 2      | 4     | 6     | 8     |
| For Sub-Frame 5                              |   | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | N/A   | 2      | 3      | 5     | 8     | 11    |
| Binary Channel Bits per Sub-Frame            |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 4104  | 11340  | 18900  | 41400 | 62100 | 82800 |
| For Sub-Frames 1,6                           |   | N/A   | 9828   | 16668  | 33768 | 50868 | 67968 |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | 9252   | 16812  | 39312 | 60012 | 80712 |
| Max. Throughput averaged over 1 frame        | kbps  | 596.8 | 3791.2 | 6369.6 | 13910 | 20945 | 27877 |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |        |        |       |       |       |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |        |        |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |        |        |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |        |        |       |       |       |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4].  |       |        |        |       |       |       |

Table A.3.2-4a Fixed Reference Channel for Maximum input level for UE Category 1 (TDD)

| Parameter                                    | Unit  | Value |        |        |        |        |        |
|--|---|-------|--------|--------|--------|--------|--------|
|  |   | 1.4   | 3      | 5      | 10     | 15     | 20     |
| Channel bandwidth                            | MHz   | 1.4   | 3      | 5      | 10     | 15     | 20     |
| Allocated resource blocks                    |   | 6     | 15     | 18     | 17     | 17     | 17     |
| Subcarriers per resource block               |   | 12    | 12     | 12     | 12     | 12     | 12     |
| Uplink-Downlink Configuration (Note 5)       |   | 1     | 1      | 1      | 1      | 1      | 1      |
| Allocated subframes per Radio Frame          |   | 2     | 3+2    | 3+2    | 3+2    | 3+2    | 3+2    |
| Modulation                                   |   | 64QAM | 64QAM  | 64QAM  | 64QAM  | 64QAM  | 64QAM  |
| Target Coding Rate                           |   | 3/4   | 3/4    | 3/4    | 3/4    | 3/4    | 3/4    |
| Number of HARQ Processes                     | Processes   | 7     | 7      | 7      | 7      | 7      | 7      |
| Maximum number of HARQ transmissions         |   | 1     | 1      | 1      | 1      | 1      | 1      |
| Information Bit Payload per Sub-Frame        |   |       |        |        |        |        |        |
| For Sub-Frames 4,9                           | Bits  | 2984  | 8504   | 10296  | 10296  | 10296  | 10296  |
| For Sub-Frames 1,6                           | Bits  | N/A   | 6968   | 8248   | 7480   | 7480   | 7480   |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              | Bits  | N/A   | 6968   | 8248   | 10296  | 10296  | 10296  |
| Transport block CRC                          | Bits  | 24    | 24     | 24     | 24     | 24     | 24     |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |        |        |        |        |        |
| For Sub-Frames 4,9                           |   | 1     | 2      | 2      | 2      | 2      | 2      |
| For Sub-Frames 1,6                           |   | N/A   | 2      | 2      | 2      | 2      | 2      |
| For Sub-Frame 5                              |   | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              |   | N/A   | 2      | 2      | 2      | 2      | 2      |
| Binary Channel Bits per Sub-Frame            |   |       |        |        |        |        |        |
| For Sub-Frames 4,9                           | Bits  | 4104  | 11340  | 13608  | 14076  | 14076  | 14076  |
| For Sub-Frames 1,6                           |   | N/A   | 9828   | 11880  | 11628  | 11628  | 11628  |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              | Bits  | N/A   | 9252   | 11520  | 14076  | 14076  | 14076  |
| Max. Throughput averaged over 1 frame        | kbps  | 596.8 | 3791.2 | 4533.6 | 4584.8 | 4584.8 | 4584.8 |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |        |        |        |        |        |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |        |        |        |        |        |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |        |        |        |        |        |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |        |        |        |        |        |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4].  |       |        |        |        |        |        |

**Table A.3.2-4b Fixed Reference Channel for Maximum input level for UE Category 2 (TDD)**

| Parameter                                    | Unit  | Value |        |        |       |       |       |
|--|---|-------|--------|--------|-------|-------|-------|
|  |   | 1.4   | 3      | 5      | 10    | 15    | 20    |
| Channel bandwidth                            | MHz   | 1.4   | 3      | 5      | 10    | 15    | 20    |
| Allocated resource blocks                    |   | 6     | 15     | 25     | 50    | 75    | 83    |
| Subcarriers per resource block               |   | 12    | 12     | 12     | 12    | 12    | 12    |
| Uplink-Downlink Configuration (Note 5)       |   | 1     | 1      | 1      | 1     | 1     | 1     |
| Allocated subframes per Radio Frame          |   | 2     | 3+2    | 3+2    | 3+2   | 3+2   | 3+2   |
| Modulation                                   |   | 64QAM | 64QAM  | 64QAM  | 64QAM | 64QAM | 64QAM |
| Target Coding Rate                           |   | 3/4   | 3/4    | 3/4    | 3/4   | 3/4   | 3/4   |
| Number of HARQ Processes                     | Processes   | 7     | 7      | 7      | 7     | 7     | 7     |
| Maximum number of HARQ transmissions         |   | 1     | 1      | 1      | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame        |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 2984  | 8504   | 14112  | 30576 | 46888 | 51024 |
| For Sub-Frames 1,6                           | Bits  | N/A   | 6968   | 11448  | 23688 | 35160 | 39232 |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | 6968   | 12576  | 30576 | 45352 | 51024 |
| Transport block CRC                          | Bits  | 24    | 24     | 24     | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           |   | 1     | 2      | 3      | 5     | 8     | 9     |
| For Sub-Frames 1,6                           |   | N/A   | 2      | 3      | 5     | 7     | 7     |
| For Sub-Frame 5                              |   | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | N/A   | 2      | 3      | 5     | 8     | 9     |
| Binary Channel Bits per Sub-Frame            |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 4104  | 11340  | 18900  | 41400 | 62100 | 68724 |
| For Sub-Frames 1,6                           |   | N/A   | 9828   | 16668  | 33768 | 50868 | 56340 |
| For Sub-Frame 5                              | Bits  | N/A   | N/A    | N/A    | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | 9252   | 16380  | 39312 | 60012 | 66636 |
| Max. Throughput averaged over 1 frame        | kbps  | 596.8 | 3791.2 | 6369.6 | 13910 | 20945 | 23154 |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |        |        |       |       |       |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |        |        |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |        |        |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |        |        |       |       |       |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4].  |       |        |        |       |       |       |

**Table A.3.2-4c Fixed Reference Channel for Maximum input level for UE DL Category 0 (TDD)**

| Parameter                                    | Unit      | Value |       |       |       |       |       |
|--|-----------|-------|-------|-------|-------|-------|-------|
|  |           | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth                            | MHz       | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks                    |           | 2     | 2     | 2     | 2     | 2     | 2     |
| Subcarriers per resource block               |           | 12    | 12    | 12    | 12    | 12    | 12    |
| Uplink-Downlink Configuration (Note 5)       |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame          |           | 2     | 3+2   | 3+2   | 3+2   | 3+2   | 3+2   |
| Modulation                                   |           | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate                           |           | 3/4   | 3/4   | 3/4   | 3/4   | 3/4   | 3/4   |
| Number of HARQ Processes                     | Processes | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmissions         |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame        |           |       |       |       |       |       |       |
| For Sub-Frames 4,9                           | Bits      | 1000  | 1000  | 1000  | 1000  | 1000  | 1000  |
| For Sub-Frames 1,6                           | Bits      | N/A   | 712   | 712   | 712   | 712   | 712   |
| For Sub-Frame 5                              | Bits      | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits      | N/A   | 1000  | 1000  | 1000  | 1000  | 1000  |
| Transport block CRC                          | Bits      | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |           |       |       |       |       |       |       |
| For Sub-Frames 4,9                           |           | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frames 1,6                           |           | N/A   | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frame 5                              |           | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |



|                                       |   |      |       |       |       |       |       |
|---------------------------------------|---|------|-------|-------|-------|-------|-------|
| For Sub-Frame 0                       |   | N/A  | 1     | 1     | 1     | 1     | 1     |
| Binary Channel Bits per Sub-Frame     |   |      |       |       |       |       |       |
| For Sub-Frames 4,9                    | Bits  | 1368 | 1512  | 1512  | 1656  | 1656  | 1656  |
| For Sub-Frames 1,6                    |   | N/A  | 1224  | 1224  | 1368  | 1368  | 1368  |
| For Sub-Frame 5                       | Bits  | N/A  | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                       | Bits  | N/A  | 1512  | 1512  | 1656  | 1656  | 1656  |
| Max. Throughput averaged over 1 frame | kbps  | 200  | 442.4 | 442.4 | 442.4 | 442.4 | 442.4 |
| Note 1:                               | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |      |       |       |       |       |       |
| Note 2:                               | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |      |       |       |       |       |       |
| Note 3:                               | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |      |       |       |       |       |       |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |      |       |       |       |       |       |
| Note 5:                               | As per Table 4.2-2 in TS 36.211 [4].  |      |       |       |       |       |       |

**Table A.3.2-4d Fixed Reference Channel for Maximum input level for UE Categories ≥ 3 (TDD Band 46)**

| Parameter                                    | Unit  | Value   | Value   |
|--|---|---------|---------|
| Channel bandwidth                            | MHz   | 10      | 20      |
| Allocated resource blocks                    |   | 50      | 100     |
| Uplink-Downlink Configuration                |   | N/A     | N/A     |
| Subcarriers per resource block               |   | 12      | 12      |
| Allocated subframes per Radio Frame (D)      |   | 8       | 8       |
| Modulation                                   |   | 64QAM   | 64QAM   |
| Target Coding Rate                           |   | 3/4     | 3/4     |
| Number of HARQ Processes                     | Processes   | N/A     | N/A     |
| Maximum number of HARQ transmissions         |   | N/A     | N/A     |
| Information Bit Payload per Sub-Frame        |   |         |         |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 30576   | 61664   |
| For Sub-Frame 1,2                            | Bits  | N/A     | N/A     |
| For Sub-Frame 0,5                            | Bits  | 30576   | 61664   |
| Transport block CRC                          | Bits  | 24      | 24      |
| Number of Code Blocks per Sub-Frame (Note 3) |   |         |         |
| For Sub-Frames 3,4,6,7,8,9                   |   | 5       | 11      |
| For Sub-Frame 1,2                            |   | N/A     | N/A     |
| For Sub-Frame 0,5                            |   | 5       | 11      |
| Binary Channel Bits Per Sub-Frame            |   |         |         |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 41400   | 82800   |
| For Sub-Frame 1,2                            | Bits  | N/A     | N/A     |
| For Sub-Frame 0,5                            | Bits  | 40536   | 81936   |
| Max. Throughput averaged over 1 frame        | kbps  | 24460.8 | 49331.2 |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz.  |         |         |
| Note 2:                                      | Reference signal, Synchronization signals allocated as per TS 36.211 [4].   |         |         |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |         |         |

**Table A.3.2-4e Fixed Reference Channel for Maximum input level for UE DL Category M1 (TDD)**

| Parameter                              | Unit      | Value |       |       |       |       |       |
|--|-----------|-------|-------|-------|-------|-------|-------|
| Channel bandwidth                      | MHz       | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks              |           | 2     | 2     | 2     | 2     | 2     | 2     |
| Subcarriers per resource block         |           | 12    | 12    | 12    | 12    | 12    | 12    |
| Uplink-Downlink Configuration (Note 5) |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame    |           | 2     | 2     | 2     | 2     | 2     | 2     |
| Modulation                             |           | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate                     |           | 3/5   | 3/5   | 3/5   | 3/5   | 3/5   | 3/5   |
| Number of HARQ Processes               | Processes | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmissions   |           | 1     | 1     | 1     | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame  |           |       |       |       |       |       |       |
| For Sub-Frames 4,9                     | Bits      | 552   | 552   | 552   | 552   | 552   | 552   |

|  |   |       |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|
| For Sub-Frames 1,6                           | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Transport block CRC                          | Bits  | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |       |       |       |       |       |
| For Sub-Frames 4,9                           |   | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frames 1,6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Binary Channel Bits per Sub-Frame            |   |       |       |       |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 912   | 1008  | 1008  | 1008  | 1008  | 1008  |
| For Sub-Frames 1,6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Max. Throughput averaged over 1 frame        | kbps  | 110.4 | 110.4 | 110.4 | 110.4 | 110.4 | 110.4 |
| Note 1:                                      | For normal subframes(0,4,5,9), 4 symbols allocated to PDCCH for 1.4MHz channel bandwidth and 3 symbols allocated to PDCCH for all other channel bandwidths. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |       |       |       |       |       |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |       |       |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |       |       |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |       |       |       |       |       |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4].  |       |       |       |       |       |       |
| Note 6:                                      | 2 resource blocks allocated to MPDCCH.  |       |       |       |       |       |       |

Table A.3.2-4f: Fixed Reference Channel for Maximum input level for UE DL Category M2 (TDD)

| Parameter                                    | Unit  | Value |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|
|  |   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Channel bandwidth                            | MHz   | 1.4   | 3     | 5     | 10    | 15    | 20    |
| Allocated resource blocks (Note 7)           |   | 2     | 8     | 15    | 15    | 15    | 15    |
| Subcarriers per resource block               |   | 12    | 12    | 12    | 12    | 12    | 12    |
| Uplink-Downlink Configuration (Note 5)       |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Allocated subframes per Radio Frame          |   | 2     | 2     | 2     | 2     | 2     | 2     |
| Modulation                                   |   | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate                           |   | 3/5   | 3/5   | 1/2   | 1/2   | 1/2   | 1/2   |
| Number of HARQ Processes                     | Processes   | 7     | 7     | 7     | 7     | 7     | 7     |
| Maximum number of HARQ transmissions         |   | 1     | 1     | 1     | 1     | 1     | 1     |
| Information Bit Payload per Sub-Frame        |   |       |       |       |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 552   | 2280  | 4008  | 4008  | 4008  | 4008  |
| For Sub-Frames 1,6                           | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Transport block CRC                          | Bits  | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of Code Blocks per Sub-Frame (Note 4) |   |       |       |       |       |       |       |
| For Sub-Frames 4,9                           |   | 1     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frames 1,6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Binary Channel Bits per Sub-Frame            |   |       |       |       |       |       |       |
| For Sub-Frames 4,9                           | Bits  | 912   | 4032  | 7560  | 7560  | 7560  | 7560  |
| For Sub-Frames 1,6                           |   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                              | Bits  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| Max. Throughput averaged over 1 frame        | kbps  | 110.4 | 456.0 | 801.6 | 801.6 | 801.6 | 801.6 |
| Note 1:                                      | For normal subframes(0,4,5,9), 4 symbols allocated to PDCCH for 1.4MHz channel bandwidth, and 3 symbols allocated for all other channel bandwidths. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |       |       |       |       |       |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |       |       |       |       |       |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |       |       |       |       |       |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |       |       |       |       |       |

|         |   |
|---------|---|
| Note 5: | As per Table 4.2-2 in TS 36.211 [4].  |
| Note 6: | 2 resource blocks allocated to MPDCCH.  |
| Note 7: | 2 resource blocks allocated to PDSCH for 1.4MHz channel bandwidth. 2 narrowbands and 4 resource blocks in each narrowband allocated to PDSCH for 3MHz channel bandwidth. For 5MHz/10MHz/15MHz/20MHz channel bandwidth, configure 3 narrowbands and 5 resource blocks in each narrowband allocated to PDSCH. |

**Table A.3.2-5 Fixed Reference Channel for Maximum input level for UE Categories 11/12 and UE DL categories  $\geq 11$  (FDD)**

| Parameter                                    | Unit   | Value  |        |         |        |         |        |
|--|--|--------|--------|---------|--------|---------|--------|
|  |  | 1.4    | 3      | 5       | 10     | 15      | 20     |
| Channel bandwidth                            | MHz  | 1.4    | 3      | 5       | 10     | 15      | 20     |
| Allocated resource blocks                    |  | 6      | 15     | 25      | 50     | 75      | 100    |
| Subcarriers per resource block               |  | 12     | 12     | 12      | 12     | 12      | 12     |
| Allocated subframes per Radio Frame          |  | 8      | 9      | 9       | 9      | 9       | 9      |
| Modulation                                   |  | 256QAM | 256QAM | 256QAM  | 256QAM | 256QAM  | 256QAM |
| Target Coding Rate                           |  | 4/5    | 4/5    | 4/5     | 4/5    | 4/5     | 4/5    |
| Number of HARQ Processes                     | Processes  | 8      | 8      | 8       | 8      | 8       | 8      |
| Maximum number of HARQ transmissions         |  | 1      | 1      | 1       | 1      | 1       | 1      |
| Information Bit Payload per Sub-Frame        |  |        |        |         |        |         |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 4392   | 12216  | 19848   | 42368  | 63776   | 84760  |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A     | N/A    | N/A     | N/A    |
| For Sub-Frame 0                              | Bits   | N/A    | 9912   | 17568   | 40576  | 63776   | 84760  |
| Transport block CRC                          | Bits   | 24     | 24     | 24      | 24     | 24      | 24     |
| Number of Code Blocks per Sub-Frame (Note 3) |  |        |        |         |        |         |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               |  | 1      | 2      | 4       | 7      | 11      | 14     |
| For Sub-Frame 5                              |  | N/A    | N/A    | N/A     | N/A    | N/A     | N/A    |
| For Sub-Frame 0                              |  | N/A    | 2      | 3       | 7      | 11      | 14     |
| Binary Channel Bits Per Sub-Frame            |  |        |        |         |        |         |        |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 5472   | 15120  | 25200   | 55200  | 82800   | 110400 |
| For Sub-Frame 5                              | Bits   | N/A    | N/A    | N/A     | N/A    | N/A     | N/A    |
| For Sub-Frame 0                              | Bits   | N/A    | 12210  | 22290   | 51840  | 79440   | 107040 |
| Max. Throughput averaged over 1 frame        | kbps   | 3513.6 | 10764  | 17635.2 | 37952  | 57398.4 | 76284  |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz. |        |        |         |        |         |        |
| Note 2:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].   |        |        |         |        |         |        |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |        |        |         |        |         |        |

**Table A.3.2-6 Fixed Reference Channel for Maximum input level for UE Categories 11/12 and UE DL categories  $\geq 11$  (TDD)**

| Parameter                                    | Unit      | Value  |        |        |        |        |        |
|--|-----------|--------|--------|--------|--------|--------|--------|
|  |           | 1.4    | 3      | 5      | 10     | 15     | 20     |
| Channel bandwidth                            | MHz       | 1.4    | 3      | 5      | 10     | 15     | 20     |
| Allocated resource blocks                    |           | 6      | 15     | 25     | 50     | 75     | 100    |
| Subcarriers per resource block               |           | 12     | 12     | 12     | 12     | 12     | 12     |
| Uplink-Downlink Configuration (Note 5)       |           | 1      | 1      | 1      | 1      | 1      | 1      |
| Allocated subframes per Radio Frame          |           | 2      | 3+2    | 3+2    | 3+2    | 3+2    | 3+2    |
| Modulation                                   |           | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding Rate                           |           | 4/5    | 4/5    | 4/5    | 4/5    | 4/5    | 4/5    |
| Number of HARQ Processes                     | Processes | 7      | 7      | 7      | 7      | 7      | 7      |
| Maximum number of HARQ transmissions         |           | 1      | 1      | 1      | 1      | 1      | 1      |
| Information Bit Payload per Sub-Frame        |           |        |        |        |        |        |        |
| For Sub-Frames 4,9                           | Bits      | 4392   | 12216  | 19848  | 42368  | 63776  | 84760  |
| For Sub-Frames 1,6                           | Bits      | N/A    | 10680  | 17568  | 36696  | 55056  | 75376  |
| For Sub-Frame 5                              | Bits      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                              | Bits      | N/A    | 9912   | 17568  | 42368  | 63776  | 84760  |
| Transport block CRC                          | Bits      | 24     | 24     | 24     | 24     | 24     | 24     |
| Number of Code Blocks per Sub-Frame (Note 4) |           |        |        |        |        |        |        |
| For Sub-Frames 4,9                           |           | 1      | 2      | 4      | 7      | 11     | 14     |
| For Sub-Frames 1,6                           |           | N/A    | 2      | 3      | 6      | 9      | 13     |
| For Sub-Frame 5                              |           | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |

|                                       |   |       |        |       |         |       |         |
|---------------------------------------|---|-------|--------|-------|---------|-------|---------|
| For Sub-Frame 0                       |   | N/A   | 2      | 3     | 7       | 11    | 14      |
| Binary Channel Bits per Sub-Frame     |   |       |        |       |         |       |         |
| For Sub-Frames 4,9                    | Bits  | 5472  | 15120  | 25200 | 55200   | 82800 | 110400  |
| For Sub-Frames 1,6                    |   | N/A   | 13104  | 22224 | 45024   | 67824 | 90624   |
| For Sub-Frame 5                       | Bits  | N/A   | N/A    | N/A   | N/A     | N/A   | N/A     |
| For Sub-Frame 0                       | Bits  | N/A   | 12336  | 22416 | 52416   | 80016 | 107616  |
| Max. Throughput averaged over 1 frame | kbps  | 878.4 | 5570.4 | 9240  | 20049.6 | 30144 | 40503.2 |
| Note 1:                               | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |       |        |       |         |       |         |
| Note 2:                               | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.   |       |        |       |         |       |         |
| Note 3:                               | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |        |       |         |       |         |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |        |       |         |       |         |
| Note 5:                               | As per Table 4.2-2 in TS 36.211 [4].  |       |        |       |         |       |         |

**Table A.3.2-7 Fixed Reference Channel for Maximum input level for UE Categories 11/12 and UE DL categories  $\geq 11$  (TDD Band 46)**

| Parameter                                    | Unit  | Value  |
|--|---|--------|
| Channel bandwidth                            | MHz   | 20     |
| Allocated resource blocks                    |   | 100    |
| Uplink-Downlink Configuration                |   | N/A    |
| Subcarriers per resource block               |   | 12     |
| Allocated subframes per Radio Frame (D)      |   | 8      |
| Modulation                                   |   | 256QAM |
| Target Coding Rate                           |   | 4/5    |
| Number of HARQ Processes                     | Processes   | N/A    |
| Maximum number of HARQ transmissions         |   | N/A    |
| Information Bit Payload per Sub-Frame        |   |        |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 84760  |
| For Sub-Frame 1,2                            | Bits  | N/A    |
| For Sub-Frame 0,5                            | Bits  | 84760  |
| Transport block CRC                          | Bits  | 24     |
| Number of Code Blocks per Sub-Frame (Note 3) |   |        |
| For Sub-Frames 3,4,6,7,8,9                   |   | 14     |
| For Sub-Frame 1,2                            |   | N/A    |
| For Sub-Frame 0,5                            |   | 14     |
| Binary Channel Bits Per Sub-Frame            |   |        |
| For Sub-Frames 3,4,6,7,8,9                   | Bits  | 110400 |
| For Sub-Frame 1,2                            | Bits  | N/A    |
| For Sub-Frame 0,5                            | Bits  | 109248 |
| Max. Throughput averaged over 1 frame        | kbps  | 67808  |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz.  |        |
| Note 2:                                      | Reference signal, Synchronization signals allocated as per TS 36.211 [4].   |        |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |        |

**Table A.3.2-8 Fixed Reference Channel for Maximum input level for UE DL category 20 and UE DL categories  $\geq 22$  (FDD)**

| Parameter                           | Unit      | Value       |             |             |             |             |             |
|-------------------------------------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| Channel bandwidth                   | MHz       | 1.4         | 3           | 5           | 10          | 15          | 20          |
| Allocated resource blocks           |           | 6           | 15          | 25          | 50          | 75          | 100         |
| Subcarriers per resource block      |           | 12          | 12          | 12          | 12          | 12          | 12          |
| Allocated subframes per Radio Frame |           | 8           | 9           | 9           | 9           | 9           | 9           |
| Modulation                          |           | 1024Q<br>AM | 1024Q<br>AM | 1024Q<br>AM | 1024Q<br>AM | 1024Q<br>AM | 1024Q<br>AM |
| Target Coding Rate                  |           | 4/5         | 4/5         | 4/5         | 4/5         | 4/5         | 4/5         |
| Number of HARQ Processes            | Processes | 8           | 8           | 8           | 8           | 8           | 8           |

|   |      |        |         |         |       |         |         |
|---|------|--------|---------|---------|-------|---------|---------|
| Maximum number of HARQ transmissions  |      | 1      | 1       | 1       | 1     | 1       | 1       |
| Information Bit Payload per Sub-Frame   |      |        |         |         |       |         |         |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 6456   | 15840   | 26416   | 55056 | 81176   | 110136  |
| For Sub-Frame 5   | Bits | N/A    | N/A     | N/A     | N/A   | N/A     | N/A     |
| For Sub-Frame 0   | Bits | N/A    | 11832   | 21384   | 52752 | 78704   | 105528  |
| Transport block CRC   | Bits | 24     | 24      | 24      | 24    | 24      | 24      |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |        |         |         |       |         |         |
| For Sub-Frames 1,2,3,4,6,7,8,9  |      | 2      | 3       | 5       | 9     | 14      | 18      |
| For Sub-Frame 5   |      | N/A    | N/A     | N/A     | N/A   | N/A     | N/A     |
| For Sub-Frame 0   |      | N/A    | 2       | 4       | 9     | 13      | 18      |
| Binary Channel Bits Per Sub-Frame   |      |        |         |         |       |         |         |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 7560   | 18900   | 31500   | 69000 | 103500  | 138000  |
| For Sub-Frame 5   | Bits | N/A    | N/A     | N/A     | N/A   | N/A     | N/A     |
| For Sub-Frame 0   | Bits | N/A    | 14700   | 27300   | 64800 | 99300   | 133800  |
| Max. Throughput averaged over 1 frame   | kbps | 5164.8 | 13855.2 | 23271.2 | 49320 | 72811.2 | 98661.6 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz, 3 MHz and 1.4 MHz.       |      |        |         |         |       |         |         |
| Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].  |      |        |         |         |       |         |         |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |        |         |         |       |         |         |

**Table A.3.2-9 Fixed Reference Channel for Maximum input level for UE DL category 20 and UE DL categories  $\geq 22$  (TDD)**

| Parameter  | Unit      | Value   |         |         |         |         |         |
|--|-----------|---------|---------|---------|---------|---------|---------|
|  |           | 1.4     | 3       | 5       | 10      | 15      | 20      |
| Channel bandwidth  | MHz       | 1.4     | 3       | 5       | 10      | 15      | 20      |
| Allocated resource blocks  |           | 6       | 15      | 25      | 50      | 75      | 100     |
| Subcarriers per resource block   |           | 12      | 12      | 12      | 12      | 12      | 12      |
| Uplink-Downlink Configuration (Note 5)   |           | 1       | 1       | 1       | 1       | 1       | 1       |
| Allocated subframes per Radio Frame  |           | 2       | 3+2     | 3+2     | 3+2     | 3+2     | 3+2     |
| Modulation   |           | 1024QAM | 1024QAM | 1024QAM | 1024QAM | 1024QAM | 1024QAM |
| Target Coding Rate   |           | 4/5     | 4/5     | 4/5     | 4/5     | 4/5     | 4/5     |
| Number of HARQ Processes   | Processes | 7       | 7       | 7       | 7       | 7       | 7       |
| Maximum number of HARQ transmissions   |           | 1       | 1       | 1       | 1       | 1       | 1       |
| Information Bit Payload per Sub-Frame  |           |         |         |         |         |         |         |
| For Sub-Frames 4,9   | Bits      | 6456    | 15840   | 26416   | 55056   | 81176   | 110136  |
| For Sub-Frames 1,6   | Bits      | N/A     | 12960   | 22152   | 45352   | 66592   | 90816   |
| For Sub-Frame 5  | Bits      | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 0  | Bits      | N/A     | 12216   | 22920   | 52752   | 78704   | 105528  |
| Transport block CRC  | Bits      | 24      | 24      | 24      | 24      | 24      | 24      |
| Number of Code Blocks per Sub-Frame (Note 4)   |           |         |         |         |         |         |         |
| For Sub-Frames 4,9   |           | 2       | 3       | 5       | 9       | 14      | 18      |
| For Sub-Frames 1,6   |           | N/A     | 3       | 4       | 8       | 11      | 15      |
| For Sub-Frame 5  |           | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 0  |           | N/A     | 2       | 4       | 9       | 13      | 18      |
| Binary Channel Bits per Sub-Frame  |           |         |         |         |         |         |         |
| For Sub-Frames 4,9   | Bits      | 7560    | 18900   | 31500   | 69000   | 103500  | 138000  |
| For Sub-Frames 1,6   | Bits      | N/A     | 16380   | 27780   | 56280   | 84780   | 113280  |
| For Sub-Frame 5  | Bits      | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 0  | Bits      | N/A     | 15420   | 28020   | 65520   | 100020  | 134520  |
| Max. Throughput averaged over 1 frame  | kbps      | 1291.2  | 6981.6  | 12005.6 | 25356.8 | 37424   | 50743.2 |
| Note 1: For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz, 3 MHz and 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |           |         |         |         |         |         |         |
| Note 2: For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance.  |           |         |         |         |         |         |         |
| Note 3: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].   |           |         |         |         |         |         |         |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |           |         |         |         |         |         |         |

|  |
|--|
| Note 5: As per Table 4.2-2 in TS 36.211 [4]. |
|--|

**Table A.3.2-10 Fixed Reference Channel for Maximum input level for UE DL category 20 and UE DL categories  $\geq 22$  (TDD Band 46)**

| Parameter   | Unit      | Value   |
|---|-----------|---------|
| Channel bandwidth   | MHz       | 20      |
| Allocated resource blocks   |           | 100     |
| Uplink-Downlink Configuration   |           | N/A     |
| Subcarriers per resource block  |           | 12      |
| Allocated subframes per Radio Frame (D)   |           | 8       |
| Modulation  |           | 1024QAM |
| Target Coding Rate  |           | 4/5     |
| Number of HARQ Processes  | Processes | N/A     |
| Maximum number of HARQ transmissions  |           | N/A     |
| Information Bit Payload per Sub-Frame   |           |         |
| For Sub-Frames 3,4,6,7,8,9  | Bits      | 110136  |
| For Sub-Frame 1,2   | Bits      | N/A     |
| For Sub-Frame 0,5   | Bits      | 110136  |
| Transport block CRC   | Bits      | 24      |
| Number of Code Blocks per Sub-Frame (Note 3)  |           |         |
| For Sub-Frames 3,4,6,7,8,9  |           | 18      |
| For Sub-Frame 1,2   |           | N/A     |
| For Sub-Frame 0,5   |           | 18      |
| Binary Channel Bits Per Sub-Frame   |           |         |
| For Sub-Frames 3,4,6,7,8,9  | Bits      | 138000  |
| For Sub-Frame 1,2   | Bits      | N/A     |
| For Sub-Frame 0,5   | Bits      | 136560  |
| Max. Throughput averaged over 1 frame   | kbps      | 88108.8 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz.  |           |         |
| Note 2: Reference signal, Synchronization signals allocated as per TS 36.211 [4].   |           |         |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |           |         |

### A.3.3 Reference measurement channels for PDSCH performance requirements (FDD)

#### A.3.3.1 Single-antenna transmission (Common Reference Symbols)

**Table A.3.3.1-1: Fixed Reference Channel QPSK R=1/3**

| Parameter                             | Unit | Value   |          |            |            |            |         |
|---------------------------------------|------|---------|----------|------------|------------|------------|---------|
|                                       |      | R.4 FDD | R.42 FDD | R.42-1 FDD | R.42-2 FDD | R.42-3 FDD | R.2 FDD |
| Reference channel                     |      |         |          |            |            |            |         |
| Channel bandwidth                     | MHz  | 1.4     | 20       | 3          | 5          | 15         | 10      |
| Allocated resource blocks (Note 4)    |      | 6       | 100      | 15         | 25         | 75         | 50      |
| Allocated subframes per Radio Frame   |      | 9       | 9        | 9          | 9          | 9          | 9       |
| Modulation                            |      | QPSK    | QPSK     | QPSK       | QPSK       | QPSK       | QPSK    |
| Target Coding Rate                    |      | 1/3     | 1/3      | 1/3        | 1/3        | 1/3        | 1/3     |
| Information Bit Payload (Note 4)      |      |         |          |            |            |            |         |
| For Sub-Frames 1,2,3,4,6,7,8,9        | Bits | 408     | 8760     | 1320       | 2216       | 6712       | 4392    |
| For Sub-Frame 5                       | Bits | N/A     | N/A      | N/A        | N/A        | N/A        | N/A     |
| For Sub-Frame 0                       | Bits | 152     | 8760     | 1064       | 1800       | 6712       | 4392    |
| Number of Code Blocks (Notes 3 and 4) |      |         |          |            |            |            |         |
| For Sub-Frames 1,2,3,4,6,7,8,9        |      | 1       | 2        | 1          | 1          | 2          | 1       |
| For Sub-Frame 5                       |      | N/A     | N/A      | N/A        | N/A        | N/A        | N/A     |
| For Sub-Frame 0                       |      | 1       | 2        | 1          | 1          | 2          | 1       |

|   |      |       |       |       |       |       |       |
|---|------|-------|-------|-------|-------|-------|-------|
| Binary Channel Bits (Note 4)  |      |       |       |       |       |       |       |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 1368  | 27600 | 3780  | 6300  | 20700 | 13800 |
| For Sub-Frame 5   | Bits | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0   | Bits | 528   | 26760 | 2940  | 5460  | 19860 | 12960 |
| Max. Throughput averaged over 1 frame (Note 4)  | Mbps | 0.342 | 7.884 | 1.162 | 1.953 | 6.041 | 3.953 |
| UE Category   |      | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 4: Given per component carrier per codeword.</p> |      |       |       |       |       |       |       |

**Table A.3.3.1-2: Fixed Reference Channel 16QAM R=1/2**

| Parameter  | Unit | Value |   |           |         |    |    |
|--|------|-------|---|-----------|---------|----|----|
|  |      |       |   | R.3-1 FDD | R.3 FDD |    |    |
| Reference channel  |      |       |   |           |         |    |    |
| Channel bandwidth  | MHz  | 1.4   | 3 | 5         | 10      | 15 | 20 |
| Allocated resource blocks  |      |       |   | 25        | 50      |    |    |
| Allocated subframes per Radio Frame  |      |       |   | 9         | 9       |    |    |
| Modulation   |      |       |   | 16QAM     | 16QAM   |    |    |
| Target Coding Rate   |      |       |   | 1/2       | 1/2     |    |    |
| Information Bit Payload  |      |       |   |           |         |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits |       |   | 6456      | 14112   |    |    |
| For Sub-Frame 5  | Bits |       |   | N/A       | N/A     |    |    |
| For Sub-Frame 0  | Bits |       |   | 5736      | 12960   |    |    |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |       |   |           |         |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9   |      |       |   | 2         | 3       |    |    |
| For Sub-Frame 5  |      |       |   | N/A       | N/A     |    |    |
| For Sub-Frame 0  |      |       |   | 1         | 3       |    |    |
| Binary Channel Bits Per Sub-Frame  |      |       |   |           |         |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits |       |   | 12600     | 27600   |    |    |
| For Sub-Frame 5  | Bits |       |   | N/A       | N/A     |    |    |
| For Sub-Frame 0  | Bits |       |   | 10920     | 25920   |    |    |
| Max. Throughput averaged over 1 frame  | Mbps |       |   | 5.738     | 12.586  |    |    |
| UE Category  |      |       |   | ≥ 1       | ≥ 2     |    |    |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |       |   |           |         |    |    |

**Table A.3.3.1-3: Fixed Reference Channel 64QAM R=3/4**

| Parameter                                    | Unit | Value |         |         |         |         |         |
|--|------|-------|---------|---------|---------|---------|---------|
|  |      |       | R.5 FDD | R.6 FDD | R.7 FDD | R.8 FDD | R.9 FDD |
| Reference channel                            |      |       |         |         |         |         |         |
| Channel bandwidth                            | MHz  | 1.4   | 3       | 5       | 10      | 15      | 20      |
| Allocated resource blocks                    |      |       | 15      | 25      | 50      | 75      | 100     |
| Allocated subframes per Radio Frame          |      |       | 9       | 9       | 9       | 9       | 9       |
| Modulation                                   |      | 64QAM | 64QAM   | 64QAM   | 64QAM   | 64QAM   | 64QAM   |
| Target Coding Rate                           |      | 3/4   | 3/4     | 3/4     | 3/4     | 3/4     | 3/4     |
| Information Bit Payload                      |      |       |         |         |         |         |         |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits |       | 8504    | 14112   | 30576   | 46888   | 61664   |
| For Sub-Frame 5                              | Bits |       | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 0                              | Bits |       | 6456    | 12576   | 28336   | 45352   | 61664   |
| Number of Code Blocks per Sub-Frame (Note 3) |      |       |         |         |         |         |         |
| For Sub-Frames 1,2,3,4,6,7,8,9               |      |       | 2       | 3       | 5       | 8       | 11      |
| For Sub-Frame 5                              |      |       | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 0                              |      |       | 2       | 3       | 5       | 8       | 11      |

|  |      |  |       |        |        |        |        |
|--|------|--|-------|--------|--------|--------|--------|
| Binary Channel Bits Per Sub-Frame  |      |  |       |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits |  | 11340 | 18900  | 41400  | 62100  | 82800  |
| For Sub-Frame 5  | Bits |  | N/A   | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0  | Bits |  | 8820  | 16380  | 38880  | 59580  | 80280  |
| Max. Throughput averaged over 1 frame  | Mbps |  | 7.449 | 12.547 | 27.294 | 42.046 | 55.498 |
| UE Category  |      |  | ≥ 1   | ≥ 2    | ≥ 2    | ≥ 2    | ≥ 3    |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |  |       |        |        |        |        |

**Table A.3.3.1-3a: Fixed Reference Channel 64QAM R=3/4**

| Parameter   | Unit | Value     |           |           |           |           |  |
|---|------|-----------|-----------|-----------|-----------|-----------|--|
|   |      | R.6-1 FDD | R.7-1 FDD | R.8-1 FDD | R.9-1 FDD | R.9-2 FDD |  |
| Reference channel   |      |           |           |           |           |           |  |
| Channel bandwidth   | MHz  | 5         | 10        | 15        | 20        | 20        |  |
| Allocated resource blocks (Note 3)  |      | 18        | 17        | 17        | 17        | 83        |  |
| Allocated subframes per Radio Frame   |      | 9         | 9         | 9         | 9         | 9         |  |
| Modulation  |      | 64QAM     | 64QAM     | 64QAM     | 64QAM     | 64QAM     |  |
| Target Coding Rate  |      | 3/4       | 3/4       | 3/4       | 3/4       | 3/4       |  |
| Information Bit Payload   |      |           |           |           |           |           |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 10296     | 10296     | 10296     | 10296     | 51024     |  |
| For Sub-Frame 5   | Bits | N/A       | N/A       | N/A       | N/A       | N/A       |  |
| For Sub-Frame 0   | Bits | 8248      | 10296     | 10296     | 10296     | 51024     |  |
| Number of Code Blocks per Sub-Frame (Note 4)  |      |           |           |           |           |           |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  |      | 2         | 2         | 2         | 2         | 9         |  |
| For Sub-Frame 5   |      | N/A       | N/A       | N/A       | N/A       | N/A       |  |
| For Sub-Frame 0   |      | 2         | 2         | 2         | 2         | 9         |  |
| Binary Channel Bits Per Sub-Frame   |      |           |           |           |           |           |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 13608     | 14076     | 14076     | 14076     | 68724     |  |
| For Sub-Frame 5   | Bits | N/A       | N/A       | N/A       | N/A       | N/A       |  |
| For Sub-Frame 0   | Bits | 11088     | 14076     | 14076     | 14076     | 66204     |  |
| Max. Throughput averaged over 1 frame   | Mbps | 9.062     | 9.266     | 9.266     | 9.266     | 45.922    |  |
| UE Category   |      |           | ≥ 1       | ≥ 1       | ≥ 1       | ≥ 2       |  |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: Localized allocation started from RB #0 is applied.</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |           |           |           |           |           |  |

**Table A.3.3.1-4: Fixed Reference Channel Single PRB (Channel Edge)**

| Parameter                                    | Unit | Value   |       |         |       |    |    |
|--|------|---------|-------|---------|-------|----|----|
|  |      | R.0 FDD |       | R.1 FDD |       |    |    |
| Reference channel                            |      |         |       |         |       |    |    |
| Channel bandwidth                            | MHz  | 1.4     | 3     | 5       | 10/20 | 15 | 20 |
| Allocated resource blocks                    |      |         | 1     |         | 1     |    |    |
| Allocated subframes per Radio Frame          |      |         | 9     |         | 9     |    |    |
| Modulation                                   |      |         | 16QAM |         | 16QAM |    |    |
| Target Coding Rate                           |      |         | 1/2   |         | 1/2   |    |    |
| Information Bit Payload                      |      |         |       |         |       |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits |         | 224   |         | 256   |    |    |
| For Sub-Frame 5                              | Bits |         | N/A   |         | N/A   |    |    |
| For Sub-Frame 0                              | Bits |         | 224   |         | 256   |    |    |
| Number of Code Blocks per Sub-Frame (Note 3) |      |         |       |         |       |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9               |      |         | 1     |         | 1     |    |    |
| For Sub-Frame 5                              |      |         | N/A   |         | N/A   |    |    |
| For Sub-Frame 0                              |      |         | 1     |         | 1     |    |    |
| Binary Channel Bits Per Sub-Frame            |      |         |       |         |       |    |    |



|  |      |       |       |
|--|------|-------|-------|
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 504   | 552   |
| For Sub-Frame 5  | Bits | N/A   | N/A   |
| For Sub-Frame 0  | Bits | 504   | 552   |
| Max. Throughput averaged over 1 frame  | Mbps | 0.202 | 0.230 |
| UE Category  |      | ≥ 1   | ≥ 1   |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |       |       |

**Table A.3.3.1-5: Fixed Reference Channel Single PRB (MBSFN Configuration)**

| Parameter  | Unit | Value            |                    |
|--|------|------------------|--------------------|
|  |      | R.29 FDD (MBSFN) | R.29-1 FDD (MBSFN) |
| Reference channel  |      |                  |                    |
| Channel bandwidth  | MHz  | 10               | 10                 |
| Allocated resource blocks  |      | 1                | 1                  |
| MBSFN Configuration  |      | 111111(Note 4)   | 11111111(No te 5)  |
| Allocated subframes per Radio Frame  |      | 3                | 3                  |
| Modulation   |      | 16QAM            | 16QAM              |
| Target Coding Rate   |      | 1/2              | 1/2                |
| Information Bit Payload  |      |                  |                    |
| For Sub-Frames 4,9   | Bits | 256              | 0(MBSFN)           |
| For Sub-Frame 5  | Bits | N/A              | N/A                |
| For Sub-Frame 0  | Bits | 256              | 256                |
| For Sub-Frame 1,2,3,6,7,8  | Bits | 0 (MBSFN)        | 0 (MBSFN)          |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |                  |                    |
| For Sub-Frames 4,9   |      | 1                | 0(MBSFN)           |
| For Sub-Frame 5  |      | N/A              | N/A                |
| For Sub-Frame 0  |      | 1                | 1                  |
| For Sub-Frame 1,2,3,6,7,8  |      | 0 (MBSFN)        | 0 (MBSFN)          |
| Binary Channel Bits Per Sub-Frame  |      |                  |                    |
| For Sub-Frames 4,9   | Bits | 552              | 0(MBSFN)           |
| For Sub-Frame 5  | Bits | N/A              | N/A                |
| For Sub-Frame 0  | Bits | 552              | 552                |
| For Sub-Frame 1,2,3,6,7,8  | Bits | 0 (MBSFN)        | 0 (MBSFN)          |
| Max. Throughput averaged over 1 frame  | kbps | 76.8             | 25.6               |
| UE Category  |      | ≥ 1              | ≥ 1                |
| <p>Note 1: 2 symbols allocated to PDCCH.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 4: MBSFN Subframe Allocation as defined in TS 36.331 [7], one frame with 6 bits is chosen for MBSFN subframe allocation</p> <p>Note 5: MBSFN Subframe Allocation as defined in TS 36.331 [7], one frame with 6 bits and MBSFN Subframe Allocation-v14xy in TS 36.331 [7], one frame with 2 bits, are chosen for MBSFN subframe allocation.</p> |      |                  |                    |

**Table A.3.3.1-6: Fixed Reference Channel QPSK R=1/10**

| Parameter                           | Unit | Value |   |   |          |    |    |
|-------------------------------------|------|-------|---|---|----------|----|----|
|                                     |      | 1.4   | 3 | 5 | R.41 FDD | 15 | 20 |
| Reference channel                   |      |       |   |   |          |    |    |
| Channel bandwidth                   | MHz  | 1.4   | 3 | 5 | 10       | 15 | 20 |
| Allocated resource blocks           |      |       |   |   | 50       |    |    |
| Allocated subframes per Radio Frame |      |       |   |   | 9        |    |    |
| Modulation                          |      |       |   |   | QPSK     |    |    |
| Target Coding Rate                  |      |       |   |   | 1/10     |    |    |
| Information Bit Payload             |      |       |   |   |          |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9      | Bits |       |   |   | 1384     |    |    |

|   |      |  |  |  |       |  |  |
|---|------|--|--|--|-------|--|--|
| For Sub-Frame 5   | Bits |  |  |  | N/A   |  |  |
| For Sub-Frame 0   | Bits |  |  |  | 1384  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |  |  |  |       |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  |      |  |  |  | 1     |  |  |
| For Sub-Frame 5   |      |  |  |  | N/A   |  |  |
| For Sub-Frame 0   |      |  |  |  | 1     |  |  |
| Binary Channel Bits Per Sub-Frame   |      |  |  |  |       |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |  |  |  | 13800 |  |  |
| For Sub-Frame 5   | Bits |  |  |  | N/A   |  |  |
| For Sub-Frame 0   | Bits |  |  |  | 12960 |  |  |
| Max. Throughput averaged over 1 frame   | Mbps |  |  |  | 1.246 |  |  |
| UE Category   |      |  |  |  | ≥ 1   |  |  |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |  |  |  |       |  |  |

**Table A.3.3.1-7: Fixed Reference Channel for CA demodulation with power imbalance**

| Parameter  | Unit        | Value    |            |            |
|--|-------------|----------|------------|------------|
|  |             | R.49 FDD | R.49-1 FDD | R.49-2 FDD |
| Reference channel  |             | R.49 FDD | R.49-1 FDD | R.49-2 FDD |
| Channel bandwidth  | MHz         | 20       | 10         | 5          |
| Allocated resource blocks  |             | 100      | 50         | 25         |
| Allocated subframes per Radio Frame  |             | 9        | 9          | 9          |
| Modulation   |             | 64QAM    | 64QAM      | 64QAM      |
| Coding Rate  |             |          |            |            |
| For Sub-Frame 1,2,3,4,6,7,8,9,   |             | 0.84     | 0.84       | 0.84       |
| For Sub-Frame 5  |             | N/A      | N/A        | N/A        |
| For Sub-Frame 0  |             | 0.87     | 0.87       | 0.86       |
| Information Bit Payload  |             |          |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits        | 63776    | 31704      | 15840      |
| For Sub-Frame 5  | Bits        | N/A      | N/A        | N/A        |
| For Sub-Frame 0  |             | 63776    | 30576      | 14112      |
| Number of Code Blocks per Sub-Frame (Note 3)   |             |          |            |            |
| For Sub-Frames 0,1,2,3,4,6,7,8,9   | Code Blocks | 11       | 6          | 3          |
| For Sub-Frame 5  | Code Blocks | N/A      | N/A        | N/A        |
| Binary Channel Bits Per Sub-Frame  |             |          |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits        | 75600    | 37800      | 18900      |
| For Sub-Frame 5  | Bits        | N/A      | N/A        | N/A        |
| For Sub-Frame 0  | Bits        | 73080    | 35280      | 16380      |
| Max. Throughput averaged over 1 frame  | Mbps        | 57.398   | 28.420     | 14.083     |
| UE Category  |             | ≥5       | ≥2         | ≥2         |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |             |          |            |            |

### A.3.3.2 Multi-antenna transmission (Common Reference Symbols)

#### A.3.3.2.1 Two antenna ports

**Table A.3.3.2.1-1: Fixed Reference Channel two antenna ports**

| Parameter         | Unit | Value    |          |            |            |            |            |          |            |            |          |            |            |
|-------------------|------|----------|----------|------------|------------|------------|------------|----------|------------|------------|----------|------------|------------|
|                   |      | R.10 FDD | R.11 FDD | R.11-1 FDD | R.11-2 FDD | R.11-3 FDD | R.11-4 FDD | R.30 FDD | R.30-1 FDD | R.35-1 FDD | R.35 FDD | R.35-2 FDD | R.35-3 FDD |
| Reference channel |      |          |          |            |            |            |            |          |            |            |          |            |            |

|  |  |       |            |            |           | FDD<br>Note 5 |       |            |            |            |            |            |            |
|--|--|-------|------------|------------|-----------|---------------|-------|------------|------------|------------|------------|------------|------------|
| Channel bandwidth                              | MHz  | 10    | 10         | 10         | 5         | 10            | 10    | 20         | 15         | 20         | 10         | 15         | 10         |
| Allocated resource blocks (Note 4)             |  | 50    | 50         | 50         | 25        | 40            | 50    | 100        | 75         | 100        | 50         | 75         | 50         |
| Allocated subframes per Radio Frame            |  | 9     | 9          | 8          | 9         | 9             | 9     | 9          | 8          | 8          | 9          | 8          | 8          |
| Modulation                                     |  | QPSK  | 16QA<br>M  | 16QA<br>M  | 16QA<br>M | 16QA<br>M     | QPSK  | 16QA<br>M  | 16QA<br>M  | 64QA<br>M  | 64QA<br>M  | 64QA<br>M  | 64QA<br>M  |
| Target Coding Rate                             |  | 1/3   | 1/2        | 1/2        | 1/2       | 1/2           | 1/2   | 1/2        | 1/2        | 0.39       | 1/2        | 0.39       | 0.39       |
| Information Bit Payload (Note 4)               |  |       |            |            |           |               |       |            |            |            |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 4392  | 12960      | 12960      | 5736      | 10296         | 6968  | 25456      | 19080      | 30576      | 19848      | 22920      | 15264      |
| For Sub-Frame 5                                | Bits   | N/A   | N/A        | N/A        | N/A       | N/A           | N/A   | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        |
| For Sub-Frame 0                                | Bits   | 4392  | 12960      | N/A        | 4968      | 10296         | 6968  | 25456      | N/A        | N/A        | 18336      | N/A        | N/A        |
| Number of Code Blocks (Notes 3 and 4)          |  |       |            |            |           |               |       |            |            |            |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 1     | 3          | 3          | 1         | 2             | 2     | 5          | 4          | 5          | 4          | 4          | 3          |
| For Sub-Frame 5                                | Bits   | N/A   | N/A        | N/A        | N/A       | N/A           | N/A   | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        |
| For Sub-Frame 0                                | Bits   | 1     | 3          | N/A        | 1         | 2             | 2     | 5          | N/A        | N/A        | 3          | N/A        | N/A        |
| Binary Channel Bits (Note 4)                   |  |       |            |            |           |               |       |            |            |            |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 13200 | 26400      | 26400      | 12000     | 21120         | 13200 | 52800      | 39600      | 79200      | 39600      | 59400      | 39600      |
| For Sub-Frame 5                                | Bits   | N/A   | N/A        | N/A        | N/A       | N/A           | N/A   | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        |
| For Sub-Frame 0                                | Bits   | 12384 | 24768      | N/A        | 10368     | 19488         | 12384 | 51168      | N/A        | N/A        | 37152      | N/A        | N/A        |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps   | 3.953 | 11.66<br>4 | 10.36<br>8 | 5.086     | 9.266         | 6.271 | 22.91<br>0 | 15.26<br>4 | 24.46<br>1 | 17.71<br>2 | 18.33<br>6 | 12.21<br>1 |
| UE Category                                    |  | ≥ 1   | ≥ 2        | ≥ 2        | ≥ 1       | ≥ 1           | ≥ 1   | ≥ 2        | ≥ 2        | 4          | ≥ 2        | ≥ 2        | ≥ 2        |
| Note 1:  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |       |            |            |           |               |       |            |            |            |            |            |            |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |       |            |            |           |               |       |            |            |            |            |            |            |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |       |            |            |           |               |       |            |            |            |            |            |            |
| Note 4:  | Given per component carrier per codeword.  |       |            |            |           |               |       |            |            |            |            |            |            |
| Note 5:  | For R.11-3 resource blocks of RB6–RB45 are allocated.  |       |            |            |           |               |       |            |            |            |            |            |            |

Table A.3.3.2.1-2: Fixed Reference Channel two antenna ports

| Parameter                                      | Unit   | Value    |          |            |            |            |            |            |            |             |          |            |            |
|--|--|----------|----------|------------|------------|------------|------------|------------|------------|-------------|----------|------------|------------|
|  |  | R.46 FDD | R.47 FDD | R.35-4 FDD | R.11-5 FDD | R.11-6 FDD | R.11-7 FDD | R.11-8 FDD | R.11-9 FDD | R.11-10 FDD | R.65 FDD | R.10-2 FDD | R.10-3 FDD |
| Reference channel                              |  |          |          |            |            |            |            |            |            |             |          |            |            |
| Channel bandwidth                              | MHz  | 10       | 10       | 10         | 1.4        | 3          | 15         | 10         | 10         | 10          | 10       | 5          | 10         |
| Allocated resource blocks (Note 4)             |  | 50       | 50       | 50         | 6          | 15         | 75         | 50         | 50         | 50          | 50       | 25         | 50         |
| Allocated number of PDCCH symbols              |  | 2        | 2        | 2          | 4          | 3          | 2          | 2          | 3          | 3           | 2        | 3          | 2          |
| Allocated subframes per Radio Frame            |  | 9        | 9        | 9          | 8          | 9          | 9          | 9          | 8          | 8           | 8        | 9          | 9          |
| Modulation                                     |  | QPSK     | 16QA M   | 64QA M     | 16QA M     | 16QA M     | 16QA M     | QPSK       | QPSK       | QPSK        | 256QA M  | QPSK       | 16QA M     |
| Target Coding Rate                             |  |          |          | 0.47       | 1/2        | 1/2        | 1/2        | 3/5        | 0.58       | 0.67        | 0.55     | 1/3        | 0.58       |
| Information Bit Payload (Note 4)               |  |          |          |            |            |            |            |            |            |             |          |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 5160     | 8760     | 18336      | 1352       | 3368       | 19080      | 7992       | 6968       | 7992        | 31704    | 1800       | 15264      |
| For Sub-Frame 5                                | Bits   | N/A      | N/A      | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        | N/A         | N/A      | n/a        | n/a        |
| For Sub-Frame 0                                | Bits   | 5160     | 8760     | 16416      | N/A        | 2664       | 19080      | 6968       | N/A        | N/A         | N/A      | 1800       | 14112      |
| Number of Code Blocks (Notes 3 and 4)          |  |          |          |            |            |            |            |            |            |             |          |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 1        | 2        | 3          | 1          | 1          | 4          | 2          | 2          | 2           | 6        | 1          | 3          |
| For Sub-Frame 5                                | Bits   | N/A      | N/A      | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        | N/A         | N/A      | n/a        | n/a        |
| For Sub-Frame 0                                | Bits   | 1        | 2        | 3          | 1          | 1          | 4          | 2          | N/A        | N/A         | N/A      | 1          | 3          |
| Binary Channel Bits (Note 4)                   |  |          |          |            |            |            |            |            |            |             |          |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 13200    | 26400    | 39600      | 2592       | 7200       | 39600      | 13200      | 12000      | 12000       | 57600    | 6000       | 26400      |
| For Sub-Frame 5                                | Bits   | N/A      | N/A      | N/A        | N/A        | N/A        | N/A        | N/A        | N/A        | N/A         | N/A      | n/a        | n/a        |
| For Sub-Frame 0                                | Bits   | 12384    | 24768    | 37152      | N/A        | 5568       | 37968      | 12384      | N/A        | N/A         | N/A      | 5184       | 24768      |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps   | 4.644    | 7.884    | 16.310     | 1.082      | 2.961      | 17.172     | 7.0904     | 5.5744     | 6.3936      | 25.363   | 1.620      | 13.6224    |
| UE Category                                    |  | ≥ 1      | ≥ 1      | ≥ 2        | ≥ 1        | ≥ 1        | ≥ 2        | ≥ 2        | ≥ 1        | ≥ 1         | 11-12    | ≥ 1        | ≥ 2        |
| UE DL Category                                 |  | ≥ 6      | ≥ 6      | ≥ 6        | ≥ 6        | ≥ 6        | ≥ 6        | ≥ 6        |            |             | ≥ 11     | ≥ 6        |            |
| Note 1:  | Void   |          |          |            |            |            |            |            |            |             |          |            |            |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |          |          |            |            |            |            |            |            |             |          |            |            |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |          |          |            |            |            |            |            |            |             |          |            |            |
| Note 4:  | Given per component carrier per codeword.  |          |          |            |            |            |            |            |            |             |          |            |            |

**Table A.3.3.2.1-3: Fixed Reference Channel two antenna ports**

| Parameter  | Unit  | Value       |             |
|--|---|-------------|-------------|
| Reference channel                                  |   | R.62<br>FDD | R.63<br>FDD |
| Channel bandwidth                                  | MHz   | 10          | 10          |
| Allocated resource blocks (Note 4)                 |   | 3           | 1           |
| Allocated DL subframes per 4 Radio Frames (Note 3) |   | 15          | 15          |
| Modulation   |   | 16QAM       | 64QAM       |
| Target Coding Rate                                 |   | 1/2         | 1/2         |
| Information Bit Payload                            |   |             |             |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9                 | Bits  | 744         | 408         |
| Number of Code Blocks                              |   |             |             |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9                 | Code blocks   | 1           | 1           |
| Binary Channel Bits                                |   |             |             |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9                 | Bits  | 1584        | 792         |
| Max. Throughput averaged over 4 frames             | Mbps  | 0.279       | 0.153       |
| UE DL Category                                     |   | 0           | 0           |
| Note 1:  | 2 symbols allocated to PDCCH  |             |             |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]   |             |             |
| Note 3:  | The downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled. |             |             |
| Note 4:  | Allocated PRB positions start from {9, 10, ..., 9+N-1}, where N is the number of allocated resource blocks.   |             |             |

**Table A.3.3.2.1-4: Fixed Reference Channel two antenna ports**

| Parameter                              | Unit   | Values     |           |           |
|--|--|------------|-----------|-----------|
| Reference channel                      |  | R.79 FDD   | R.103 FDD | R.104 FDD |
| Channel bandwidth                      | MHz  | 10         | 10        | 10        |
| Allocated resource blocks (Note 4)     |  | 3          | 3         | 3         |
| Allocated DL subframes per Radio Frame |  | Note 3     | Note 5    | Note 3    |
| Modulation                             |  | 16QAM      | QPSK      | 64QAM     |
| Target Coding Rate                     |  | 1/2        | 1/3       | 0.4       |
| Information Bit Payload                |  |            |           |           |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9     | Bits   | 744        | 224       | 968       |
| Number of Code Blocks                  |  |            |           |           |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9     | Code blocks  | 1          | 1         | 1         |
| Binary Channel Bits                    |  |            |           |           |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9     | Bits   | 1584       | 792       | 2376      |
| Max. Throughput averaged over 1 frame  | Mbps   | 0.149      | 0.0187    | 0.194     |
| UE DL Category                         |  | M1, M2 ≥ 0 | M1, M2    | M1, M2    |
| Note 1:                                | 2 symbols allocated to PDCCH.  |            |           |           |
| Note 2:                                | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |            |           |           |
| Note 3:                                | The downlink subframes are scheduled at the 0th and 1st subframes every 10ms. Information bit payload is available if downlink subframe is scheduled (starting from 0th subframe). The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmissions. |            |           |           |
| Note 4:                                | Allocated PRB positions for PDSCH are {3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband.  |            |           |           |
| Note 5:                                | The downlink subframes are scheduled at the 0th subframes every 12ms. Information bit payload is available if downlink subframe is scheduled (starting from 5th subframe). The corresponding MPDCCH is scheduled 5 subframes before the corresponding PDSCH transmissions.         |            |           |           |

Table A.3.3.2.1-5: Fixed Reference Channel two antenna ports

| Parameter                                | Unit  | Values       |            |            |
|--|---|--------------|------------|------------|
|  |   | R.81 FDD     | R.81-1 FDD | R.81-2 FDD |
| Reference channel                        |   | R.81 FDD     | R.81-1 FDD | R.81-2 FDD |
| Channel bandwidth                        | MHz   | 10           | 10         | 10         |
| Allocated resource blocks (Note 4)       |   | 6            | 6          | 6          |
| Allocated PDSCH subframes                |   | (Note 3)     | (Note 6)   | (Note 7)   |
| Modulation                               |   | QPSK         | QPSK       | QPSK       |
| Target Coding Rate                       |   | 1/10         | 1/10       | 1/10       |
| Information Bit Payload                  |   |              |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9       | Bits  | 152          | 152        | 152        |
| Number of Code Blocks                    |   |              |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9       | Code blocks   | 1            | 1          | 1          |
| Binary Channel Bits                      |   |              |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9       | Bits  | 1584         | 1584       | 1584       |
| Max. Throughput averaged over one period | kbps  | 0.950        | 1.9        | 4.75       |
| UE DL Category                           |   | M1, $\geq 0$ | $\geq 1$   | $\geq 1$   |
| Note 1:                                  | 2 symbols allocated to PDCCH  |              |            |            |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]   |              |            |            |
| Note 3:                                  | PDSCH subframes are scheduled at the 65th to 128th subframes every period=160 ms. Information bit payload is available at the 65th to 128th subframes with repetition. (Starting from the 0th subframe) |              |            |            |
| Note 4:                                  | Allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband.  |              |            |            |
| Note 5:                                  | MPDCCH are scheduled at the 0th to 63rd subframes with repetition. The allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband. (Starting from the 0th subframe)                  |              |            |            |
| Note 6:                                  | PDSCH subframes are scheduled at the 33th to 64th subframes every period=80 ms. Information bit payload is available at the 33th to 64th subframes with repetition. (Starting from the 0th subframe)    |              |            |            |
| Note 7:                                  | PDSCH subframes are scheduled at the 9th to 24th subframes every period=32 ms. Information bit payload is available at the 9th to 24th subframes with repetition. (Starting from the 0th subframe)      |              |            |            |

Table A.3.3.2.1-6: Fixed Reference Channel two antenna ports

| Parameter                               | Unit | Values   |            |          |          |          |            |            |            |
|---|------|----------|------------|----------|----------|----------|------------|------------|------------|
|   |      | R.87 FDD | R.87-1 FDD | R.84 FDD | R.aa FDD | R.bb FDD | R.87-2 FDD | R.87-3 FDD | R.87-4 FDD |
| Reference channel                       |      | R.87 FDD | R.87-1 FDD | R.84 FDD | R.aa FDD | R.bb FDD | R.87-2 FDD | R.87-3 FDD | R.87-4 FDD |
| Channel bandwidth                       | MHz  | 10       | 10         | 10       | 10       | 10       | 5          | 15         | 20         |
| Allocated resource blocks (Note 4)      |      | 50       | 50         | 39       | 50       | 50       | 25         | 75         | 100        |
| Allocated number of PDCCH symbols       |      | 2        | 2          | 2        | 2        | 2        | 2          | 2          | 2          |
| Allocated subframes per Radio subframes |      | 8        | 8          | 9        | 9        | 9        | 8          | 8          | 8          |
| Modulation                              |      | 64QAM    | 16QAM      | 16QAM    | QPSK     | 16QAM    | 64QAM      | 64QAM      | 64QAM      |
| Target Coding Rate                      |      |          |            |          |          |          |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9          |      | 0.39     | 0.44       | 1/2      | 0.6      | 0.3      | 0.39       | 0.39       | 0.39       |
| For Sub-Frames 5                        |      | N/A      | N/A        | N/A      | N/A      | N/A      | N/A        | N/A        | N/A        |
| For Sub-Frames 0                        |      | N/A      | N/A        | N/A      | 0.65     | 0.32     | N/A        | N/A        | N/A        |
| Information Bit Payload (Note 4)        |      |          |            |          |          |          |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9          | Bits | 15264    | 11448      | 9912     | 7992     | 7992     | 7736       | 22920      | 30576      |
| For Sub-Frames 5                        | Bits | N/A      | N/A        | N/A      | N/A      | N/A      | N/A        | N/A        | N/A        |
| For Sub-Frames 0                        |      | N/A      | N/A        | 9912     | 7992     | 7992     | N/A        | N/A        | N/A        |
| Number of Code Blocks(Notes 3 and 4)    |      |          |            |          |          |          |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9          |      | 3        | 2          | 2        | 2        | 2        | 2          | 4          | 5          |
| For Sub-Frames 5                        |      | N/A      | N/A        | N/A      | N/A      | N/A      | N/A        | N/A        | N/A        |
| For Sub-Frames 0                        |      | N/A      | N/A        | 2        | 2        | 2        | N/A        | N/A        | N/A        |
| Binary Channel Bits (Note 4)            |      |          |            |          |          |          |            |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9          | Bits | 39600    | 26400      | 20592    | 13200    | 26400    | 19800      | 59400      | 79200      |

|  |      |        |       |        |        |        |        |        |        |
|--|------|--------|-------|--------|--------|--------|--------|--------|--------|
| For Sub-Frames 5   |      | N/A    | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 0   |      | N/A    | N/A   | 20592  | 12384  | 24768  | N/A    | N/A    | N/A    |
| Max. Throughput averaged over 1 frame (Note 4)   | Mbps | 12.211 | 9.158 | 8.9208 | 7.1928 | 7.1928 | 6.1888 | 18.336 | 24.461 |
| UE Category  |      | ≥ 1    | ≥ 1   | 1bis   | ≥ 1    | ≥ 2    | ≥ 1    | ≥ 1    | ≥ 1    |
| UE DL Category   |      | ≥ 6    | ≥ 6   | N/A    | ≥ 6    | ≥ 6    | ≥ 6    | ≥ 6    | ≥ 6    |
| Note 1: Void<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 4: Given per component carrier per codeword.<br>Note 5: For R.84 FDD, 39 RBs are allocated on RB 0-20 and 30-47. |      |        |       |        |        |        |        |        |        |

**Table A.3.3.2.1-7: Fixed Reference Channel two antenna ports**

| Parameter  | Unit | Value      |            |             |
|--|------|------------|------------|-------------|
|  |      | R.47-1 FDD | R.47-2 FDD | R.47-3 FDD  |
| Reference channel  |      |            |            |             |
| Channel bandwidth  | MHz  | 5          | 15         | 20          |
| Allocated resource blocks (Note 4)   |      | 25         | 75         | 100         |
| Allocated number of PDCCH symbols  |      | 2          | 2          | 2           |
| Allocated subframes per Radio Frame  |      | 9          | 9          | 9           |
| Modulation   |      | 16QAM      | 16QAM      | 16QAM       |
| Target Coding Rate   |      |            |            |             |
| Information Bit Payload (Note 4)   |      |            |            |             |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 4008       | 12960      | 17568       |
| For Sub-Frame 5  | Bits | N/A        | N/A        | N/A         |
| For Sub-Frame 0  | Bits | 3496       | 12960      | 17568       |
| Number of Code Blocks  |      |            |            |             |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 1          | 3          | 3           |
| For Sub-Frame 5  | Bits | N/A        | N/A        | N/A         |
| For Sub-Frame 0  | Bits | 1          | 3          | 3           |
| Binary Channel Bits (Note 3)   |      |            |            |             |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 12000      | 39600      | 52800       |
| For Sub-Frame 5  | Bits | N/A        | N/A        | N/A         |
| For Sub-Frame 0  | Bits | 10368      | 37968      | 51168       |
| Max. Throughput averaged over 1 frame (Note 3)   | Mbps | 3.556      | 11.664     | 15.811<br>2 |
| UE Category  |      | ≥ 1        | ≥ 1        | ≥ 1         |
| UE DL Category   |      | ≥ 6        | ≥ 6        | ≥ 6         |
| Note 1: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 3: Given per component carrier per codeword. |      |            |            |             |

**Table A.3.3.2.1-8: Fixed Reference Channel two antenna ports**

| Parameter                          | Unit | Values      |             |             |             |
|------------------------------------|------|-------------|-------------|-------------|-------------|
|                                    |      | R.90 FDD    | R.91 FDD    | R.92-1 FDD  | R.92-2 FDD  |
| Reference channel                  |      |             |             |             |             |
| Channel bandwidth                  | MHz  | 10          | 10          | 10          | 10          |
| Allocated resource blocks          |      | 18 (Note 7) | 18 (Note 7) | 36 (Note 8) | 36 (Note 8) |
| Allocated DL subframes             |      | Note 3      | Note 4      | Note 5      | Note 6      |
| Modulation                         |      | QPSK        | QPSK        | QPSK        | QPSK        |
| Target Coding Rate                 |      | 1/3         | 1/10        | 1/2         | 1/2         |
| Information Bit Payload            |      |             |             |             |             |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Bits | 1544        | 488         | 4392        | 4392        |
| Number of Code Blocks              |      |             |             |             |             |

|  |             |       |        |          |          |
|--|-------------|-------|--------|----------|----------|
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9   | Code blocks | 1     | 1      | 1        | 1        |
| Binary Channel Bits  |             |       |        |          |          |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9   | Bits        | 4752  | 4752   | 9504     | 9504     |
| Max. Throughput averaged over one period   | kbps        | 48.25 | 3.8125 | 219.6    | 439.2    |
| UE DL Category   |             | M2    | M2     | $\geq 1$ | $\geq 1$ |
| Note 1: 2 symbols allocated to PDCCH   |             |       |        |          |          |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |             |       |        |          |          |
| Note 3: The downlink subframes are scheduled at the 0th to 24th subframes every period=32 ms. Information bit payload is available at the 17th to 24th subframes with repetition. MPDCCH are scheduled at the 0th to 15th subframes with repetition. (Starting from the 0th subframe)  |             |       |        |          |          |
| Note 4: The downlink subframes are scheduled at the 0th to 96th subframes every period=128 ms. Information bit payload is available at the 65th to 96th subframes with repetition. MPDCCH are scheduled at the 0th to 63rd subframes with repetition. (Starting from the 0th subframe) |             |       |        |          |          |
| Note 5: The downlink subframes are scheduled at the 0th to 12th subframes every period= 20 ms. Information bit payload is available at the 9th to 12th subframes with repetition. MPDCCH are scheduled at the 0th to 7th subframes with repetition. (Starting from the 0th subframe)   |             |       |        |          |          |
| Note 6: The downlink subframes are scheduled at the 0th to 4th subframes every period=10 ms. Information bit payload is available at the 3rd to 4th subframes with repetition. MPDCCH are scheduled at the 0th to 1st subframes with repetition. (Starting from the 0th subframe)      |             |       |        |          |          |
| Note 7: Allocated PRB positions are {0, 1, ..., 17} within the assigned wideband.  |             |       |        |          |          |
| Note 8: Allocated PRB positions are {1, 2, 3, ..., 18, 31, 32, ..., 48}.   |             |       |        |          |          |
| Note 9: Allocated PRB positions for MPDCCH are {0, 1, 2, 3, 4, 5} within the scheduled narrowband.   |             |       |        |          |          |

Table A.3.3.2.1-9: Fixed Reference Channel two antenna ports

| Parameter   | Unit | Value       |  |
|---|------|-------------|--|
| Reference channel   |      | R.11-13 FDD |  |
| Channel bandwidth   | MHz  | 10          |  |
| Allocated resource blocks (Note 4)  |      | 50          |  |
| Allocated subframes per Radio Frame   |      | 9           |  |
| Modulation  |      | 16QAM       |  |
| Target Coding Rate  |      | 1/2         |  |
| Information Bit Payload (Note 4)  |      |             |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 10680       |  |
| For Sub-Frame 5   | Bits | N/A         |  |
| For Sub-Frame 0   | Bits | 10680       |  |
| Number of Code Blocks (Notes 3 and 4)   |      |             |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 2           |  |
| For Sub-Frame 5   | Bits | N/A         |  |
| For Sub-Frame 0   | Bits | 2           |  |
| Binary Channel Bits (Note 4)  |      |             |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 21648       |  |
| For Sub-Frame 5   | Bits | N/A         |  |
| For Sub-Frame 0   | Bits | 17424       |  |
| Max. Throughput averaged over 1 frame (Note 4)  | Mbps | 9.612       |  |
| UE Category   |      | $\geq 2$    |  |
| Note 1: 2 symbols allocated to PDCCH.   |      |             |  |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |      |             |  |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |             |  |
| Note 4: Given per component carrier per codeword.   |      |             |  |
| Note 5: 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0,1,2,3,4,6,7,8,9.   |      |             |  |



## A.3.3.2.2 Four antenna ports

Table A.3.3.2.2-1: Fixed Reference Channel four antenna ports

| Parameter   | Unit   | Value       |             |             |               |               |               |             |               |               |               |               |               |
|---|--|-------------|-------------|-------------|---------------|---------------|---------------|-------------|---------------|---------------|---------------|---------------|---------------|
|   |  | R.12<br>FDD | R.13<br>FDD | R.14<br>FDD | R.14-1<br>FDD | R.14-2<br>FDD | R.14-3<br>FDD | R.36<br>FDD | R.14-4<br>FDD | R.14-5<br>FDD | R.14-6<br>FDD | R.14-7<br>FDD | R.36-1<br>FDD |
| Reference channel                                 |  |             |             |             |               |               |               |             |               |               |               |               |               |
| Channel bandwidth                                 | MHz  | 1.4         | 10          | 10          | 10            | 10            | 20            | 10          | 1.4           | 3             | 5             | 15            | 10            |
| Allocated resource blocks<br>(Note 4)             |  | 6           | 50          | 50          | 6             | 3             | 100           | 50          | 6             | 15            | 25            | 75            | 50            |
| Allocated subframes per<br>Radio Frame            |  | 9           | 9           | 9           | 8             | 8             | 9             | 9           | 8             | 9             | 9             | 9             | 9             |
| Modulation  |  | QPSK        | QPSK        | 16QA<br>M   | 16QAM         | 16QAM         | 16QAM         | 64QA<br>M   | 16QAM         | 16QAM         | 16QAM         | 16QAM         | 64QAM         |
| Target Coding Rate                                |  | 1/3         | 1/3         | 1/2         | 1/2           | 1/2           | 1/2           | 1/2         | 1/2           | 1/2           | 1/2           | 1/2           | 0.55          |
| Information Bit Payload (Note<br>4)               |  |             |             |             |               |               |               |             |               |               |               |               |               |
| For Sub-Frames<br>1,2,3,4,6,7,8,9                 | Bits   | 408         | 4392        | 12960       | 1544          | 744           | 25456         | 18336       | 1192          | 3368          | 5736          | 19080         | 21384         |
| For Sub-Frame 5                                   | Bits   | N/A         | N/A         | N/A         | N/A           | N/A           | n/a           | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   | Bits   | 152         | 3624        | 11448       | N/A           | N/A           | 22920         | 18336       | N/A           | 2664          | 4968          | 19080         | 19848         |
| Number of Code Blocks<br>(Notes 3 and 4)          |  |             |             |             |               |               |               |             |               |               |               |               |               |
| For Sub-Frames<br>1,2,3,4,6,7,8,9                 |  | 1           | 1           | 3           | 1             | 1             | 5             | 3           | 1             | 1             | 1             | 4             | 4             |
| For Sub-Frame 5                                   |  | N/A         | N/A         | N/A         | N/A           | N/A           | n/a           | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   |  | 1           | 1           | 2           | N/A           | N/A           | 4             | 3           | N/A           | 1             | 1             | 4             | 4             |
| Binary Channel Bits (Note 4)                      |  |             |             |             |               |               |               |             |               |               |               |               |               |
| For Sub-Frames<br>1,2,3,4,6,7,8,9                 | Bits   | 1248        | 12800       | 25600       | 3072          | 1536          | 51200         | 38400       | 2496          | 6960          | 11600         | 38400         | 38400         |
| For Sub-Frame 5                                   | Bits   | N/A         | N/A         | N/A         | N/A           | N/A           | n/a           | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   | Bits   | 480         | 12032       | 24064       | N/A           | N/A           | 49664         | 36096       | N/A           | 5424          | 10064         | 36864         | 36096         |
| Max. Throughput averaged<br>over 1 frame (Note 4) | Mbps   | 0.342       | 3.876       | 11.513      | 1.235         | 0.595         | 22.656        | 16.502      | 0.954         | 2.961         | 5.086         | 17.172        | 19.092        |
| UE Category                                       |  | ≥ 1         | ≥ 1         | ≥ 2         | ≥ 1           | ≥ 1           | ≥ 2           | ≥ 2         | ≥ 1           | ≥ 1           | ≥ 1           | ≥ 2           | ≥ 2           |
| Note 1:   | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |             |             |             |               |               |               |             |               |               |               |               |               |
| Note 2:   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |             |             |             |               |               |               |             |               |               |               |               |               |
| Note 3:   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |             |             |             |               |               |               |             |               |               |               |               |               |
| Note 4:   | Given per component carrier per codeword.  |             |             |             |               |               |               |             |               |               |               |               |               |

Table A.3.3.2.2-2: Fixed Reference Channel four antenna ports

| Parameter                                      | Unit | Value    |            |            |            |                                    |                                    |          |                |                |
|--|------|----------|------------|------------|------------|------------------------------------|------------------------------------|----------|----------------|----------------|
|  |      | R.72 FDD | R.72-1 FDD | R.72-2 FDD | R.72-3 FDD | R.73 FDD                           | R.73-1 FDD                         | R.74 FDD | R.85 FDD       | R.93 FDD       |
| Reference channel                              |      | R.72 FDD | R.72-1 FDD | R.72-2 FDD | R.72-3 FDD | R.73 FDD                           | R.73-1 FDD                         | R.74 FDD | R.85 FDD       | R.93 FDD       |
| Channel bandwidth                              | MHz  | 10       | 5          | 15         | 20         | 10                                 | 10                                 | 10       | 10             | 10             |
| Allocated resource blocks (Note 4)             |      | 50       | 25         | 75         | 100        | 50                                 | 50                                 | 50       | 24<br>(Note 5) | 24<br>(Note 5) |
| Allocated subframes per Radio Frame            |      | 9        | 9          | 9          | 9          | 9                                  | 9                                  | 9        | 9              | 9              |
| Modulation                                     |      | 256QAM   | 256QAM     | 256QAM     | 256QAM     | 64QAM                              | 16QAM                              | 16QAM    | 64QAM          | 64QAM          |
| Target Coding Rate                             |      | 0.62     | 0.69       | 0.61       | 0.62       | 0.43                               | 1/2                                | 1/2      | 1/2            | 0.52           |
| Information Bit Payload (Note 4)               |      |          |            |            |            |                                    |                                    |          |                |                |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits | 31704    | 15840      | 46888      | 63776      | 16416<br>(CW0)<br>32856<br>(CW1)   | 12960<br>(CW0)<br>25456<br>(CW1)   | 25456    | 10296          | 9528           |
| For Sub-Frame 5                                | Bits | N/A      | N/A        | N/A        | N/A        | N/A                                | N/A                                | N/A      | N/A            | N/A            |
| For Sub-Frame 0                                | Bits | 31704    | 15840      | 46888      | 63776      | 15264<br>(CW0)<br>30576<br>(CW1)   | 11448<br>(CW0)<br>22920<br>(CW1)   | 22920    | 10296          | 9528           |
| Number of Code Blocks<br>(Notes 3 and 4)       |      |          |            |            |            |                                    |                                    |          |                |                |
| For Sub-Frames 1,2,3,4,6,7,8,9                 |      | 6        | 3          | 8          | 11         | 3 (CW0)<br>6 (CW1)                 | 3 (CW0)<br>5 (CW1)                 | 5        | 2              | 2              |
| For Sub-Frame 5                                |      | N/A      | N/A        | N/A        | N/A        | N/A                                | N/A                                | N/A      | N/A            | N/A            |
| For Sub-Frame 0                                |      | 6        | 3          | 8          | 11         | 3 (CW0)<br>5 (CW1)                 | 2 (CW0)<br>4 (CW1)                 | 5        | 2              | 2              |
| Binary Channel Bits (Note 4)                   |      |          |            |            |            |                                    |                                    |          |                |                |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits | 51200    | 23200      | 76800      | 102400     | 38400<br>(CW0)<br>76800<br>(CW1)   | 25600<br>(CW0)<br>51200<br>(CW1)   | 51200    | 18432          | 18432          |
| For Sub-Frame 5                                | Bits | N/A      | N/A        | N/A        | N/A        | N/A                                | N/A                                | N/A      | N/A            | N/A            |
| For Sub-Frame 0                                | Bits | 48128    | 20128      | 73728      | 99328      | 36096<br>(CW0)<br>72192<br>(CW1)   | 24064<br>(CW0)<br>48128<br>(CW1)   | 48128    | 18432          | 18432          |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 28.534   | 14.256     | 42.1992    | 57.3984    | 14.659<br>(CW0)<br>29.342<br>(CW1) | 11.513<br>(CW0)<br>22.657<br>(CW1) | 22.657   | 9.2664         | 8.575          |
| UE Category                                    |      | ≥ 11     | ≥ 11       | ≥ 11       | ≥ 11       | ≥ 5                                | ≥ 5                                | ≥ 5      | 1bis           | 1bis           |

|         |  |
|---------|--|
| Note 1: | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |
| Note 2: | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |
| Note 3: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |
| Note 4: | Given per component carrier per codeword.  |
| Note 5: | 24 resource blocks (RB 0-20 and 30-32) are allocated in sub-frames 0, 1, 2, 3, 4, 6, 7, 8, 9   |

Table A.3.3.2.2-3: Fixed Reference Channel four antenna ports

| Parameter                                      | Unit   | Value         |               |               |              |
|--|--|---------------|---------------|---------------|--------------|
|  |  | R.74-1<br>FDD | R.74-2<br>FDD | R.74-3<br>FDD | R.101<br>FDD |
| Reference channel                              |  |               |               |               |              |
| Channel bandwidth                              | MHz  | 5             | 15            | 20            | 10           |
| Allocated resource blocks (Note 4)             |  | 25            | 75            | 100           | 50           |
| Allocated subframes per Radio Frame            |  | 9             | 9             | 9             | 9            |
| Modulation                                     |  | 16QAM         | 16QAM         | 16QAM         | 1024QAM      |
| Target Coding Rate                             |  | 1/2           | 1/2           | 1/2           | 3/4          |
| Information Bit Payload (Note 4)               |  |               |               |               |              |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 11448         | 37888         | 51024         | 52752        |
| For Sub-Frame 5                                | Bits   | N/A           | N/A           | N/A           | N/A          |
| For Sub-Frame 0                                | Bits   | 9912          | 37888         | 51024         | N/A          |
| Number of Code Blocks (Notes 3 and 4)          |  |               |               |               |              |
| For Sub-Frames 1,2,3,4,6,7,8,9                 |  | 2             | 7             | 9             | 9            |
| For Sub-Frame 5                                |  | N/A           | N/A           | N/A           | N/A          |
| For Sub-Frame 0                                |  | 2             | 7             | 9             | N/A          |
| Binary Channel Bits (Note 4)                   |  |               |               |               |              |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 23200         | 76800         | 102400        | 68000        |
| For Sub-Frame 5                                | Bits   | N/A           | N/A           | N/A           | N/A          |
| For Sub-Frame 0                                | Bits   | 20128         | 73728         | 99328         | N/A          |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps   | 10.1496       | 34.0992       | 45.9216       | 42.2016      |
| UE Category                                    |  | ≥ 5           | ≥ 5           | ≥ 5           | TBD          |
| UE DL Category                                 |  |               |               |               | 20, ≥ 22     |
| Note 1:  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. 1 symbol allocated to PDCCH for reference channel with 1024QAM. |               |               |               |              |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |               |               |               |              |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |               |               |               |              |
| Note 4:  | Given per component carrier per codeword.  |               |               |               |              |

Table A.3.3.2.2-4: Fixed Reference Channel four antenna ports

| Parameter                                       | Unit   | Values   |
|---|--|----------|
| Reference channel                               |  | R.95 FDD |
| Channel bandwidth                               | MHz  | 10       |
| Allocated resource blocks (Note 4)              |  | 3        |
| Allocated DL subframes per Radio Frame (Note 3) |  | 2        |
| Modulation                                      |  | 16QAM    |
| Target Coding Rate                              |  | 1/2      |
| Information Bit Payload                         |  |          |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9              | Bits   | 744      |
| Number of Code Blocks                           |  |          |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9              | Code blocks  | 1        |
| Binary Channel Bits                             |  |          |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9              | Bits   | 1536     |
| Max. Throughput averaged over 1 frame           | Mbps   | 0.149    |
| UE DL Category                                  |  | M2       |
| Note 1:   | 2 symbols allocated to PDCCH.  |          |
| Note 2:   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |          |
| Note 3:   | The downlink subframes are scheduled at the 0th and 1st subframes every 10ms. Information bit payload is available if downlink subframe is scheduled (starting from 0th subframe). The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmissions. |          |
| Note 4:   | Allocated PRB positions for PDSCH are {3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband.  |          |

### A.3.3.3 Reference Measurement Channel for UE-Specific Reference Symbols

#### A.3.3.3.0 Two antenna ports (no CSI-RS)

The reference measurement channels in Table A.3.3.3.0-1 apply with two CRS antenna ports and without CSI-RS.

**Table A.3.3.3.0-1: Fixed Reference Channel without CSI-RS**

| Parameter  | Unit | Value    |          |
|--|------|----------|----------|
| Reference channel  |      | R.70 FDD | R.71 FDD |
| Channel bandwidth  | MHz  | 10       | 10       |
| Allocated resource blocks  |      | 50       | 50       |
| Allocated subframes per Radio Frame  |      | 10       | 10       |
| Modulation   |      | QPSK     | 16QAM    |
| Target Coding Rate   |      | 0.65     | 0.6      |
| Information Bit Payload  |      |          |          |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 6968     | 12960    |
| For Sub-Frame 5  | Bits | N/A      | N/A      |
| For Sub-Frame 0  | Bits | N/A      | N/A      |
| Number of Code Blocks per Sub-Frame (Note 4)   |      |          |          |
| For Sub-Frames 1,2,3,4,6,7,8,9   |      | 2        | 3        |
| For Sub-Frame 5  |      | N/A      | N/A      |
| For Sub-Frame 0  |      | N/A      | N/A      |
| Binary Channel Bits Per Sub-Frame  |      |          |          |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 10800    | 21600    |
| For Sub-Frame 5  | Bits | N/A      | N/A      |
| For Sub-Frame 0  | Bits | N/A      | N/A      |
| Max. Throughput averaged over 1 frame  | Mbps | 5.5744   | 10.368   |
| UE Category  |      | ≥ 1      | ≥ 2      |
| Note 1: 3 symbols allocated to PDCCH.  |      |          |          |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |      |          |          |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |      |          |          |

The reference measurement channels in Table A.3.3.3.0-2 apply for verifying demodulation performance for UE-specific reference symbols without CSI-RS.

**Table A.3.3.3.0-2: Fixed Reference Channel without CSI-RS**

| Parameter                          | Unit        | Value    |            |            |
|------------------------------------|-------------|----------|------------|------------|
| Reference channel                  |             | R.80 FDD | R.80-1 FDD | R.80-2 FDD |
| Channel bandwidth                  | MHz         | 10       | 10         | 10         |
| Allocated resource blocks (Note 4) |             | 6        | 6          | 6          |
| Allocated PDSCH subframes          |             | Note 3   | Note 6     | Note 7     |
| Modulation                         |             | QPSK     | QPSK       | QPSK       |
| Target Coding Rate                 |             | 1/3      | 1/3        | 1/3        |
| Information Bit Payload            |             |          |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Bits        | 504      | 504        | 504        |
| Number of Code Blocks              |             |          |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Code blocks | 1        | 1          | 1          |
| Binary Channel Bits                |             |          |            |            |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Bits        | 1440     | 1440       | 1440       |

| Max. Throughput averaged over one period | kbps  | 15.75        | 31.5     | 50.4     |
|--|---|--------------|----------|----------|
| UE DL Category                           |   | M1, $\geq 0$ | $\geq 1$ | $\geq 1$ |
| Note 1:                                  | 2 symbols allocated to PDCCH  |              |          |          |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]   |              |          |          |
| Note 3:                                  | PDSCH subframes are scheduled at the 9th to 16th subframes every period=32 ms. Information bit payload is available from the 9-th to 16th subframes with repetition. (Starting from the 0th subframe) |              |          |          |
| Note 4:                                  | Allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband.  |              |          |          |
| Note 5:                                  | MPDCCH are scheduled at the 0th to 7th subframes with repetition. The allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband. (Starting from the 0th subframe)                 |              |          |          |
| Note 6:                                  | PDSCH subframes are scheduled at the 3th to 6th subframes every period=16 ms. Information bit payload is available from the 3th to 6th subframes with repetition. (Starting from the 0th subframe)    |              |          |          |
| Note 7:                                  | PDSCH subframes are scheduled at the 2th to 3th subframes every period=10 ms. Information bit payload is available from the 2th to 3th subframes with repetition. (Starting from the 0th subframe)    |              |          |          |

### A.3.3.3.1 Two antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.1-1 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports.

Table A.3.3.3.1-1: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports

| Parameter                             | Unit   | Value       |             |             |             |             |              |             |             |             |             |
|---------------------------------------|--|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|
|                                       |  | R.51 FDD    | R.51-1 FDD  | R.76 FDD    | R.51-2 FDD  | R.51-3 FDD  | R.51-4 FDD   | R.86 FDD    | R.86A FDD   | R.X FDD     | R.94 FDD    |
| Reference channel                     |  | R.51 FDD    | R.51-1 FDD  | R.76 FDD    | R.51-2 FDD  | R.51-3 FDD  | R.51-4 FDD   | R.86 FDD    | R.86A FDD   | R.X FDD     | R.94 FDD    |
| Channel bandwidth                     | MHz  | 10          | 10          | 10          | 5           | 15          | 20           | 10          | 10          | 10          | 10          |
| Allocated resource blocks             |  | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 25 (Note 5) | 75 (Note 6) | 100 (Note 7) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 24 (Note 8) |
| Allocated subframes per Radio Frame   |  | 9           | 9           | 9           | 9           | 9           | 9            | 9           | 9           | 9           | 9           |
| Modulation                            |  | 16QAM       | 16QAM       | QPSK        | 16QAM       | 16QAM       | 16QAM        | QPSK        | QPSK        | 64QAM       | QPSK        |
| Target Coding Rate                    |  | 1/2         | 0.54        |             | 1/2         | 1/2         | 1/2          | 1/3         | 1/3         | 1/2         | 2/3         |
| Information Bit Payload               |  |             |             |             |             |             |              |             |             |             |             |
| For Sub-Frames 1,4,6,9                | Bits   | 11448       | 12960       | 6200        | 5736        | 16992       | 22920        | 4392        | 3624        | 18336       | 3752        |
| For Sub-Frames 2,3,7,8                | Bits   | 11448       | 12960       | 6200        | 5736        | 16992       | 22920        | 4392        | 3624        | 18336       | 3752        |
| For Sub-Frame 5                       | Bits   | N/A         | N/A         | n/a         | N/A         | N/A         | N/A          | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frame 0                       | Bits   | 9528        | 10680       | 4968        | 3880        | 14112       | 19848        | 3624        | 2984        | 14688       | 3752        |
| Number of Code Blocks (Note 4)        |  |             |             |             |             |             |              |             |             |             |             |
| For Sub-Frames 1,4,6,9                | Code blocks  | 2           | 3           | 2           | 1           | 3           | 4            | 1           | 1           | 3           | 1           |
| For Sub-Frames 2,3,7,8                | Code blocks  | 2           | 3           | 2           | 1           | 3           | 4            | 1           | 1           | 3           | 1           |
| For Sub-Frame 5                       | Bits   | N/A         | N/A         | n/a         | N/A         | N/A         | N/A          | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frame 0                       | Bits   | 2           | 2           | 1           | 1           | 3           | 4            | 1           | 1           | 3           | 1           |
| Binary Channel Bits                   |  |             |             |             |             |             |              |             |             |             |             |
| For Sub-Frames 1,4,6,9                | Bits   | 24000       | 24000       | 12000       | 10800       | 36000       | 48000        | 12000       | 11600       | 36000       | 5760        |
| For Sub-Frames 2,7                    |  | 23600       | 23600       | 11800       | 10600       | 35400       | 47200        | 11800       | 11600       | 35400       | 5664        |
| For Sub-Frames 3,8                    |  | 23200       | 23200       | 12000       | 10400       | 34800       | 46400        | 11600       | 11200       | 34800       | 5568        |
| For Sub-Frame 5                       | Bits   | N/A         | N/A         | n/a         | N/A         | N/A         | N/A          | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frame 0                       | Bits   | 19680       | 19680       | 9840        | 6912        | 30240       | 42240        | 11184       | 9512        | 29520       | 5760        |
| Max. Throughput averaged over 1 frame | Mbps   | 10.1112     | 11.436      | 5.4568      | 4.9768      | 15.0048     | 20.3208      | 3.876       | 3.1976      | 16.138      | 3.376       |
| UE Category                           |  | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2          | 1bis        | ≥ 1         | ≥ 2         | 1bis        |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |             |             |             |             |             |              |             |             |             |             |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |             |             |             |             |             |              |             |             |             |             |
| Note 3:                               | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.                |             |             |             |             |             |              |             |             |             |             |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |             |             |             |             |             |              |             |             |             |             |
| Note 5:                               | 25 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 17 resource blocks (RB0–RB9 and RB18–RB24) are allocated in sub-frame 0.                 |             |             |             |             |             |              |             |             |             |             |
| Note 6:                               | 75 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 63 resource blocks (RB0–R31 and RB44–RB74) are allocated in sub-frame 0.                 |             |             |             |             |             |              |             |             |             |             |
| Note 7:                               | 100 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 88 resource blocks (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0.               |             |             |             |             |             |              |             |             |             |             |
| Note 8:                               | 24 resource blocks (RB 0-20 and 30-32) are allocated in sub-frames 0, 1, 2, 3, 4, 6, 7, 8, 9   |             |             |             |             |             |              |             |             |             |             |

The reference measurement channels in Table A3.3.3.1-2 apply for verifying demodulation performance for UE-specific reference symbols with two cell specific antenna ports and two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS in same subframe.

**Table A.3.3.3.1-2: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter                             | Unit  | Value       |             |             |             |             |
|---------------------------------------|---|-------------|-------------|-------------|-------------|-------------|
| Reference channel                     |   | R.52 FDD    | R.52-1 FDD  | R.53 FDD    | R.54 FDD    | R.97 FDD    |
| Channel bandwidth                     | MHz   | 10          | 10          | 10          | 10          | 10          |
| Allocated resource blocks             |   | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame   |   | 9           | 9           | 9           | 9           | 9           |
| Modulation                            |   | 64QAM       | 16QAM       | 64QAM       | 16QAM       | 16QAM       |
| Target Coding Rate                    |   | 1/2         | 0.54        | 1/2         | 1/2         | 1/2         |
| Information Bit Payload               |   |             |             |             |             |             |
| For Sub-Frames 1,3,4,6,8,9            | Bits  | 18336       | 12960       | 18336       | 11448       | 11448       |
| For Sub-Frames 2,7                    | Bits  | 16416       | 12960       | 16416       | 11448       | 11448       |
| For Sub-Frame 5                       | Bits  | n/a         | n/a         | n/a         | n/a         | n/a         |
| For Sub-Frame 0                       | Bits  | 14688       | 10680       | 14688       | 9528        | 9528        |
| Number of Code Blocks (Note 4)        |   |             |             |             |             |             |
| For Sub-Frames 1,3,4,6,8,9            | Code blocks   | 3           | 3           | 3           | 2           | 2           |
| For Sub-Frames 2, 7                   | Code blocks   | 3           | 3           | 3           | 2           | 2           |
| For Sub-Frame 5                       | Bits  | n/a         | n/a         | n/a         | n/a         | n/a         |
| For Sub-Frame 0                       | Bits  | 3           | 2           | 3           | 2           | 2           |
| Binary Channel Bits                   |   |             |             |             |             |             |
| For Sub-Frames 1,3,4,6,8,9            | Bits  | 36000       | 24000       | 36000       | 24000       | 24000       |
| For Sub-Frames 2,7                    |   | 34200       | 22800       | 33600       | 22800       | 22400       |
| For Sub-Frame 5                       | Bits  | n/a         | n/a         | n/a         | n/a         | n/a         |
| For Sub-Frame 0                       | Bits  | 29520       | 19680       | 29520       | 19680       | 19680       |
| Max. Throughput averaged over 1 frame | Mbps  | 15.7536     | 11.436      | 15.7536     | 10.1112     | 10.1112     |
| Note 1:                               | 2 symbols allocated to PDCCH.   |             |             |             |             |             |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |             |             |             |             |
| Note 3:                               | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |             |             |             |             |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |             |             |             |             |             |



**Table A.3.3.3.1-3: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports**

| Parameter                             | Unit   | Value       |             |              |             |             |             |              |
|---------------------------------------|--|-------------|-------------|--------------|-------------|-------------|-------------|--------------|
|                                       |  | R.76-1 FDD  | R.76-2 FDD  | R.76-3 FDD   | R.76-4 FDD  | R.76-5 FDD  | R.76-6 FDD  | R.76-7 FDD   |
| Reference channel                     |  |             |             |              |             |             |             |              |
| Channel bandwidth                     | MHz  | 5           | 15          | 20           | 5           | 10          | 15          | 20           |
| Allocated resource blocks             |  | 25 (Note 5) | 75 (Note 6) | 100 (Note 7) | 25 (Note 5) | 50 (Note 3) | 75 (Note 6) | 100 (Note 7) |
| Allocated subframes per Radio Frame   |  | 9           | 9           | 9            | 9           | 9           | 9           | 9            |
| Modulation                            |  | QPSK        | QPSK        | QPSK         | QPSK        | QPSK        | QPSK        | QPSK         |
| Target Coding Rate                    |  |             |             |              |             |             |             |              |
| Information Bit Payload               |  |             |             |              |             |             |             |              |
| For Sub-Frames 1,4,6,9                | Bits   | 2600        | 9144        | 12216        | 3496        | 7992        | 11832       | 15840        |
| For Sub-Frames 2,3,7,8                | Bits   | 2600        | 9144        | 12216        | 3496        | 7992        | 11832       | 15840        |
| For Sub-Frame 5                       | Bits   | n/a         | n/a         | n/a          | n/a         | n/a         | n/a         | n/a          |
| For Sub-Frame 0                       | Bits   | 1736        | 7736        | 10680        | 2344        | 6456        | 9912        | 14112        |
| Number of Code Blocks (Note 4)        |  |             |             |              |             |             |             |              |
| For Sub-Frames 1,4,6,9                | Code blocks  | 1           | 2           | 2            | 1           | 2           | 2           | 3            |
| For Sub-Frames 2,3,7,8                | Code blocks  | 1           | 2           | 2            | 1           | 2           | 2           | 3            |
| For Sub-Frame 5                       | Bits   | n/a         | n/a         | n/a          | n/a         | n/a         | n/a         | n/a          |
| For Sub-Frame 0                       | Bits   | 1           | 2           | 2            | 1           | 2           | 2           | 3            |
| Binary Channel Bits                   |  |             |             |              |             |             |             |              |
| For Sub-Frames 1,4,6,9                | Bits   | 5400        | 18000       | 24000        | 5400        | 12000       | 18000       | 24000        |
| For Sub-Frames 2,7                    |  | 5300        | 17700       | 23600        | 5300        | 11800       | 17700       | 23600        |
| For Sub-Frames 3,8                    |  | 5200        | 17400       | 23200        | 5200        | 12000       | 17400       | 23200        |
| For Sub-Frame 5                       | Bits   | n/a         | n/a         | n/a          | n/a         | n/a         | n/a         | n/a          |
| For Sub-Frame 0                       | Bits   | 3456        | 15120       | 21120        | 3456        | 9840        | 15120       | 21120        |
| Max. Throughput averaged over 1 frame | Mbps   | 2.2536      | 8.0888      | 10.8408      | 3.0312      | 7.0392      | 10.4568     | 14.0832      |
| UE Category                           |  | ≥ 2         | ≥ 2         | ≥ 2          | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2          |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |             |             |              |             |             |             |              |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |             |             |              |             |             |             |              |
| Note 3:                               | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.                |             |             |              |             |             |             |              |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |             |             |              |             |             |             |              |
| Note 5:                               | 25 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 17 resource blocks (RB0–RB9 and RB18–RB24) are allocated in sub-frame 0.                 |             |             |              |             |             |             |              |
| Note 6:                               | 75 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 63 resource blocks (RB0–R31 and RB44–RB74) are allocated in sub-frame 0.                 |             |             |              |             |             |             |              |
| Note 7:                               | 100 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 88 resource blocks (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0.               |             |             |              |             |             |             |              |
| Note 8:                               | Given per component carrier per codeword.  |             |             |              |             |             |             |              |

### A.3.3.3.2 Four antenna ports (CSI-RS)

The reference measurement channels in Table A.3.3.3.2-1 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-1: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter                           | Unit        | Value       |             |             |             |             |             |             |             |             |             |             |
|-------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                                     |             | R.43 FDD    | R.43-1 FDD  | R.43-2 FDD  | R.50 FDD    | R.48 FDD    | R.66 FDD    | R.75 FDD    | R.75A FDD   | R.cc FDD    | R.45A-1 FDD | R.102 FDD   |
| Reference channel                   |             |             |             |             |             |             |             |             |             |             |             |             |
| Channel bandwidth                   | MHz         | 10          | 10          | 10          | 10          | 10          | 10          | 10          | 10          | 10          | 10          | 10          |
| Allocated resource blocks           |             | 50 (Note 3) | 50 (Note 3) | 50 (Note 5) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame |             | 9           | 9           | 9           | 9           | 9           | 9           | 9           | 9           | 9           | 9           | 9           |
| Modulation                          |             | QPSK        | QPSK        | QPSK        | 64QAM       | QPSK        | 256QAM      | 16QAM       | 16QAM       | 16QAM       | 16QAM       | 1024QAM     |
| Target Coding Rate                  |             | 1/3         | 1/3         | 1/3         | 1/2         |             | 0.77        | 0.57        | 0.51        | 0.64        | 1/2         | 3/4         |
| Information Bit Payload             |             |             |             |             |             |             |             |             |             |             |             |             |
| For Sub-Frames 1,4,6,9              | Bits        | 3624        | 3624        | 3624        | 18336       | 6200        | 36696       | 25456       | 25456       | 15264       | 11448       | 52752       |
| For Sub-Frames 2,3,7,8              | Bits        | 3624        | 3624        | 3624        | 16416       | 6200        | 35160       | 25456       | 25456       | 15264       | 11448       | 52752       |
| For Sub-Frame 5                     | Bits        | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frame 0                     | Bits        | 2984        | 2984        | 3368        | 14688       | 4968        | 30576       | 21384       | 21384       | 12576       | 9528        | N/A         |
| Number of Code Blocks (Note 4)      |             |             |             |             |             |             |             |             |             |             |             |             |
| For Sub-Frames 1,4,6,9              | Code blocks | 1           | 1           | 1           | 3           | 2           | 6           | 5           | 5           | 3           | 2           | 9           |
| For Sub-Frames 2,3,7,8              | Code blocks | 1           | 1           | 1           | 3           | 2           | 6           | 5           | 5           | 3           | 2           | 9           |
| For Sub-Frame 5                     | Bits        | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frame 0                     | Bits        | 1           | 1           | 1           | 3           | 1           | 5           | 4           | 4           | 3           | 2           | N/A         |
| Binary Channel Bits                 |             |             |             |             |             |             |             |             |             |             |             |             |
| For Sub-Frames 1,6                  | Bits        | 12000       | 13200       | 13200       | 36000       | 12000       | 48000       | 43200       | 48000       | 24000       | 24000       | 66000       |
| For Sub-                            | Bits        | 12000       | 12000       | 12000       | 36000       | 12000       | 48000       | 43200       | 48000       | 24000       | 24000       | 66000       |

|                                       |   |        |        |       |         |        |        |        |        |         |         |          |
|---------------------------------------|---|--------|--------|-------|---------|--------|--------|--------|--------|---------|---------|----------|
| Frames 4,9                            |   |        |        |       |         |        |        |        |        |         |         |          |
| For Sub-Frames 2,7                    | Bits  | 11600  | 12800  | 12800 | 34800   | 11600  | 46400  | 41600  | 46400  | 23200   | 23200   | 64000    |
| For Sub-Frames 3,8                    | Bits  | 11600  | 12800  | 12800 | 34800   | 12000  | 46400  | 41600  | 46400  | 23200   | 23200   | 66000    |
| For Sub-Frame 5                       | Bits  | N/A    | N/A    | N/A   | N/A     | N/A    | N/A    | N/A    | N/A    | N/A     | N/A     | N/A      |
| For Sub-Frame 0                       | Bits  | 9840   | 9840   | 10560 | 29520   | 9840   | 39360  | 35424  | 40224  | 19680   | 19680   | N/A      |
| Max. Throughput averaged over 1 frame | Mbps  | 3.1976 | 3.1976 | 3.236 | 15.3696 | 5.4568 | 31.800 | 22.503 | 22.503 | 13.4688 | 10.1112 | 46.5832  |
| UE Category                           |   | ≥ 1    | ≥ 1    | ≥ 1   | ≥ 2     | ≥ 1    | 11-12  | ≥ 5    | ≥ 5    | ≥ 2     | ≥ 2     | TBD      |
| UE DL Category                        |   | ≥ 6    | ≥ 6    | ≥ 6   | ≥ 6     | ≥ 6    | ≥ 11   | ≥ 6    | ≥ 6    | ≥ 6     | ≥ 6     | 20, ≥ 22 |
| Note 1:                               | 2 symbols allocated to PDCCH. 1 symbol allocated to PDCCH for reference channel with 1024QAM.   |        |        |       |         |        |        |        |        |         |         |          |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |        |        |       |         |        |        |        |        |         |         |          |
| Note 3:                               | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.   |        |        |       |         |        |        |        |        |         |         |          |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |        |        |       |         |        |        |        |        |         |         |          |
| Note 5:                               | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 47 resource blocks (RB0–RB23 and RB27–RB49) are allocated in sub-frame 0. In sub-frame 0, PDSCH is rate matched around RB22, RB23 and RB27. |        |        |       |         |        |        |        |        |         |         |          |

The reference measurement channels in Table A.3.3.3.2-2 apply for verifying FDD PMI accuracy measurement and CRI accuracy measurement with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-2: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter                                    | Unit | Value           |                 |            |                 |                 |                 |
|--|------|-----------------|-----------------|------------|-----------------|-----------------|-----------------|
|  |      | R.44 FDD        | R.45 FDD        | R.45-1 FDD | R.60 FDD        | R.50A - 1 FDD   | R.45A-2 FDD     |
| Reference channel                            |      |                 |                 |            |                 |                 |                 |
| Channel bandwidth                            | MHz  | 10              | 10              | 10         | 10              | 10              | 10              |
| Allocated resource blocks                    |      | 50 <sup>3</sup> | 50 <sup>3</sup> | 39         | 50 <sup>3</sup> | 50 <sup>3</sup> | 50 <sup>3</sup> |
| Allocated subframes per Radio Frame          |      | 10              | 10              | 10         | 10              | 7               | 10              |
| Modulation                                   |      | QPSK            | 16QAM           | 16QAM      | QPSK            | 64QAM           | 16QAM           |
| Target Coding Rate                           |      | 1/3             | 1/2             | 1/2        | 1/2             | 1/2             | 1/2             |
| Information Bit Payload                      |      |                 |                 |            |                 |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         | Bits | 3624            | 11448           | 8760       | 6200            | 18336           | 11448           |
| For Sub-Frames (CSI-RS subframe)             | Bits | 3624            | 11448           | 8760       | 6200            | N/A             | 11448           |
| For Sub-Frames (ZeroPowerCSI-RS subframe)    | Bits | N/A             | N/A             | N/A        | N/A             | N/A             | N/A             |
| For Sub-Frame 5                              | Bits | N/A             | N/A             | N/A        | N/A             | N/A             | N/A             |
| For Sub-Frame 0                              | Bits | 2984            | 9528            | 8760       | N/A             | 14688           | 9528            |
| Number of Code Blocks per Sub-Frame (Note 4) |      |                 |                 |            |                 |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         |      | 1               | 2               | 2          | 2               | 3               | 2               |

|   |  |        |         |       |       |         |         |
|---|--|--------|---------|-------|-------|---------|---------|
| For Sub-Frames (CSI-RS subframe)          |  | 1      | 2       | 2     | 2     | N/A     | 2       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits   | N/A    | N/A     | N/A   | N/A   | N/A     | N/A     |
| For Sub-Frame 5                           |  | N/A    | N/A     | N/A   | N/A   | N/A     | N/A     |
| For Sub-Frame 0                           |  | 1      | 2       | 2     | N/A   | 3       | 2       |
| Binary Channel Bits Per Sub-Frame         |  |        |         |       |       |         |         |
| For Sub-Frames (Non CSI-RS subframe)      | Bits   | 12000  | 24000   | 18720 | 12000 | 36000   | 24000   |
| For Sub-Frames (CSI-RS subframe)          | Bits   | 11600  | 23200   | 18096 | 11600 | N/A     | 23600   |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits   | N/A    | N/A     | N/A   | N/A   | N/A     | N/A     |
| For Sub-Frame 5                           | Bits   | N/A    | N/A     | N/A   | N/A   | N/A     | N/A     |
| For Sub-Frame 0                           | Bits   | 9840   | 19680   | 18720 | N/A   | 29520   | 19680   |
| Max. Throughput averaged over 1 frame     | Mbps   | 3.1976 | 10.1112 | 7.884 | 4.96  | 12.4704 | 10.1112 |
| UE Category                               |  | ≥ 1    | ≥ 2     | ≥ 1   | ≥ 1   | ≥ 2     | ≥ 2     |
| Note 1:                                   | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz  |        |         |       |       |         |         |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |        |         |       |       |         |         |
| Note 3:                                   | For R.44, R.45 and R.60, 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. For R.45-1, 39 resource blocks are allocated in all subframes (RB0–RB20 and RB30–RB47). For R.50A-1, 50 resource blocks are allocated in sub-frames 2, 3, 4, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |        |         |       |       |         |         |
| Note 4:                                   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |        |         |       |       |         |         |

The reference measurement channels in Table A.3.3.3.2-3 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-3: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter                              | Unit   | Value    |
|--|--|----------|
| Reference channel                      |  | R.64 FDD |
| Channel bandwidth                      | MHz  | 10       |
| Allocated resource blocks (Note 4)     |  | 6        |
| Allocated subframes per 4 Radio Frames |  | 15       |
| Modulation                             |  | QPSK     |
| Target Coding Rate                     |  | 1/3      |
| Information Bit Payload                |  |          |
| For Sub-Frames 0,1,4,5,6,9 (Note 3)    | Bits   | 504      |
| For Sub-Frames 2,3,7,8 (Note 3)        | Bits   | 504      |
| Number of Code Blocks                  |  |          |
| For Sub-Frames 0,1,4,5,6,9             | Code blocks  | 1        |
| For Sub-Frames 2,3,7,8                 | Code blocks  | 1        |
| Binary Channel Bits                    |  |          |
| For Sub-Frames 0,1,4,5,6,9             | Bits   | 1440     |
| For Sub-Frames 2,3,7,8                 | Bits   | 1392     |
| Max. Throughput averaged over 4 frames | Mbps   | 0.189    |
| UE DL Category                         |  | 0        |
| Note 1:                                | 2 symbols allocated to PDCCH.  |          |
| Note 2:                                | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]. |          |

|         |   |
|---------|---|
| Note 3: | The downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled. |
| Note 4: | Allocated PRB positions start from {9, 10, ..., 9+N-1}, where N is the number of allocated resource blocks.   |

The reference measurement channels in Table A.3.3.3.2-4 apply with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-4: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value    |
|--|--|----------|
| Reference channel                            |  | R.69 FDD |
| Channel bandwidth                            | MHz  | 10       |
| Allocated resource blocks                    |  | 50       |
| Allocated subframes per Radio Frame          |  | 8        |
| Modulation                                   |  | QPSK     |
| Target Coding Rate                           |  |          |
| For Sub-Frames 2,3,4,6,7,8,9                 |  | 0.74     |
| For Sub-Frame 1                              |  | 0.8      |
| Information Bit Payload                      |  |          |
| For Sub-Frames 2,3,4,6,7,8,9                 | Bits   | 7992     |
| For Sub-Frame 1                              | Bits   | 7992     |
| For Sub-Frame 5                              | Bits   | N/A      |
| For Sub-Frame 0                              | Bits   | N/A      |
| Number of Code Blocks per Sub-Frame (Note 4) |  |          |
| For Sub-Frames 2,3,4,6,7,8,9                 |  | 2        |
| For Sub-Frame 1                              |  | 2        |
| For Sub-Frame 5                              |  | N/A      |
| For Sub-Frame 0                              |  | N/A      |
| Binary Channel Bits Per Sub-Frame            |  |          |
| For Sub-Frames 2,3,4,6,7,8,9                 | Bits   | 10800    |
| For Sub-Frame 1                              | Bits   | 10000    |
| For Sub-Frame 5                              | Bits   | N/A      |
| For Sub-Frame 0                              | Bits   | N/A      |
| Max. Throughput averaged over 1 frame        | Mbps   | 6.3936   |
| UE Category                                  |  | ≥ 1      |
| Note 1:                                      | 3 symbols allocated to PDCCH.  |          |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |          |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |          |

The reference measurement channels in Table A.3.3.3.2-5 apply with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-5: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter                           | Unit | Value       | Value       |
|-------------------------------------|------|-------------|-------------|
| Reference channel                   |      | R.98 FDD    | R.99 FDD    |
| Channel bandwidth                   | MHz  | 10          | 10          |
| Allocated resource blocks           |      | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame |      | 9           | 9           |
| Modulation                          |      | 16QAM       | 16QAM       |
| Target Coding Rate                  |      | 1/2         | 1/2         |
| Information Bit Payload             |      |             |             |
| For Sub-Frames 1,3,4,6,8,9          | Bits | 22920       | 11448       |
| For Sub-Frames 2,7                  | Bits | 22920       | 11448       |
| For Sub-Frame 5                     | Bits | n/a         | n/a         |
| For Sub-Frame 0                     | Bits | 19080       | 9528        |
| Number of Code Blocks (Note 4)      |      |             |             |

|   |             |        |         |
|---|-------------|--------|---------|
| For Sub-Frames 1,3,4,6,8,9  | Code blocks | 4      | 2       |
| For Sub-Frames 2, 7   | Code blocks | 4      | 2       |
| For Sub-Frame 5   | Bits        | n/a    | n/a     |
| For Sub-Frame 0   | Bits        | 4      | 2       |
| Binary Channel Bits   |             |        |         |
| For Sub-Frames 1,3,4,6,8,9  | Bits        | 43200  | 21600   |
| For Sub-Frames 2,7  |             | 38400  | 19200   |
| For Sub-Frame 5   | Bits        | n/a    | n/a     |
| For Sub-Frame 0   | Bits        | 35424  | 17712   |
| Max. Throughput averaged over 1 frame   | Mbps        | 20.244 | 10.1112 |
| Note 1: 2 symbols allocated to PDCCH.   |             |        |         |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |        |         |
| Note 3: 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |        |         |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |             |        |         |

The reference measurement channels in Table A.3.3.3.2-6 apply with four CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-6: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter   | Unit        | Value       |
|---|-------------|-------------|
| Reference channel   |             | R.100 FDD   |
| Channel bandwidth   | MHz         | 10          |
| Allocated resource blocks   |             | 50 (Note 3) |
| Allocated subframes per Radio Frame   |             | 9           |
| Modulation  |             | 16QAM       |
| Target Coding Rate  |             | 1/2         |
| Information Bit Payload   |             |             |
| For Sub-Frames 1,3,4,6,8,9  | Bits        | 22920       |
| For Sub-Frames 2,7  | Bits        | 22920       |
| For Sub-Frame 5   | Bits        | n/a         |
| For Sub-Frame 0   | Bits        | 19080       |
| Number of Code Blocks (Note 4)  |             |             |
| For Sub-Frames 1,3,4,6,8,9  | Code blocks | 4           |
| For Sub-Frames 2, 7   | Code blocks | 4           |
| For Sub-Frame 5   | Bits        | n/a         |
| For Sub-Frame 0   | Bits        | 4           |
| Binary Channel Bits   |             |             |
| For Sub-Frames 1,3,4,6,8,9  | Bits        | 41600       |
| For Sub-Frames 2,7  |             | 36800       |
| For Sub-Frame 5   | Bits        | n/a         |
| For Sub-Frame 0   | Bits        | 34112       |
| Max. Throughput averaged over 1 frame   | Mbps        | 20.244      |
| Note 1: 2 symbols allocated to PDCCH.   |             |             |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |             |
| Note 3: 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |             |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |             |             |

### A.3.3.3.2A Eight antenna ports (CSI-RS)

The reference measurement channels in Table A.3.3.3.2A-1 apply for verifying FDD CRI accuracy measurement with two CRS antenna ports and eight CSI-RS antenna ports.

**Table A.3.3.3.2A-1: Fixed Reference Channel for eight antenna ports (CSI-RS)**

| Parameter                                    | Unit  | Value           |                 |
|--|---|-----------------|-----------------|
|  |   | R.50A-2<br>FDD  | R.50A-3<br>FDD  |
| Reference channel                            |   | R.50A-2<br>FDD  | R.50A-3<br>FDD  |
| Channel bandwidth                            | MHz   | 10              | 10              |
| Allocated resource blocks                    |   | 50 <sup>3</sup> | 50 <sup>3</sup> |
| Allocated subframes per Radio Frame          |   | 7               | 5               |
| Modulation                                   |   | 64QAM           | 64QAM           |
| Target Coding Rate                           |   | 1/2             | 1/2             |
| Information Bit Payload                      |   |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         | Bits  | 18336           | 18336           |
| For Sub-Frames (CSI-RS subframe)             | Bits  | N/A             | N/A             |
| For Sub-Frames (ZeroPowerCSI-RS subframe)    | Bits  | N/A             | N/A             |
| For Sub-Frame 5                              | Bits  | N/A             | N/A             |
| For Sub-Frame 0                              | Bits  | 14688           | 14688           |
| Number of Code Blocks per Sub-Frame (Note 4) |   |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         |   | 3               | 3               |
| For Sub-Frames (CSI-RS subframe)             |   | N/A             | N/A             |
| For Sub-Frames (ZeroPowerCSI-RS subframe)    | Bits  | N/A             | N/A             |
| For Sub-Frame 5                              |   | N/A             | N/A             |
| For Sub-Frame 0                              |   | 3               | 3               |
| Binary Channel Bits Per Sub-Frame            |   |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         | Bits  | 36000           | 36000           |
| For Sub-Frames (CSI-RS subframe)             | Bits  | N/A             | N/A             |
| For Sub-Frames (ZeroPowerCSI-RS subframe)    | Bits  | N/A             | N/A             |
| For Sub-Frame 5                              | Bits  | N/A             | N/A             |
| For Sub-Frame 0                              | Bits  | 29520           | 29520           |
| Max. Throughput averaged over 1 frame        | Mbps  | 12.4704         | 8.8032          |
| UE Category                                  |   | ≥ 2             | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz   |                 |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]   |                 |                 |
| Note 3:                                      | For R.50A-2, 50 resource blocks are allocated in sub-frames 2, 3, 4, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. For R.50A-3, 50 resource blocks are allocated in sub-frames 3, 4, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |                 |                 |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  |                 |                 |

**Table A.3.3.3.2A-2: Fixed Reference Channel for eight antenna ports (CSI-RS)**

| Parameter                            | Unit | Value          |
|--------------------------------------|------|----------------|
| Reference channel                    |      | R.108 FDD      |
| Channel bandwidth                    | MHz  | 10             |
| Allocated resource blocks            |      | 4 <sup>3</sup> |
| Allocated subframes per Radio Frame  |      | 8              |
| Modulation                           |      | QPSK           |
| Target Coding Rate                   |      | 1/2            |
| Information Bit Payload              |      |                |
| For Sub-Frames (Non CSI-RS subframe) | Bits | 472            |
| For Sub-Frames (CSI-RS subframe)     | Bits | 472            |
| For Sub-Frame 5,7                    | Bits | N/A            |

|  |  |          |
|--|--|----------|
| Number of Code Blocks per Sub-Frame (Note 4) |  |          |
| For Sub-Frames (Non CSI-RS subframe)         |  | 1        |
| For Sub-Frames (CSI-RS subframe)             |  | 1        |
| For Sub-Frame 5,7                            |  | N/A      |
| Binary Channel Bits Per Sub-Frame            |  |          |
| For Sub-Frames (Non CSI-RS subframe)         | Bits   | 960      |
| For Sub-Frames (CSI-RS subframe)             | Bits   | 896      |
| For Sub-Frame 5,7                            | Bits   | N/A      |
| Max. Throughput averaged over 1 frame        | Mbps   | 0.3776   |
| UE Category                                  |  | $\geq 1$ |
| Note 1:                                      | 2 symbols allocated to PDCCH.  |          |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |          |
| Note 3:                                      | Allocated PRB positions for PDSCH are {2, 3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband. |          |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)                           |          |

### A.3.3.3.3 Twelve antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.3-1 apply for verifying PMI accuracy performance for UE-specific reference symbols with two cell-specific antenna ports and twelve CSI-RS antenna ports.

**Table A.3.3.3.3-1: Fixed Reference Channel for CDM-multiplexed DM RS with twelve CSI-RS antenna ports**

| Parameter                                 | Unit        | Value       |
|---|-------------|-------------|
| Reference channel                         |             | R.77 FDD    |
| Channel bandwidth                         | MHz         | 10          |
| Allocated resource blocks                 |             | 50 (Note 3) |
| Allocated subframes per Radio Frame       |             | 9           |
| Modulation                                |             | 64QAM       |
| Target Coding Rate                        |             | 1/2         |
| Information Bit Payload                   |             |             |
| For Sub-Frames (Non CSI-RS subframe)      | Bits        | 18336       |
| For Sub-Frames (CSI-RS subframe)          | Bits        | 16416       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits        | N/A         |
| For Sub-Frame 5                           | Bits        | N/A         |
| For Sub-Frame 0                           |             | 14688       |
| Number of Code Blocks per Sub-Frame       | Code blocks |             |
| For Sub-Frames (Non CSI-RS subframe)      | Code blocks | 3           |
| For Sub-Frames (CSI-RS subframe)          | Bits        | 3           |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits        | N/A         |
| For Sub-Frame 5                           |             | N/A         |
| For Sub-Frame 0                           | Bits        | 3           |
| Binary Channel Bits Per Sub-Frame         |             |             |
| For Sub-Frames (Non CSI-RS subframe)      |             | 36000       |
| For Sub-Frames (CSI-RS subframe)          | Bits        | 32400       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits        | N/A         |
| For Sub-Frame 5                           | Bits        | N/A         |
| For Sub-Frame 0                           | Bits        | 29520       |
| Max. Throughput averaged over 1 frame     | Mbps        | 15.7536     |



|             |   |          |
|-------------|---|----------|
| UE Category |   | $\geq 2$ |
| Note 1:     | 2 symbols allocated to PDCCH.   |          |
| Note 2:     | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |          |
| Note 3:     | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |          |
| Note 4:     | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |          |

#### A.3.3.3.4 Sixteen antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.4-1 apply for verifying PMI accuracy performance for UE-specific reference symbols with two cell-specific antenna ports and sixteen CSI-RS antenna ports.

**Table A.3.3.3.4-1: Fixed Reference Channel for CDM-multiplexed DM RS with sixteen CSI-RS antenna ports**

| Parameter                                 | Unit  | Value       |
|---|---|-------------|
| Reference channel                         |   | R.78 FDD    |
| Channel bandwidth                         | MHz   | 10          |
| Allocated resource blocks                 |   | 50 (Note 3) |
| Allocated subframes per Radio Frame       |   | 9           |
| Modulation                                |   | 16QAM       |
| Target Coding Rate                        |   | 1/2         |
| Information Bit Payload                   |   |             |
| For Sub-Frames (Non CSI-RS subframe)      | Bits  | 11448       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 9912        |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         |
| For Sub-Frame 0                           |   | 9528        |
| Number of Code Blocks per Sub-Frame       | Code blocks   |             |
| For Sub-Frames (Non CSI-RS subframe)      | Code blocks   | 2           |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 2           |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           |   | N/A         |
| For Sub-Frame 0                           | Bits  | 2           |
| Binary Channel Bits Per Sub-Frame         |   |             |
| For Sub-Frames (Non CSI-RS subframe)      |   | 24000       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 20800       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         |
| For Sub-Frame 0                           | Bits  | 19680       |
| Max. Throughput averaged over 1 frame     | Mbps  | 9.804       |
| UE Category                               |   | $\geq 2$    |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |             |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |
| Note 3:                                   | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

### A.3.3.3.5 Twenty-four antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.5-1 apply for verifying PMI accuracy performance for UE-specific reference symbols with two cell-specific antenna ports and twenty-four CSI-RS antenna ports.

**Table A.3.3.3.5-1: Fixed Reference Channel for CDM-multiplexed DM RS with twenty-four CSI-RS antenna ports**

| Parameter                                 | Unit  | Value       |             |
|---|---|-------------|-------------|
|   |   | R.88 FDD    | R.88A FDD   |
| Reference channel                         |   | R.88 FDD    | R.88A FDD   |
| Channel bandwidth                         | MHz   | 10          | 10          |
| Allocated resource blocks                 |   | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame       |   | 9           | 9           |
| Modulation                                |   | 16QAM       | 16QAM       |
| Target Coding Rate                        |   | 1/2         | 1/2         |
| Information Bit Payload                   |   |             |             |
| For Sub-Frames (Non CSI-RS subframe)      | Bits  | 11448       | 11448       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 9912        | 11448       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         | N/A         |
| For Sub-Frame 0                           |   | 9528        | 9528        |
| Number of Code Blocks per Sub-Frame       | Code blocks   |             |             |
| For Sub-Frames (Non CSI-RS subframe)      | Code blocks   | 2           | 2           |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 2           | 2           |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         | N/A         |
| For Sub-Frame 5                           |   | N/A         | N/A         |
| For Sub-Frame 0                           | Bits  | 2           | 2           |
| Binary Channel Bits Per Sub-Frame         |   |             |             |
| For Sub-Frames (Non CSI-RS subframe)      |   | 24000       | 24000       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 19200       | 22400       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         | N/A         |
| For Sub-Frame 0                           | Bits  | 19680       | 19680       |
| Max. Throughput averaged over 1 frame     | Mbps  | 9.804       | 10.1112     |
| UE Category                               |   | ≥ 2         | ≥ 2         |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |             |             |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |             |
| Note 3:                                   | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |             |
| Note 4:                                   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |             |             |

### A.3.3.3.6 Thirty-two antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.6-1 apply for verifying PMI accuracy performance for UE-specific reference symbols with two cell-specific antenna ports and thirty-two CSI-RS antenna ports.

**Table A.3.3.3.6-1: Fixed Reference Channel for CDM-multiplexed DM RS with thirty-two CSI-RS antenna ports**

| Parameter                                 | Unit  | Value       |
|---|---|-------------|
| Reference channel                         |   | R.89 FDD    |
| Channel bandwidth                         | MHz   | 10          |
| Allocated resource blocks                 |   | 50 (Note 3) |
| Allocated subframes per Radio Frame       |   | 9           |
| Modulation                                |   | 64QAM       |
| Target Coding Rate                        |   | 1/2         |
| Information Bit Payload                   |   |             |
| For Sub-Frames (Non CSI-RS subframe)      | Bits  | 18336       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 15264       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         |
| For Sub-Frame 0                           |   | 14688       |
| Number of Code Blocks per Sub-Frame       | Code blocks   |             |
| For Sub-Frames (Non CSI-RS subframe)      | Code blocks   | 3           |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 3           |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           |   | N/A         |
| For Sub-Frame 0                           | Bits  | 3           |
| Binary Channel Bits Per Sub-Frame         |   |             |
| For Sub-Frames (Non CSI-RS subframe)      |   | 36000       |
| For Sub-Frames (CSI-RS subframe)          | Bits  | 26400       |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits  | N/A         |
| For Sub-Frame 5                           | Bits  | N/A         |
| For Sub-Frame 0                           | Bits  | 29520       |
| Max. Throughput averaged over 1 frame     | Mbps  | 15.5232     |
| UE Category                               |   | $\geq 2$    |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |             |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |
| Note 3:                                   | 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. |             |
| Note 4:                                   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).             |             |

## A.3.4 Reference measurement channels for PDSCH performance requirements (TDD)

### A.3.4.1 Single-antenna transmission (Common Reference Symbols)

**Table A.3.4.1-1: Fixed Reference Channel QPSK R=1/3**

| Parameter                                 | Unit | Value   |          |          |         |            |            |            |
|---|------|---------|----------|----------|---------|------------|------------|------------|
|   |      | R.4 TDD | R.42 TDD | R.2A TDD | R.2 TDD | R.42-1 TDD | R.42-2 TDD | R.42-3 TDD |
| Reference channel                         |      |         |          |          |         |            |            |            |
| Channel bandwidth                         | MHz  | 1.4     | 20       | 10       | 10      | 3          | 5          | 15         |
| Allocated resource blocks (Note 6)        |      | 6       | 100      | 50       | 50      | 15         | 25         | 75         |
| Uplink-Downlink Configuration (Note 4)    |      | 1       | 1        | 2        | 1       | 1          | 1          | 1          |
| Allocated subframes per Radio Frame (D+S) |      | 3       | 3+2      | 5+2      | 3+2     | 3+2        | 3+2        | 3+2        |

| Modulation                                     |  | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  |
|--|--|-------|-------|-------|-------|-------|-------|-------|
| Target Coding Rate                             |  | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   | 1/3   |
| Information Bit Payload (Note 6)               |  |       |       |       |       |       |       |       |
| For Sub-Frames 4,9                             | Bits   | 408   | 8760  | 4392  | 4392  | 1320  | 2216  | 6712  |
| For Sub-Frames 1,6                             | Bits   | N/A   | 7736  | 3240  | 3240  | 1128  | 1864  | 5992  |
| For Sub-Frames 3,8                             | Bits   | N/A   | N/A   | 4392  | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                                | Bits   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                                | Bits   | 208   | 8760  | 4392  | 4392  | 1064  | 1800  | 6712  |
| Number of Code Blocks (Notes 5 and 6)          |  |       |       |       |       |       |       |       |
| For Sub-Frames 4,9                             |  | 1     | 2     | 1     | 1     | 1     | 1     | 2     |
| For Sub-Frames 1,6                             |  | N/A   | 2     | 1     | 1     | 1     | 1     | 1     |
| For Sub-Frames 3,8                             |  | N/A   | N/A   | 1     | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                                |  | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                                |  | 1     | 2     | 1     | 1     | 1     | 1     | 2     |
| Binary Channel Bits (Note 6)                   |  |       |       |       |       |       |       |       |
| For Sub-Frames 4,9                             | Bits   | 1368  | 27600 | 13800 | 13800 | 3780  | 6300  | 20700 |
| For Sub-Frames 1,6                             | Bits   | N/A   | 22656 | 11256 | 11256 | 3276  | 5556  | 16956 |
| For Sub-Frames 3,8                             |  | N/A   | N/A   | 13800 | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 5                                | Bits   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   | N/A   |
| For Sub-Frame 0                                | Bits   | 672   | 26904 | 13104 | 13104 | 3084  | 5604  | 20004 |
| Max. Throughput averaged over 1 frame (Note 6) | Mbps   | 0.102 | 4.175 | 2.844 | 1.966 | 0.596 | 0.996 | 3.212 |
| UE Category                                    |  | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   |
| Note 1:  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |       |       |       |       |       |       |       |
| Note 2:  | For BW=1.4 MHz, the information bit payloads of special subframes are set to zero (no scheduling) to avoid problems with insufficient PDCCH performance at the test point.   |       |       |       |       |       |       |       |
| Note 3:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |       |       |       |       |       |       |       |
| Note 4:  | As per Table 4.2-2 in TS 36.211 [4].   |       |       |       |       |       |       |       |
| Note 5:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |       |       |       |       |       |       |       |
| Note 6:  | Given per component carrier per codeword.  |       |       |       |       |       |       |       |

Table A.3.4.1-2: Fixed Reference Channel 16QAM R=1/2

| Parameter                                    | Unit | Value |   |              |            |    |    |
|--|------|-------|---|--------------|------------|----|----|
|  |      |       |   | R.3-1<br>TDD | R.3<br>TDD |    |    |
| Reference channel                            |      |       |   |              |            |    |    |
| Channel bandwidth                            | MHz  | 1.4   | 3 | 5            | 10         | 15 | 20 |
| Allocated resource blocks                    |      |       |   | 25           | 50         |    |    |
| Uplink-Downlink Configuration (Note 3)       |      |       |   | 1            | 1          |    |    |
| Allocated subframes per Radio Frame (D+S)    |      |       |   | 3+2          | 3+2        |    |    |
| Modulation                                   |      |       |   | 16QAM        | 16QAM      |    |    |
| Target Coding Rate                           |      |       |   | 1/2          | 1/2        |    |    |
| Information Bit Payload                      |      |       |   |              |            |    |    |
| For Sub-Frames 4,9                           | Bits |       |   | 6456         | 14112      |    |    |
| For Sub-Frames 1,6                           | Bits |       |   | 5160         | 11448      |    |    |
| For Sub-Frame 5                              | Bits |       |   | N/A          | N/A        |    |    |
| For Sub-Frame 0                              | Bits |       |   | 5736         | 12960      |    |    |
| Number of Code Blocks per Sub-Frame (Note 4) |      |       |   |              |            |    |    |
| For Sub-Frames 4,9                           |      |       |   | 2            | 3          |    |    |
| For Sub-Frames 1,6                           |      |       |   | 1            | 2          |    |    |
| For Sub-Frame 5                              |      |       |   | N/A          | N/A        |    |    |
| For Sub-Frame 0                              |      |       |   | 1            | 3          |    |    |
| Binary Channel Bits Per Sub-Frame            |      |       |   |              |            |    |    |
| For Sub-Frames 4,9                           | Bits |       |   | 12600        | 27600      |    |    |
| For Sub-Frames 1,6                           | Bits |       |   | 11112        | 22512      |    |    |
| For Sub-Frame 5                              | Bits |       |   | N/A          | N/A        |    |    |
| For Sub-Frame 0                              | Bits |       |   | 11208        | 26208      |    |    |
| Max. Throughput averaged over 1 frame        | Mbps |       |   | 2.897        | 6.408      |    |    |
| UE Category                                  |      |       |   | ≥ 1          | ≥ 2        |    |    |

|         |  |
|---------|--|
| Note 1: | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |
| Note 2: | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |
| Note 3: | As per Table 4.2-2 in TS 36.211 [4].   |
| Note 4: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |

**Table A.3.4.1-3: Fixed Reference Channel 64QAM R=3/4**

| Parameter                                    | Unit   | Value   |         |         |         |         |        |
|--|--|---------|---------|---------|---------|---------|--------|
|  |  | R.5 TDD | R.6 TDD | R.7 TDD | R.8 TDD | R.9 TDD |        |
| Reference channel                            |  |         |         |         |         |         |        |
| Channel bandwidth                            | MHz  | 1.4     | 3       | 5       | 10      | 15      | 20     |
| Allocated resource blocks                    |  |         | 15      | 25      | 50      | 75      | 100    |
| Uplink-Downlink Configuration (Note 3)       |  |         | 1       | 1       | 1       | 1       | 1      |
| Allocated subframes per Radio Frame (D+S)    |  |         | 3+2     | 3+2     | 3+2     | 3+2     | 3+2    |
| Modulation                                   |  | 64QAM   | 64QAM   | 64QAM   | 64QAM   | 64QAM   | 64QAM  |
| Target Coding Rate                           |  |         | 3/4     | 3/4     | 3/4     | 3/4     | 3/4    |
| Information Bit Payload                      |  |         |         |         |         |         |        |
| For Sub-Frames 4,9                           | Bits   |         | 8504    | 14112   | 30576   | 46888   | 61664  |
| For Sub-Frames 1,6                           | Bits   |         | 6968    | 11448   | 23688   | 35160   | 46888  |
| For Sub-Frame 5                              | Bits   |         | N/A     | N/A     | N/A     | N/A     | N/A    |
| For Sub-Frame 0                              | Bits   |         | 6968    | 12576   | 30576   | 45352   | 61664  |
| Number of Code Blocks per Sub-Frame (Note 4) |  |         |         |         |         |         |        |
| For Sub-Frames 4,9                           |  |         | 2       | 3       | 5       | 8       | 11     |
| For Sub-Frames 1,6                           |  |         | 2       | 2       | 4       | 6       | 8      |
| For Sub-Frame 5                              |  |         | N/A     | N/A     | N/A     | N/A     | N/A    |
| For Sub-Frame 0                              |  |         | 2       | 3       | 5       | 8       | 11     |
| Binary Channel Bits Per Sub-Frame            |  |         |         |         |         |         |        |
| For Sub-Frames 4,9                           | Bits   |         | 11340   | 18900   | 41400   | 62100   | 82800  |
| For Sub-Frames 1,6                           | Bits   |         | 9828    | 16668   | 33768   | 50868   | 67968  |
| For Sub-Frame 5                              | Bits   |         | N/A     | N/A     | N/A     | N/A     | N/A    |
| For Sub-Frame 0                              | Bits   |         | 9252    | 16812   | 39312   | 60012   | 80712  |
| Max. Throughput averaged over 1 frame        | Mbps   |         | 3.791   | 6.370   | 13.910  | 20.945  | 27.877 |
| UE Category                                  |  |         | ≥ 1     | ≥ 2     | ≥ 2     | ≥ 2     | ≥ 3    |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |         |         |         |         |         |        |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |         |         |         |         |         |        |
| Note 3:                                      | As per Table 4.2-2 TS 36.211 [4].  |         |         |         |         |         |        |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |         |         |         |         |         |        |

**Table A.3.4.1-3a: Fixed Reference Channel 64QAM R=3/4**

| Parameter                                    | Unit | Value     |           |           |           |           |       |
|--|------|-----------|-----------|-----------|-----------|-----------|-------|
|  |      | R.6-1 TDD | R.7-1 TDD | R.8-1 TDD | R.9-1 TDD | R.9-2 TDD |       |
| Reference channel                            |      |           |           |           |           |           |       |
| Channel bandwidth                            | MHz  |           | 5         | 10        | 15        | 20        | 20    |
| Allocated resource blocks (Note 3)           |      |           | 18        | 17        | 17        | 17        | 83    |
| Uplink-Downlink Configuration (Note 4)       |      |           | 1         | 1         | 1         | 1         | 1     |
| Allocated subframes per Radio Frame (D+S)    |      |           | 3+2       | 3+2       | 3+2       | 3+2       | 3+2   |
| Modulation                                   |      |           | 64QAM     | 64QAM     | 64QAM     | 64QAM     | 64QAM |
| Target Coding Rate                           |      |           | 3/4       | 3/4       | 3/4       | 3/4       | 3/4   |
| Information Bit Payload                      |      |           |           |           |           |           |       |
| For Sub-Frames 4,9                           | Bits |           | 10296     | 10296     | 10296     | 10296     | 51024 |
| For Sub-Frames 1,6                           | Bits |           | 8248      | 7480      | 7480      | 7480      | 39232 |
| For Sub-Frame 5                              | Bits |           | N/A       | N/A       | N/A       | N/A       | N/A   |
| For Sub-Frame 0                              | Bits |           | 8248      | 10296     | 10296     | 10296     | 51024 |
| Number of Code Blocks per Sub-Frame (Note 5) |      |           |           |           |           |           |       |
| For Sub-Frames 4,9                           |      |           | 2         | 2         | 2         | 2         | 9     |

|                                       |  |  |       |       |       |       |        |
|---------------------------------------|--|--|-------|-------|-------|-------|--------|
| For Sub-Frames 1,6                    |  |  | 2     | 2     | 2     | 2     | 7      |
| For Sub-Frame 5                       |  |  | N/A   | N/A   | N/A   | N/A   | N/A    |
| For Sub-Frame 0                       |  |  | 2     | 2     | 2     | 2     | 9      |
| Binary Channel Bits Per Sub-Frame     |  |  |       |       |       |       |        |
| For Sub-Frames 4,9                    | Bits   |  | 13608 | 14076 | 14076 | 14076 | 68724  |
| For Sub-Frames 1,6                    | Bits   |  | 11880 | 11628 | 11628 | 11628 | 56340  |
| For Sub-Frame 5                       | Bits   |  | N/A   | N/A   | N/A   | N/A   | N/A    |
| For Sub-Frame 0                       | Bits   |  | 11520 | 14076 | 14076 | 14076 | 66636  |
| Max. Throughput averaged over 1 frame | Mbps   |  | 4.534 | 4.585 | 4.585 | 4.585 | 23.154 |
| UE Category                           |  |  | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 2    |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |  |       |       |       |       |        |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |  |       |       |       |       |        |
| Note 3:                               | Localized allocation started from RB #0 is applied.  |  |       |       |       |       |        |
| Note 4:                               | As per Table 4.2-2 TS 36.211 [4].  |  |       |       |       |       |        |
| Note 5:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |  |       |       |       |       |        |

Table A.3.4.1-4: Fixed Reference Channel Single PRB

| Parameter                                    | Unit   | Value |            |   |         |    |    |
|--|--|-------|------------|---|---------|----|----|
|  |  |       | R.0<br>TDD |   | R.1 TDD |    |    |
| Reference channel                            |  |       |            |   |         |    |    |
| Channel bandwidth                            | MHz  | 1.4   | 3          | 5 | 10/20   | 15 | 20 |
| Allocated resource blocks                    |  |       | 1          |   | 1       |    |    |
| Uplink-Downlink Configuration (Note 3)       |  |       | 1          |   | 1       |    |    |
| Allocated subframes per Radio Frame (D+S)    |  |       | 3+2        |   | 3+2     |    |    |
| Modulation                                   |  |       | 16QAM      |   | 16QAM   |    |    |
| Target Coding Rate                           |  |       | 1/2        |   | 1/2     |    |    |
| Information Bit Payload                      |  |       |            |   |         |    |    |
| For Sub-Frames 4,9                           | Bits   |       | 224        |   | 256     |    |    |
| For Sub-Frames 1,6                           | Bits   |       | 208        |   | 208     |    |    |
| For Sub-Frame 5                              | Bits   |       | N/A        |   | N/A     |    |    |
| For Sub-Frame 0                              | Bits   |       | 224        |   | 256     |    |    |
| Number of Code Blocks per Sub-Frame (Note 4) |  |       |            |   |         |    |    |
| For Sub-Frames 4,9                           |  |       | 1          |   | 1       |    |    |
| For Sub-Frames 1,6                           |  |       | 1          |   | 1       |    |    |
| For Sub-Frame 5                              |  |       | N/A        |   | N/A     |    |    |
| For Sub-Frame 0                              |  |       | 1          |   | 1       |    |    |
| Binary Channel Bits Per Sub-Frame            |  |       |            |   |         |    |    |
| For Sub-Frames 4,9                           | Bits   |       | 504        |   | 552     |    |    |
| For Sub-Frames 1,6                           | Bits   |       | 456        |   | 456     |    |    |
| For Sub-Frame 5                              | Bits   |       | N/A        |   | N/A     |    |    |
| For Sub-Frame 0                              | Bits   |       | 504        |   | 552     |    |    |
| Max. Throughput averaged over 1 frame        | Mbps   |       | 0.109      |   | 0.118   |    |    |
| UE Category                                  |  |       | ≥ 1        |   | ≥ 1     |    |    |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |       |            |   |         |    |    |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |       |            |   |         |    |    |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |       |            |   |         |    |    |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |       |            |   |         |    |    |

Table A.3.4.1-5: Fixed Reference Channel Single PRB (MBSFN Configuration)

| Parameter                    | Unit | Value               |
|------------------------------|------|---------------------|
| Reference channel            |      | R.29 TDD<br>(MBSFN) |
| Channel bandwidth            | MHz  | 10                  |
| Allocated resource blocks    |      | 1                   |
| MBSFN Configuration (Note 5) |      | 010010              |

|   |      |           |
|---|------|-----------|
| Uplink-Downlink Configuration (Note 3)  |      | 1         |
| Allocated subframes per Radio Frame (D+S)   |      | 1+2       |
| Modulation  |      | 16QAM     |
| Target Coding Rate  |      | 1/2       |
| Information Bit Payload   |      |           |
| For Sub-Frames 4,9  | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6  | Bits | 208       |
| For Sub-Frame 5   | Bits | N/A       |
| For Sub-Frame 0   | Bits | 256       |
| Number of Code Blocks per Sub-Frame (Note 4)  |      |           |
| For Sub-Frames 4,9  | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6  | Bits | 1         |
| For Sub-Frame 5   | Bits | N/A       |
| For Sub-Frame 0   | Bits | 1         |
| Binary Channel Bits Per Sub-Frame   |      |           |
| For Sub-Frames 4,9  | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6  | Bits | 456       |
| For Sub-Frame 5   | Bits | N/A       |
| For Sub-Frame 0   | Bits | 552       |
| Max. Throughput averaged over 1 frame   | kbps | 67.2      |
| UE Category   |      | ≥ 1       |
| <p>Note 1: 2 symbols allocated to PDCCH.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: as per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 5: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation</p> |      |           |

Table A.3.4.1-6: Fixed Reference Channel QPSK R=1/10

| Parameter   | Unit | Value |   |   |             |    |    |
|---|------|-------|---|---|-------------|----|----|
|   |      |       |   |   |             |    |    |
| Reference channel   |      |       |   |   | R.41<br>TDD |    |    |
| Channel bandwidth   | MHz  | 1.4   | 3 | 5 | 10          | 15 | 20 |
| Allocated resource blocks   |      |       |   |   | 50          |    |    |
| Uplink-Downlink Configuration (Note 4)  |      |       |   |   | 1           |    |    |
| Allocated subframes per Radio Frame (D+S)   |      |       |   |   | 3+2         |    |    |
| Modulation  |      |       |   |   | QPSK        |    |    |
| Target Coding Rate  |      |       |   |   | 1/10        |    |    |
| Information Bit Payload   |      |       |   |   |             |    |    |
| For Sub-Frames 4,9  | Bits |       |   |   | 1384        |    |    |
| For Sub-Frames 1,6  | Bits |       |   |   | 1032        |    |    |
| For Sub-Frame 5   | Bits |       |   |   | N/A         |    |    |
| For Sub-Frame 0   | Bits |       |   |   | 1384        |    |    |
| Number of Code Blocks per Sub-Frame (Note 5)  |      |       |   |   |             |    |    |
| For Sub-Frames 4,9  |      |       |   |   | 1           |    |    |
| For Sub-Frames 1,6  |      |       |   |   | 1           |    |    |
| For Sub-Frame 5   |      |       |   |   | N/A         |    |    |
| For Sub-Frame 0   |      |       |   |   | 1           |    |    |
| Binary Channel Bits Per Sub-Frame   |      |       |   |   |             |    |    |
| For Sub-Frames 4,9  | Bits |       |   |   | 13800       |    |    |
| For Sub-Frames 1,6  | Bits |       |   |   | 11256       |    |    |
| For Sub-Frame 5   | Bits |       |   |   | N/A         |    |    |
| For Sub-Frame 0   | Bits |       |   |   | 13104       |    |    |
| Max. Throughput averaged over 1 frame   | Mbps |       |   |   | 0.622       |    |    |
| UE Category   |      |       |   |   | ≥ 1         |    |    |
| <p>Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&amp;6, only 2 OFDM symbols are allocated to PDCCH.</p> |      |       |   |   |             |    |    |

|         |  |
|---------|--|
| Note 2: | For BW=1.4 MHz, the information bit payloads of special subframes are set to zero (no scheduling) to avoid problems with insufficient PDCCH performance at the test point. |
| Note 3: | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |
| Note 4: | As per Table 4.2-2 in TS 36.211 [4].   |
| Note 5: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                    |

Table A.3.4.1-7: Fixed Reference Channel for CA demodulation with power imbalance

| Parameter  | Unit  | Value    |            |
|--|---|----------|------------|
|  |   | R.49 TDD | R.49-1 TDD |
| Reference channel                                      |   | R.49 TDD | R.49-1 TDD |
| Channel bandwidth                                      | MHz   | 20       | 15         |
| Allocated resource blocks                              |   | 100      | 75         |
| Uplink-Downlink Configuration (Note 1)                 |   | 1        | 1          |
| Allocated subframes per Radio Frame (D+S)              |   | 3+2      | 3+2        |
| Modulation   |   | 64QAM    | 64QAM      |
| Number of OFDM symbols for PDCCH per component carrier |   |          |            |
| For Sub-Frames 0,4,5,9                                 | OFDM symbols  | 3        | 3          |
| For Sub-Frames 1,6                                     | OFDM symbols  | 2        | 2          |
| Target Coding Rate                                     |   |          |            |
| For Sub-Frames 4,9                                     |   | 0.84     | 0.83       |
| For Sub-Frames 1,6                                     |   | 0.81     | 0.80       |
| For Sub-Frames 5                                       |   | N/A      | N/A        |
| For Sub-Frames 0                                       |   | 0.87     | 0.86       |
| Information Bit Payload                                |   |          |            |
| For Sub-Frames 0, 4, 9                                 | Bits  | 63776    | 46888      |
| For Sub-Frame 1,6                                      | Bits  | 55056    | 40576      |
| For Sub-Frame 5  | Bits  | N/A      | N/A        |
| Number of Code Blocks per Sub-Frame (Note 2)           |   |          |            |
| For Sub-Frames 0, 4, 9                                 | Code Blocks   | 11       | 8          |
| For Sub-Frame 1,6                                      | Code Blocks   | 9        | 7          |
| For Sub-Frame 5  | Code Blocks   | N/A      | N/A        |
| Binary Channel Bits Per Sub-Frame                      |   |          |            |
| For Sub-Frames 4,9                                     | Bits  | 75600    | 56700      |
| For Sub-Frame 1,6                                      | Bits  | 67968    | 50868      |
| For Sub-Frame 5  | Bits  | N/A      | N/A        |
| For Sub-Frame 0  | Bits  | 73512    | 54612      |
| Max. Throughput averaged over 1 frame                  | Mbps  | 30.144   | 22.182     |
| UE Category  |   | ≥5       | ≥3         |
| Note 1:  | Reference signal, synchronization signals and PBC allocated as per TS 36.211 [4].   |          |            |
| Note 2:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |          |            |



## A.3.4.2 Multi-antenna transmission (Common Reference Signals)

## A.3.4.2.1 Two antenna ports

Table A.3.4.2.1-1: Fixed Reference Channel two antenna ports

| Parameter                                      | Unit |             |             |               |               |                         | Value         |             |               |               |             |               |
|--|------|-------------|-------------|---------------|---------------|-------------------------|---------------|-------------|---------------|---------------|-------------|---------------|
|  |      | R.10<br>TDD | R.11<br>TDD | R.11-1<br>TDD | R.11-2<br>TDD | R.11-3<br>TDD<br>Note 6 | R.11-4<br>TDD | R.30<br>TDD | R.30-1<br>TDD | R.30-2<br>TDD | R.35<br>TDD | R.35-1<br>TDD |
| Reference channel                              |      |             |             |               |               |                         |               |             |               |               |             |               |
| Channel bandwidth                              | MHz  | 10          | 10          | 10            | 5             | 10                      | 10            | 20          | 20            | 20            | 10          | 20            |
| Allocated resource blocks (Note 5)             |      | 50          | 50          | 50            | 25            | 40                      | 50            | 100         | 100           | 100           | 50          | 100           |
| Uplink-Downlink Configuration (Note 3)         |      | 1           | 1           | 1             | 1             | 1                       | 1             | 1           | 1             | 1             | 1           | 1             |
| Allocated subframes per Radio Frame (D+S)      |      | 3+2         | 3+2         | 2+2           | 3+2           | 3+2                     | 2             | 3+2         | 2+2           | 2             | 2+2         | 2             |
| Modulation                                     |      | QPSK        | 16QAM       | 16QAM         | 16QAM         | 16QAM                   | QPSK          | 16QAM       | 16QAM         | 16QAM         | 64QAM       | 64QAM         |
| Target Coding Rate                             |      | 1/3         | 1/2         | 1/2           | 1/2           | 1/2                     | 1/2           | 1/2         | 1/2           | 1/2           | 1/2         | 0.39          |
| Information Bit Payload (Note 5)               |      |             |             |               |               |                         |               |             |               |               |             |               |
| For Sub-Frames 4,9                             | Bits | 4392        | 12960       | 12960         | 5736          | 10296                   | 6968          | 25456       | 25456         | 25456         | 19848       | 30576         |
| For Sub-Frames 1,6                             |      | 3240        | 9528        | 9528          | 5160          | 9144                    | N/A           | 22920       | 21384         | N/A           | 15840       | N/A           |
| For Sub-Frame 5                                | Bits | N/A         | N/A         | N/A           | N/A           | N/A                     | N/A           | N/A         | N/A           | N/A           | N/A         | N/A           |
| For Sub-Frame 0                                | Bits | 4392        | 12960       | N/A           | 4968          | 10296                   | N/A           | 25456       | N/A           | N/A           | N/A         | N/A           |
| Number of Code Blocks (Notes 4 and 5)          |      |             |             |               |               |                         |               |             |               |               |             |               |
| For Sub-Frames 4,9                             |      | 1           | 3           | 3             | 1             | 2                       | 2             | 5           | 5             | 5             | 4           | 5             |
| For Sub-Frames 1,6                             |      | 1           | 2           | 2             | 1             | 2                       | N/A           | 4           | 4             | N/A           | 3           | N/A           |
| For Sub-Frame 5                                |      | N/A         | N/A         | N/A           | N/A           | N/A                     | N/A           | N/A         | N/A           | N/A           | N/A         | N/A           |
| For Sub-Frame 0                                |      | 1           | 3           | N/A           | 1             | 2                       | N/A           | 5           | N/A           | N/A           | N/A         | N/A           |
| Binary Channel Bits (Note 5)                   |      |             |             |               |               |                         |               |             |               |               |             |               |
| For Sub-Frames 4,9                             | Bits | 13200       | 26400       | 26400         | 12000         | 21120                   | 13200         | 52800       | 52800         | 52800         | 39600       | 79200         |
| For Sub-Frames 1,6                             |      | 10656       | 21312       | 21312         | 10512         | 16992                   | 10656         | 42912       | 42912         | N/A           | 31968       | N/A           |
| For Sub-Frame 5                                | Bits | N/A         | N/A         | N/A           | N/A           | N/A                     | N/A           | N/A         | N/A           | N/A           | N/A         | N/A           |
| For Sub-Frame 0                                | Bits | 12528       | 25056       | N/A           | 10656         | 19776                   | 12528         | 51456       | N/A           | N/A           | N/A         | N/A           |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 1.966       | 5.794       | 4.498         | 2.676         | 4.918                   | 1.39          | 12.221      | 9.368         | 5.091         | 7.138       | 6.115         |

| UE Category |  | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 | 3 | ≥ 2 | 4 |  |
|-------------|--|-----|-----|-----|-----|-----|-----|-----|-----|---|-----|---|--|
| Note 1:     | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |     |     |     |     |     |     |     |     |   |     |   |  |
| Note 2:     | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |     |     |     |     |     |     |     |     |   |     |   |  |
| Note 3:     | As per Table 4.2-2 in TS 36.211 [4].   |     |     |     |     |     |     |     |     |   |     |   |  |
| Note 4:     | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |     |     |     |     |     |     |     |     |   |     |   |  |
| Note 5:     | Given per component carrier per codeword.  |     |     |     |     |     |     |     |     |   |     |   |  |
| Note 6:     | For R.11-3 resource blocks of RB6–RB45 are allocated.  |     |     |     |     |     |     |     |     |   |     |   |  |

Table A.3.4.2.1-2: Fixed Reference Channel two antenna ports

| Parameter   | Unit | Value       |             |               |               |               |               |               |               |                |                |                |               |
|---|------|-------------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|---------------|
|   |      | R.46<br>TDD | R.47<br>TDD | R.35-2<br>TDD | R.11-5<br>TDD | R.11-6<br>TDD | R.11-7<br>TDD | R.11-8<br>TDD | R.11-9<br>TDD | R.11-10<br>TDD | R.11-11<br>TDD | R.11-12<br>TDD | R.10-3<br>TDD |
| Reference channel   |      |             |             |               |               |               |               |               |               |                |                |                |               |
| Channel bandwidth   | MHz  | 10          | 10          | 10            | 1.4           | 3             | 5             | 10            | 15            | 10             | 10             | 10             | 10            |
| Allocated resource blocks<br>(Note 5)                     |      | 50          | 50          | 50            | 6             | 15            | 25            | 50            | 75            | 50             | 50             | 50             | 50            |
| Uplink-Downlink<br>Configuration (Note 3)                 |      | 1           | 1           | 1             | 1             | 1             | 1             | 1             | 1             | 1              | 1              | 1              | 1             |
| Allocated number of PDCCH<br>symbols in normal subframes  |      | 2           | 2           | 2             | 4             | 3             | 3             | 2             | 2             | 2              | 3              | 3              | 2             |
| Allocated number of PDCCH<br>symbols in special subframes |      | 2           | 2           | 2             | 2             | 2             | 2             | 2             | 2             | 2              | 2              | 2              | 2             |
| Allocated subframes per<br>Radio Frame (D+S)              |      | 3+2         | 3+2         | 2+2           | 2+2           | 2+2           | 2+2           | 2+2           | 2+2           | 3+2            | 2+2            | 2+2            | 3+2           |
| Modulation  |      | QPSK        | 16QAM       | 64QAM         | 16QAM         | 16QAM         | 16QAM         | 16QAM         | 16QAM         | QPSK           | QPSK           | QPSK           | 16QAM         |
| Target Coding Rate  |      |             |             | 0.47          | 1/2           | 1/2           | 1/2           | 1/2           | 1/2           | 3/5            |                |                |               |
| For Sub-Frames 4,9  |      |             |             |               |               |               |               |               |               |                | 0.58           | 0.66           | 0.58          |
| For Sub-Frames 1,6  |      |             |             |               |               |               |               |               |               |                | 0.48           | 0.54           | 0.57          |
| Information Bit Payload (Note<br>5)                       |      |             |             |               |               |               |               |               |               |                |                |                |               |
| For Sub-Frames 4,9  | Bits | 5160        | 8760        | 18336         | 1352          | 3368          | 5736          | 12960         | 19080         | 7992           | 6968           | 7992           | 15264         |
| For Sub-Frames 1,6  |      | 3880        | 7480        | 14688         | 1128          | 3112          | 5160          | 10680         | 15840         | 5736           | 5160           | 5736           | 12216         |
| For Sub-Frame 5   | Bits | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           | N/A            | N/A            | N/A            | N/A           |
| For Sub-Frame 0   | Bits | 5160        | 8760        | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           | 7992           | N/A            | N/A            | 14112         |
| Number of Code Blocks<br>(Notes 4 and 5)                  |      |             |             |               |               |               |               |               |               |                |                |                |               |
| For Sub-Frames 4,9  |      | 1           | 2           | 3             | 1             | 1             | 1             | 3             | 4             | 2              | 2              | 2              | 3             |
| For Sub-Frames 1,6  |      | 1           | 2           | 3             | 1             | 1             | 1             | 2             | 3             | 1              | 1              | 1              | 2             |
| For Sub-Frame 5   |      | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           | N/A            | N/A            | N/A            | N/A           |
| For Sub-Frame 0   |      | 1           | 2           | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           | 2              | N/A            | N/A            | 3             |
| Binary Channel Bits (Note 5)                              |      |             |             |               |               |               |               |               |               |                |                |                |               |
| For Sub-Frames 4,9  | Bits | 13200       | 26400       | 39600         | 2592          | 7200          | 12000         | 26400         | 39600         | 13200          | 12000          | 12000          | 26400         |

|  |      |          |          |          |          |          |          |          |          |          |          |          |          |
|--|------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| For Sub-Frames 1,6                             |      | 10656    | 21312    | 31968    | 2304     | 6192     | 10512    | 21312    | 32112    | 10656    | 10656    | 10656    | 21312    |
| For Sub-Frame 5                                | Bits | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      |
| For Sub-Frame 0                                | Bits | 12528    | 25056    | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | 12528    | N/A      | N/A      | 25056    |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 2.324    | 4.124    | 6.604    | 0.496    | 1.296    | 2.179    | 4.498    | 6.984    | 3.5448   | 2.4256   | 2.7456   | 6.9072   |
| UE Category                                    |      | $\geq 1$ | $\geq 1$ | $\geq 2$ | $\geq 1$ | $\geq 1$ | $\geq 1$ | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 1$ | $\geq 1$ | $\geq 1$ |

Note 1: Void

Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].

Note 3: As per Table 4.2-2 in TS 36.211 [4].

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 5: Given per component carrier per codeword

**Table A.3.4.2.1-3: Fixed Reference Channel two antenna ports**

| Parameter   | Unit        | Value    |          |
|---|-------------|----------|----------|
|   |             | R.62 TDD | R.63 TDD |
| Reference channel   |             | R.62 TDD | R.63 TDD |
| Channel bandwidth   | MHz         | 10       | 10       |
| Allocated resource blocks (Note 4)  |             | 3        | 1        |
| Uplink-Downlink Configuration (Note 3)  |             | 1        | 1        |
| Allocated subframes per Radio Frame (D+S)   |             | 4+2      | 4+2      |
| Modulation  |             | 16QAM    | 64QAM    |
| Target Coding Rate  |             | 1/2      | 1/2      |
| Information Bit Payload   |             |          |          |
| For Sub-Frames 0,4,5,9  | Bits        | 744      | 408      |
| For Sub-Frames 1,6  | Bits        | 440      | 280      |
| Number of Code Blocks   |             |          |          |
| For Sub-Frames 0,4,5,9  | Code blocks | 1        | 1        |
| For Sub-Frames 1,6  | Code blocks | 1        | 1        |
| Binary Channel Bits   |             |          |          |
| For Sub-Frames 0,4,5,9  | Bits        | 1584     | 792      |
| For Sub-Frames 1,6  |             | 1296     | 648      |
| Max. Throughput averaged over 1 frame   | Mbps        | 0.3856   | 0.2192   |
| UE DL Category  |             | 0        | 0        |
| Note 1: 2 symbols allocated to PDCCH.   |             |          |          |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].                          |             |          |          |
| Note 3: As per Table 4.2-2 in TS 36.211 [4].  |             |          |          |
| Note 4: Allocated PRB positions start from {9, 10, ..., 9+N-1}, where N is the number of allocated resource blocks. |             |          |          |

**Table A.3.4.2.1-4: Fixed Reference Channel two antenna ports**

| Parameter   | Unit | Value    |          |
|---|------|----------|----------|
|   |      | R.65 TDD | R.84 TDD |
| Reference channel   |      | R.65 TDD | R.84 TDD |
| Channel bandwidth   | MHz  | 20       | 10       |
| Allocated resource blocks (Note 5)  |      | 100      | 39       |
| Uplink-Downlink Configuration (Note 3)  |      | 1        | 1        |
| Allocated subframes per Radio Frame (D+S)   |      | 2+2      | 3+2      |
| Modulation  |      | 256QAM   | 16QAM    |
| Target Coding Rate  |      |          | 1/2      |
| Information Bit Payload (Note 5)  |      |          |          |
| For Sub-Frames 4,9  | Bits | 63776    | 9912     |
| For Sub-Frames 1,6  |      | 46888    | 7480     |
| For Sub-Frame 5   | Bits | N/A      | N/A      |
| For Sub-Frame 0   | Bits | N/A      | 9912     |
| Number of Code Blocks (Notes 4 and 5)   |      |          |          |
| For Sub-Frames 4,9  |      | 11       | 2        |
| For Sub-Frames 1,6  |      | 9        | 2        |
| For Sub-Frame 5   |      | N/A      | N/A      |
| For Sub-Frame 0   |      | N/A      | 2        |
| Binary Channel Bits (Note 5)  |      |          |          |
| For Sub-Frames 4,9  | Bits | 115200   | 20592    |
| For Sub-Frames 1,6  |      | 95424    | 16848    |
| For Sub-Frame 5   | Bits | N/A      | N/A      |
| For Sub-Frame 0   | Bits | N/A      | 20592    |
| Max. Throughput averaged over 1 frame (Note 5)  | Mbps | 22.133   | 4.4696   |
| UE Category   |      | 11-12    | 1bis     |
| UE DL Category  |      | ≥ 11     | N/A      |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 |      |          |          |

OFDM symbols are allocated to PDCCH. For 256QAM reference channel 1 symbol is allocated.

Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].

Note 3: As per Table 4.2-2 in TS 36.211 [4].

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 5: Given per component carrier per codeword

**Table A.3.4.2.1-5: Fixed Reference Channel two antenna ports when EIMTA-MainConfigServCell-r12 is configured**

| Parameter  | Unit  | Value    |       |       |       |       |       |       |  |
|--|---|----------|-------|-------|-------|-------|-------|-------|--|
| Reference channel  |   | R.67 TDD |       |       |       |       |       |       |  |
| Channel bandwidth  | MHz   | 10       |       |       |       |       |       |       |  |
| Allocated resource blocks (Note 5)   |   | 50       |       |       |       |       |       |       |  |
| Modulation   |   | 16QAM    |       |       |       |       |       |       |  |
| Target Coding Rate   |   | 0.4      |       |       |       |       |       |       |  |
| Dynamic Uplink-Downlink Configuration (Note 3)   |   | 0        | 1     | 2     | 3     | 4     | 5     | 6     |  |
| Allocated subframes per Radio Frame (D+S)  |   | 1+2      | 3+2   | 5+2   | 5+1   | 6+1   | 7+1   | 2+2   |  |
| Information Bit Payload (Note 5)   |   |          |       |       |       |       |       |       |  |
| For Sub-Frame 0  | Bits  | 9912     | 9912  | 9912  | 9912  | 9912  | 9912  | 9912  |  |
| For Sub-Frame 1  | Bits  | 7480     | 7480  | 7480  | 7480  | 7480  | 7480  | 7480  |  |
| For Sub-Frame 2  | Bits  | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 3  | Bits  | NA       | NA    | 9912  | NA    | NA    | 9912  | NA    |  |
| For Sub-Frame 4  | Bits  | NA       | 9912  | 9912  | NA    | 9912  | 9912  | NA    |  |
| For Sub-Frame 5  | Bits  | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 6  | Bits  | 7480     | 7480  | 7480  | 9912  | 9912  | 9912  | 7480  |  |
| For Sub-Frame 7  | Bits  | NA       | NA    | NA    | 9912  | 9912  | 9912  | NA    |  |
| For Sub-Frame 8  | Bits  | NA       | NA    | 9912  | 9912  | 9912  | 9912  | NA    |  |
| For Sub-Frame 9  | Bits  | NA       | 9912  | 9912  | 9912  | 9912  | 9912  | 9912  |  |
| Number of Code Blocks (Notes 4 and 5)  |   |          |       |       |       |       |       |       |  |
| For Sub-Frame 0  |   | 2        | 2     | 2     | 2     | 2     | 2     | 2     |  |
| For Sub-Frame 1  |   | 2        | 2     | 2     | 2     | 2     | 2     | 2     |  |
| For Sub-Frame 2  |   | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 3  |   | NA       | NA    | 2     | NA    | NA    | 2     | NA    |  |
| For Sub-Frame 4  |   | NA       | 2     | 2     | NA    | 2     | 2     | NA    |  |
| For Sub-Frame 5  |   | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 6  |   | 2        | 2     | 2     | 2     | 2     | 2     | 2     |  |
| For Sub-Frame 7  |   | NA       | NA    | NA    | 2     | 2     | 2     | NA    |  |
| For Sub-Frame 8  |   | NA       | NA    | 2     | 2     | 2     | 2     | NA    |  |
| For Sub-Frame 9  |   | NA       | 2     | 2     | 2     | 2     | 2     | 2     |  |
| Binary Channel Bits (Note 5)   |   |          |       |       |       |       |       |       |  |
| For Sub-Frame 0  | Bits  | 25056    | 25056 | 25056 | 25056 | 25056 | 25056 | 25056 |  |
| For Sub-Frame 1  | Bits  | 21312    | 21312 | 21312 | 21312 | 21312 | 21312 | 21312 |  |
| For Sub-Frame 2  | Bits  | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 3  | Bits  | NA       | NA    | 26400 | NA    | NA    | 26400 | NA    |  |
| For Sub-Frame 4  | Bits  | NA       | 26400 | 26400 | NA    | 26400 | 26400 | NA    |  |
| For Sub-Frame 5  | Bits  | NA       | NA    | NA    | NA    | NA    | NA    | NA    |  |
| For Sub-Frame 6  | Bits  | 21312    | 21312 | 21312 | 26112 | 26112 | 26112 | 21312 |  |
| For Sub-Frame 7  | Bits  | NA       | NA    | NA    | 26400 | 26400 | 26400 | NA    |  |
| For Sub-Frame 8  | Bits  | NA       | NA    | 26400 | 26400 | 26400 | 26400 | NA    |  |
| For Sub-Frame 9  | Bits  | NA       | 26400 | 26400 | 26400 | 26400 | 26400 | 26400 |  |
| Max. Throughput averaged over 1 frame (Note 5)   | Mbps  | 2.49     | 4.47  | 6.45  | 5.70  | 6.70  | 7.69  | 3.48  |  |
| Max. Throughput averaged over 1 frame and over all dynamic UL-DL configurations (Note 5) | Mbps  | 5.28     |       |       |       |       |       |       |  |
| UE Category  |   | ≥ 1      |       |       |       |       |       |       |  |
| Note 1:  | 2 OFDM symbols are allocated to PDCCH in all subframes  |          |       |       |       |       |       |       |  |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |          |       |       |       |       |       |       |  |
| Note 3:  | As per Table 4.2-2 in TS 36.211 [4].  |          |       |       |       |       |       |       |  |
| Note 4:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |          |       |       |       |       |       |       |  |

|   |
|---|
| Note 5: Given per component carrier per codeword. |
|---|

**Table A.3.4.2.1-6: Fixed Reference Channel two antenna ports**

| Parameter                                 | Unit  | Values     |           |           |
|---|---|------------|-----------|-----------|
|   |   | R.79 TDD   | R.103 TDD | R.104 TDD |
| Reference channel                         |   | R.79 TDD   | R.103 TDD | R.104 TDD |
| Channel bandwidth                         | MHz   | 10         | 10        | 10        |
| Allocated resource blocks (Note 4)        |   | 3          | 3         | 3         |
| Allocated subframes per Radio Frame (D+S) |   | 4+2        | (Note 5)  | 4         |
| Modulation                                |   | 16QAM      | QPSK      | 64QAM     |
| Target Coding Rate                        |   | 1/2        | 1/3       | 0.4       |
| Information Bit Payload                   |   |            |           |           |
| For Sub-Frames 0,4,5,9                    | Bits  | 744        | 224       | 968       |
| For Sub-Frames 1,6                        | Bits  | 440        | N/A       | N/A       |
| Number of Code Blocks                     |   |            |           |           |
| For Sub-Frames 0,4,5,9                    | Code blocks   | 1          | 1         | 1         |
| For Sub-Frames 0,4,5,9                    | Code blocks   | 1          | 1         | 1         |
| Binary Channel Bits                       |   |            |           |           |
| For Sub-Frames 0,4,5,9                    | Bits  | 1584       | 792       | 2376      |
| For Sub-Frames 1,6                        | Bits  | 1296       | N/A       | N/A       |
| Max. Throughput averaged over 1 frame     | Mbps  | 0.3856     | 0.0112    | 0.3872    |
| UE DL Category                            |   | M1, M2 ≥ 0 | M1, M2    | M1, M2    |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |            |           |           |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |            |           |           |
| Note 3:                                   | As per Table 4.2-2 in TS 36.211 [4].  |            |           |           |
| Note 4:                                   | Allocated PRB positions for PDSCH are {3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband.   |            |           |           |
| Note 5:                                   | MPDCCH are scheduled at the 0th to 3rd BL/CE DL subframes with repetition every period=20ms. The associated PDSCH is scheduled at the 5th BL/CE DL subframe with repetition every period=20ms (starting from the 0th subframe). |            |           |           |

**Table A.3.4.2.1-7: Fixed Reference Channel two antenna ports**

| Parameter                                | Unit  | Value    |            |            |
|--|---|----------|------------|------------|
|  |   | R.81 TDD | R.81-1 TDD | R.81-2 TDD |
| Reference channel                        |   | R.81 TDD | R.81-1 TDD | R.81-2 TDD |
| Channel bandwidth                        | MHz   | 10       | 10         | 10         |
| Allocated resource blocks (Note 4)       |   | 6        | 6          | 6          |
| Uplink-Downlink Configuration (Note 3)   |   | 1        | 1          | 1          |
| Allocated PDSCH subframes                |   | Note 6   | Note 7     | Note 8     |
| Modulation                               |   | QPSK     | QPSK       | QPSK       |
| Target Coding Rate                       |   | 1/10     | 1/10       | 1/10       |
| Information Bit Payload                  |   |          |            |            |
| For Sub-Frames 0,4,5,9                   | Bits  | 152      | 152        | 152        |
| For Sub-Frames 1,6                       | Bits  | N/A      | N/A        | N/A        |
| Number of Code Blocks                    |   |          |            |            |
| For Sub-Frames 0,4,5,9                   | Code blocks   | 1        | 1          | 1          |
| For Sub-Frames 1,6                       | Code blocks   | N/A      | N/A        | N/A        |
| Binary Channel Bits                      |   |          |            |            |
| For Sub-Frames 0,4,5,9                   | Bits  | 1584     | 1584       | 1584       |
| For Sub-Frames 1,6                       | Bits  | N/A      | N/A        | N/A        |
| Max. Throughput averaged over one period | kbps  | 0.297    | 0.594      | 1.9        |
| UE DL Category                           |   | M1, ≥ 0  | ≥ 1        | ≥ 1        |
| Note 1:                                  | 2 symbols allocated to PDCCH.   |          |            |            |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |          |            |            |
| Note 3:                                  | As per Table 4.2-2 in TS 36.211 [4].  |          |            |            |
| Note 4:                                  | Allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband.  |          |            |            |
| Note 5:                                  | The allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband. If it is not the BL/CE DL subframes, MPDCCH/PDSCH transmission is postponed until the next BL/CE DL subframe. Note the DL subframes in the TDD uplink-downlink configuration are considered as the BL/CE DL subframes. |          |            |            |

|         |  |
|---------|--|
| Note 6: | MPDCCH are scheduled at the 0th to 63rd BL/CE DL subframes with repetition every period=512ms. The associated PDSCH is scheduled at the 65th to 128th BL/CE DL subframes with repetition every 512ms (starting from the 0th subframe). |
| Note 7: | MPDCCH are scheduled at the 0th to 31rd BL/CE DL subframes with repetition every period=256ms. The associated PDSCH is scheduled at the 33rd to 64 rd BL/CE DL subframes with repetition every 256ms (starting from the 0th subframe). |
| Note 8: | MPDCCH are scheduled at the 0th to 7rd BL/CE DL subframes with repetition every period=80ms. The associated PDSCH is scheduled at the 9rd to 24 rd BL/CE DL subframes with repetition every 80ms (starting from the 0th subframe).     |

**Table A.3.4.2.1-8: Fixed Reference Channel two antenna ports**

| Parameter                                      | Unit   | Values   |            |          |          |            |            |            |
|--|--|----------|------------|----------|----------|------------|------------|------------|
|  |  | R.87 TDD | R.87-1 TDD | R.aa TDD | R.bb TDD | R.87-2 TDD | R.87-3 TDD | R.87-4 TDD |
| Reference channel                              |  |          |            |          |          |            |            |            |
| Channel bandwidth                              | MHz  | 10       | 10         | 10       | 10       | 5          | 15         | 20         |
| Allocated resource blocks (Note 4)             |  | 50       | 50         | 50       | 50       | 25         | 75         | 100        |
| Uplink-Downlink Configuration (Note 2)         |  | 1        | 1          | 1        | 1        | 1          | 1          | 1          |
| Allocated number of PDCCH symbols              |  | 2        | 2          | 2        | 2        | 2          | 2          | 2          |
| Allocated subframes per Radio Frame (D+S)      |  | 2+2      | 2+2        | 3+2      | 3+2      | 2+2        | 2+2        | 2+2        |
| Modulation                                     |  | 64QAM    | 16QAM      | QPSK     | 16QAM    | 64QAM      | 64QAM      | 64QAM      |
| Target Coding Rate                             |  |          |            |          |          |            |            |            |
| For Sub-Frames 4,9                             |  | 0.39     | 0.44       | 0.61     | 0.3      | 0.39       | 0.39       | 0.39       |
| For Sub-Frames 1,6                             |  | 0.36     | 0.40       | 0.54     | 0.27     | 0.36       | 0.36       | 0.36       |
| For Sub-Frames 0                               |  | N/A      | N/A        | 0.64     | 0.32     | N/A        | N/A        | N/A        |
| For Sub-Frames 5                               |  | N/A      | N/A        | N/A      | N/A      | N/A        | N/A        | N/A        |
| Information Bit Payload (Note 4)               |  |          |            |          |          |            |            |            |
| For Sub-Frames 4,9                             | Bits   | 15264    | 11448      | 7992     | 7992     | 7736       | 22920      | 30576      |
| For Sub-Frames 1,6                             | Bits   | 11448    | 8504       | 5736     | 5736     | 5544       | 16992      | 22920      |
| For Sub-Frames 0                               | Bits   | N/A      | N/A        | 7992     | 7992     | N/A        | N/A        | N/A        |
| For Sub-Frames 5                               |  | N/A      | N/A        | N/A      | N/A      | N/A        | N/A        | N/A        |
| Number of Code Blocks(Notes 3 and 4)           |  |          |            |          |          |            |            |            |
| For Sub-Frames 4,9                             |  | 3        | 4          | 2        | 2        | 2          | 4          | 5          |
| For Sub-Frames 1,6                             |  | 2        | 4          | 2        | 2        | 2          | 2          | 2          |
| For Sub-Frames 0                               |  | N/A      | N/A        | 2        | 2        | N/A        | N/A        | N/A        |
| For Sub-Frames 5                               |  | N/A      | N/A        | N/A      | N/A      | N/A        | N/A        | N/A        |
| Binary Channel Bits (Note 4)                   |  |          |            |          |          |            |            |            |
| For Sub-Frames 4,9                             | Bits   | 39600    | 26400      | 13200    | 26400    | 19800      | 59400      | 79200      |
| For Sub-Frames 1,6                             |  | 31968    | 21312      | 10656    | 21312    | 15768      | 48168      | 64368      |
| For Sub-Frames 0                               |  | N/A      | N/A        | 12528    | 25056    | N/A        | N/A        | N/A        |
| For Sub-Frames 5                               |  | N/A      | N/A        | N/A      | N/A      | N/A        | N/A        | N/A        |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps   | 5.342    | 3.99       | 3.5448   | 3.5448   | 2.656      | 7.982      | 10.699     |
| UE Category                                    |  | ≥ 1      | ≥ 1        | ≥ 1      | ≥ 2      | ≥ 1        | ≥ 1        | ≥ 1        |
| Note 1:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |          |            |          |          |            |            |            |
| Note 2:  | As per Table 4.2-2 in TS 36.211 [4].   |          |            |          |          |            |            |            |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) |          |            |          |          |            |            |            |
| Note 4:  | Given per component carrier per codeword.  |          |            |          |          |            |            |            |

**Table A.3.4.2.1-9: Fixed Reference Channel two antenna ports**

| Parameter                              | Unit | Value      |            |            |
|--|------|------------|------------|------------|
|  |      | R.47-1 TDD | R.47-2 TDD | R.47-3 TDD |
| Reference channel                      |      |            |            |            |
| Channel bandwidth                      | MHz  | 5          | 15         | 20         |
| Allocated resource blocks              |      | 25         | 75         | 100        |
| Uplink-Downlink Configuration (Note 2) |      | 1          | 1          | 1          |

|  |   |       |       |        |
|--|---|-------|-------|--------|
| Allocated number of PDCCH symbols in normal subframes  |   | 2     | 2     | 2      |
| Allocated number of PDCCH symbols in special subframes |   | 2     | 2     | 2      |
| Allocated subframes per Radio Frame (D+S)              |   | 3+2   | 3+2   | 3+2    |
| Modulation   |   | 16QAM | 16QAM | 16QAM  |
| Target Coding Rate                                     |   |       |       |        |
| For Sub-Frames 4,9                                     |   |       |       |        |
| For Sub-Frames 1,6                                     |   |       |       |        |
| Information Bit Payload (Note 4)                       |   |       |       |        |
| For Sub-Frames 4,9                                     | Bits  | 4008  | 12960 | 17568  |
| For Sub-Frames 1,6                                     |   | 3624  | 9912  | 15264  |
| For Sub-Frame 5  | Bits  | N/A   | N/A   | N/A    |
| For Sub-Frame 0  | Bits  | 3496  | 12960 | 17568  |
| Number of Code Blocks (Notes 3 and 4)                  |   |       |       |        |
| For Sub-Frames 4,9                                     |   | 1     | 3     | 3      |
| For Sub-Frames 1,6                                     |   | 1     | 2     | 3      |
| For Sub-Frame 5  |   | N/A   | N/A   | N/A    |
| For Sub-Frame 0  |   | 2     | 3     | 3      |
| Binary Channel Bits (Note 4)                           |   |       |       |        |
| For Sub-Frames 4,9                                     | Bits  | 12000 | 39680 | 52800  |
| For Sub-Frames 1,6                                     |   | 10512 | 32112 | 42912  |
| For Sub-Frame 5  | Bits  | N/A   | N/A   | N/A    |
| For Sub-Frame 0  | Bits  | 10656 | 38256 | 51456  |
| Max. Throughput averaged over 1 frame (Note 4)         | Mbps  | 1.876 | 5.874 | 8.3232 |
| UE Category  |   | ≥ 1   | ≥ 1   | ≥ 1    |
| Note 1:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |       |       |        |
| Note 2:  | As per Table 4.2-2 in TS 36.211 [4].  |       |       |        |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |       |       |        |
| Note 4:  | Given per component carrier per codeword  |       |       |        |

Table A.3.4.2.1-10: Fixed Reference Channel two antenna ports

| Parameter                                | Unit   | Value       |             |              |              |
|--|--|-------------|-------------|--------------|--------------|
|  |  | R.90 TDD    | R.91 TDD    | R.92-1 TDD   | R.92-2 TDD   |
| Reference channel                        |  | R.90 TDD    | R.91 TDD    | R.92-1 TDD   | R.92-2 TDD   |
| Channel bandwidth                        | MHz  | 10          | 10          | 10           | 10           |
| Allocated resource blocks                |  | 18 (Note 9) | 18 (Note 9) | 36 (Note 10) | 36 (Note 10) |
| Uplink-Downlink Configuration (Note 3)   |  | 1           | 1           | 1            | 1            |
| Allocated PDSCH subframes                |  | (Note 4)    | (Note 5)    | (Note 6)     | (Note 7)     |
| Modulation                               |  | QPSK        | QPSK        | QPSK         | QPSK         |
| Target Coding Rate                       |  | 1/3         | 1/10        | 1/2          | 1/2          |
| Information Bit Payload                  |  |             |             |              |              |
| For Sub-Frames 0,4,5,9                   | Bits   | 1544        | 488         | 4392         | 4392         |
| For Sub-Frames 1,6                       | Bits   | N/A         | N/A         | N/A          | N/A          |
| Number of Code Blocks                    |  |             |             |              |              |
| For Sub-Frames 0,4,5,9                   | Code blocks  | 1           | 1           | 1            | 1            |
| For Sub-Frames 1,6                       | Code blocks  | N/A         | N/A         | N/A          | N/A          |
| Binary Channel Bits                      |  |             |             |              |              |
| For Sub-Frames 0,4,5,9                   | Bits   | 4752        | 4752        | 9504         | 9504         |
| For Sub-Frames 1,6                       |  | N/A         | N/A         | N/A          | N/A          |
| Max. Throughput averaged over one period | kbps   | 19.3        | 1.90625     | 137.25       | 219.6        |
| UE DL Category                           |  | M2          | M2          | ≥ 1          | ≥ 1          |
| Note 1:                                  | 2 symbols allocated to PDCCH.  |             |             |              |              |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]. |             |             |              |              |
| Note 3:                                  | As per Table 4.2-2 in TS 36.211 [4].   |             |             |              |              |



|          |   |
|----------|---|
| Note 4:  | MPDCCH are scheduled at the 0th to 15th BL/CE DL subframes with repetition every period=80ms. The associated PDSCH is scheduled at the 17th to 24th BL/CE DL subframes with repetition every period=80ms (starting from the 0th subframe).    |
| Note 5:  | MPDCCH are scheduled at the 0th to 31st BL/CE DL subframes with repetition every period= 256ms. The associated PDSCH is scheduled at the 33rd to 64th BL/CE DL subframes with repetition every period=256ms (starting from the 0th subframe). |
| Note 6:  | MPDCCH are scheduled at the 0th to 3rd BL/CE DL subframes with repetition every period=32ms. The associated PDSCH is scheduled at the 5th to 8th BL/CE DL subframes with repetition every period=32ms (starting from the 0th subframe).       |
| Note 7:  | MPDCCH are scheduled at the 0th to 1st BL/CE DL subframes with repetition every period=20ms. The associated PDSCH is scheduled at the 2nd to 3rd BL/CE DL subframes with repetition every period=20ms (starting from the 0th subframe).       |
| Note 8:  | If it is not the BL/CE DL subframes, MPDCCH/PDSCH transmission is postponed until the next BL/CE DL subframe. Note the DL subframes in the TDD uplink-downlink configuration are considered as the BL/CE DL subframes.                        |
| Note 9:  | Allocated PRB positions are {0, 1, ..., 17} within the assigned wideband.   |
| Note 10: | Allocated PRB positions are {1, 2, 3, ..., 18, 31, 32, ..., 48}.  |
| Note 11: | Allocated PRB positions for MPDCCH are {0, 1, 2, 3, 4, 5} within the scheduled narrowband.  |

**Table A.3.4.2.1-11: Fixed Reference Channel two antenna ports**

| Parameter                                      | Unit  | Value       |  |
|--|---|-------------|--|
| Reference channel                              |   | R.11-13 TDD |  |
| Channel bandwidth                              | MHz   | 10          |  |
| Allocated resource blocks (Note 5)             |   | 50          |  |
| Uplink-Downlink Configuration (Note 3)         |   | 4           |  |
| Special subframe configuration                 |   | 4           |  |
| Allocated subframes per Radio Frame (D+S)      |   | 7+1         |  |
| Modulation                                     |   | 16QAM       |  |
| Target Coding Rate                             |   | 1/2         |  |
| Information Bit Payload (Note 5)               |   |             |  |
| For Sub-Frames 0,4,6,7,8,9                     | Bits  | 10680       |  |
| For Sub-Frames 1                               |   | 7736        |  |
| For Sub-Frames 5                               |   | NA          |  |
| Number of Code Blocks (Notes 4 and 5)          |   |             |  |
| For Sub-Frames 0,4,5,6,7,8,9                   |   | 2           |  |
| For Sub-Frames 1                               |   | 2           |  |
| For Sub-Frames 5                               |   | NA          |  |
| Binary Channel Bits (Note 5)                   |   |             |  |
| For Sub-Frames 0,4,5,6,7,8,9                   | Bits  | 21648       |  |
| For Sub-Frames 1                               |   | 17424       |  |
| For Sub-Frames 5                               |   | NA          |  |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps  | 7.1816      |  |
| UE Category                                    |   | ≥ 2         |  |
| Note 1:  | 2 symbols allocated to PDCCH.   |             |  |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |             |  |
| Note 3:  | As per Table 4.2-2 in TS 36.211 [4].  |             |  |
| Note 4:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |             |  |
| Note 5:  | Given per component carrier per codeword.   |             |  |
| Note 6:  | 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0,1,4,5,6,7,8,9.   |             |  |

## A.3.4.2.2 Four antenna ports

Table A.3.4.2.2-1: Fixed Reference Channel four antenna ports

| Parameter   | Unit   | Value       |             |             |               |               |             |             |               |               |               |               |               |               |
|---|--|-------------|-------------|-------------|---------------|---------------|-------------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|
|   |  | R.12<br>TDD | R.13<br>TDD | R.14<br>TDD | R.14-1<br>TDD | R.14-2<br>TDD | R.43<br>TDD | R.36<br>TDD | R.43-1<br>TDD | R.43-2<br>TDD | R.43-3<br>TDD | R.43-4<br>TDD | R.43-5<br>TDD | R.36-1<br>TDD |
| Reference channel                                 |  |             |             |             |               |               |             |             |               |               |               |               |               |               |
| Channel bandwidth                                 | MHz  | 1.4         | 10          | 10          | 10            | 10            | 20          | 10          | 1.4           | 3             | 5             | 10            | 15            | 10            |
| Allocated resource blocks<br>(Note 6)             |  | 6           | 50          | 50          | 6             | 3             | 100         | 50          | 6             | 15            | 25            | 50            | 75            | 50            |
| Uplink-Downlink<br>Configuration (Note 4)         |  | 1           | 1           | 1           | 1             | 1             | 1           | 1           | 1             | 1             | 1             | 1             | 1             | 1             |
| Allocated subframes per<br>Radio Frame (D+S)      |  | 3           | 3+2         | 2+2         | 2             | 2             | 2+2         | 2+2         | 2             | 2+2           | 2+2           | 2+2           | 2+2           | 2+2           |
| Modulation  |  | QPSK        | QPSK        | 16QAM       | 16QAM         | 16QAM         | 16QAM       | 64QAM       | 16QAM         | 16QAM         | 16QAM         | 16QAM         | 16QAM         | 64QAM         |
| Target Coding Rate                                |  | 1/3         | 1/3         | 1/2         | 1/2           | 1/2           | 1/2         | 1/2         | 1/2           | 1/2           | 1/2           | 1/2           | 1/2           | 0.55          |
| Information Bit Payload<br>(Note 6)               |  |             |             |             |               |               |             |             |               |               |               |               |               |               |
| For Sub-Frames 4,9                                | Bits   | 408         | 4392        | 12960       | 1544          | 744           | 25456       | 18336       | 1192          | 3368          | 5736          | 12960         | 19080         | 21384         |
| For Sub-Frames 1,6                                | Bits   | N/A         | 3240        | 9528        | N/A           | N/A           | 21384       | 15840       | N/A           | 2856          | 5160          | 10680         | 15840         | 16992         |
| For Sub-Frame 5                                   | Bits   | N/A         | N/A         | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   | Bits   | 208         | 4392        | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| Number of Code Blocks<br>(Notes 5 and 6)          |  |             |             |             |               |               |             |             |               |               |               |               |               |               |
| For Sub-Frames 4,9                                |  | 1           | 1           | 3           | 1             | 1             | 5           | 3           | 1             | 1             | 1             | 3             | 4             | 4             |
| For Sub-Frames 1,6                                |  | N/A         | 1           | 2           | N/A           | N/A           | 4           | 3           | N/A           | 1             | 1             | 2             | 3             | 3             |
| For Sub-Frame 5                                   |  | N/A         | N/A         | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   |  | 1           | 1           | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| Binary Channel Bits (Note<br>6)                   |  |             |             |             |               |               |             |             |               |               |               |               |               |               |
| For Sub-Frames 4,9                                | Bits   | 1248        | 12800       | 25600       | 3072          | 1536          | 51200       | 38400       | 2496          | 6960          | 11600         | 25600         | 38400         | 38400         |
| For Sub-Frames 1,6                                |  | N/A         | 10256       | 20512       | N/A           | N/A           | 41312       | 30768       | N/A           | 5952          | 10112         | 20512         | 30912         | 30768         |
| For Sub-Frame 5                                   | Bits   | N/A         | N/A         | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| For Sub-Frame 0                                   | Bits   | 624         | 12176       | N/A         | N/A           | N/A           | N/A         | N/A         | N/A           | N/A           | N/A           | N/A           | N/A           | N/A           |
| Max. Throughput averaged<br>over 1 frame (Note 6) | Mbps   | 0.102       | 1.966       | 4.498       | 0.309         | 0.149         | 9.368       | 6.835       | 0.238         | 1.245         | 2.179         | 4.728         | 6.984         | 7.675         |
| UE Category                                       |  | ≥ 1         | ≥ 1         | ≥ 2         | ≥ 1           | ≥ 1           | ≥ 2         | ≥ 2         | ≥ 1           | ≥ 1           | ≥ 1           | ≥ 2           | ≥ 2           | ≥ 2           |
| Note 1:   | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |             |             |             |               |               |             |             |               |               |               |               |               |               |
| Note 2:   | For BW=1.4 MHz, the information bit payloads of special subframes are set to zero (no scheduling) to avoid problems with insufficient PDCCH performance at the test point.   |             |             |             |               |               |             |             |               |               |               |               |               |               |
| Note 3:   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |             |             |             |               |               |             |             |               |               |               |               |               |               |
| Note 4:   | As per Table 4.2-2 in TS 36.211 [4].   |             |             |             |               |               |             |             |               |               |               |               |               |               |
| Note 5:   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |             |             |             |               |               |             |             |               |               |               |               |               |               |

|   |
|---|
| Note 6: Given per component carrier per codeword. |
|---|

Table A.3.4.2.2-2: Fixed Reference Channel four antenna ports

| Parameter                                 | Unit | Value    |            |            |            |                            |                            |          |                |                |
|---|------|----------|------------|------------|------------|----------------------------|----------------------------|----------|----------------|----------------|
|   |      | R.72 TDD | R.72-1 TDD | R.72-2 TDD | R.72-3 TDD | R.73 TDD                   | R.73-1 TDD                 | R.74 TDD | R.85 TDD       | R.93 TDD       |
| Reference channel                         |      | R.72 TDD | R.72-1 TDD | R.72-2 TDD | R.72-3 TDD | R.73 TDD                   | R.73-1 TDD                 | R.74 TDD | R.85 TDD       | R.93 TDD       |
| Channel bandwidth                         | MHz  | 10       | 5          | 15         | 20         | 10                         | 10                         | 10       | 10<br>(Note 7) | 10<br>(Note 7) |
| Allocated resource blocks (Note 6)        |      | 50       | 25         | 75         | 100        | 50                         | 50                         | 50       | 24             | 24             |
| Uplink-Downlink Configuration (Note 4)    |      | 1        | 1          | 1          | 1          | 1                          | 1                          | 1        | 1              | 1              |
| Allocated subframes per Radio Frame (D+S) |      | 2+2      | 2+2        | 2+2        | 2+2        | 2+2                        | 2+2                        | 2+2      | 3+2            | 3+2            |
| Modulation                                |      | 256QAM   | 256QAM     | 256QAM     | 256QAM     | 64QAM                      | 16QAM                      | 16QAM    | 64QAM          | 64QAM          |
| Target Coding Rate                        |      | 0.60     | 0.62       | 0.59       | 0.60       | 0.44                       | 1/2                        | 1/2      | 1/2            | 0.5            |
| Information Bit Payload (Note 6)          |      |          |            |            |            |                            |                            |          |                |                |
| For Sub-Frames 4,9                        | Bits | 31704    | 15840      | 46888      | 63776      | 16416 (CW0)<br>32856 (CW1) | 12960 (CW0)<br>25456 (CW1) | 25456    | 10296          | 9528           |
| For Sub-Frames 1,6                        | Bits | 23688    | 11448      | 35160      | 46888      | 12216 (CW0)<br>24496 (CW1) | 9528 (CW0)<br>19080 (CW1)  | 19080    | 8248           | 7224           |
| For Sub-Frame 5                           | Bits | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | N/A            | N/A            |
| For Sub-Frame 0                           | Bits | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | 10296          | 9528           |
| Number of Code Blocks (Notes 5 and 6)     |      |          |            |            |            |                            |                            |          |                |                |
| For Sub-Frames 4,9                        |      | 6        | 3          | 8          | 11         | 3 (CW0)<br>6 (CW1)         | 3 (CW0)<br>5 (CW1)         | 5        | 2              | 2              |
| For Sub-Frames 1,6                        |      | 4        | 2          | 6          | 8          | 2 (CW0)<br>4 (CW1)         | 2 (CW0)<br>4 (CW1)         | 4        | 2              | 2              |
| For Sub-Frame 5                           |      | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | N/A            | N/A            |
| For Sub-Frame 0                           |      | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | 2              | 2              |
| Binary Channel Bits (Note 6)              |      |          |            |            |            |                            |                            |          |                |                |
| For Sub-Frames 4,9                        | Bits | 51200    | 23200      | 76800      | 102400     | 38400 (CW0)<br>76800 (CW1) | 25600 (CW0)<br>51200 (CW1) | 51200    | 18432          | 18432          |
| For Sub-Frames 1,6                        |      | 41024    | 20224      | 61824      | 82624      | 30768 (CW0)<br>61536 (CW1) | 21312 (CW0)<br>42624 (CW1) | 41024    | 14976          | 14976          |
| For Sub-Frame 5                           | Bits | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | N/A            | N/A            |
| For Sub-Frame 0                           | Bits | N/A      | N/A        | N/A        | N/A        | N/A                        | N/A                        | N/A      | 18432          | 18432          |

|  |  |         |        |         |         |                                |                            |       |        |       |
|--|--|---------|--------|---------|---------|--------------------------------|----------------------------|-------|--------|-------|
| Max. Throughput averaged over 1 frame (Note 6) | Mbps   | 11.0784 | 5.4576 | 16.4096 | 22.1328 | 5.726 (CW0)<br>11.470<br>(CW1) | 4.498 (CW0)<br>8.907 (CW1) | 8.907 | 4.7384 | 4.303 |
| UE Category                                    |  | ≥ 11    | ≥ 11   | ≥ 11    | ≥ 11    | ≥ 5                            | ≥ 5                        | ≥ 5   | 1bis   | 1bis  |
| Note 1:  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |         |        |         |         |                                |                            |       |        |       |
| Note 2:  | For BW=1.4 MHz, the information bit payloads of special subframes are set to zero (no scheduling) to avoid problems with insufficient PDCCH performance at the test point.   |         |        |         |         |                                |                            |       |        |       |
| Note 3:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |         |        |         |         |                                |                            |       |        |       |
| Note 4:  | As per Table 4.2-2 in TS 36.211 [4].   |         |        |         |         |                                |                            |       |        |       |
| Note 5:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |         |        |         |         |                                |                            |       |        |       |
| Note 6:  | Given per component carrier per codeword.  |         |        |         |         |                                |                            |       |        |       |
| Note 7:  | 24 resource blocks (RB 0-20 and 30-32) are allocated in sub-frames 0, 1, 2, 3, 4, 6, 7, 8, 9   |         |        |         |         |                                |                            |       |        |       |

Table A.3.4.2.2-3: Fixed Reference Channel four antenna ports

| Parameter                                 | Unit | Value      |            |            |           |
|---|------|------------|------------|------------|-----------|
|   |      | R.74-1 TDD | R.74-2 TDD | R.74-3 TDD | R.101 TDD |
| Reference channel                         |      | R.74-1 TDD | R.74-2 TDD | R.74-3 TDD | R.101 TDD |
| Channel bandwidth                         | MHz  | 5          | 15         | 20         | 10        |
| Allocated resource blocks (Note 6)        |      | 25         | 75         | 100        | 50        |
| Uplink-Downlink Configuration (Note 4)    |      | 1          | 1          | 1          | 1         |
| Allocated subframes per Radio Frame (D+S) |      | 2+2        | 2+2        | 2+2        | 3+2       |
| Modulation                                |      | 16QAM      | 16QAM      | 16QAM      | 1024QAM   |
| Target Coding Rate                        |      | 1/2        | 1/2        | 1/2        |           |
| Information Bit Payload (Note 6)          |      |            |            |            |           |
| For Sub-Frames 4,9                        | Bits | 11448      | 37888      | 51024      | 52752     |
| For Sub-Frames 1,6                        | Bits | 10296      | 31704      | 42368      | 39232     |
| For Sub-Frame 5                           | Bits | N/A        | N/A        | N/A        | N/A       |
| For Sub-Frame 0                           | Bits | N/A        | N/A        | N/A        | 52752     |
| Number of Code Blocks                     |      |            |            |            |           |
| For Sub-Frames 4,9                        |      | 2          | 7          | 9          | 9         |
| For Sub-Frames 1,6                        |      | 2          | 5          | 7          | 9         |
| For Sub-Frame 0,5                         |      | N/A        | N/A        | N/A        | N/A       |
| Binary Channel Bits                       |      |            |            |            |           |
| For Sub-Frames 4,9                        | Bits | 23200      | 76800      | 102400     | 68000     |
| For Sub-Frames 1,6                        | Bits | 20224      | 61824      | 82624      | 55280     |
| For Sub-Frame 5                           | Bits | N/A        | N/A        | N/A        | N/A       |
| For Sub-Frame 0                           | Bits | N/A        | N/A        | N/A        | 65600     |

|  |  |          |          |          |               |
|--|--|----------|----------|----------|---------------|
| Max. Throughput averaged over 1 frame (Note 5) | Mbps   | 4.3488   | 13.9184  | 18.6784  | 23.6720       |
| UE Category                                    |  | $\geq 5$ | $\geq 5$ | $\geq 5$ | TBD           |
| UE DL Category                                 |  | -        | -        | -        | 20, $\geq 22$ |
| Note 1:  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. 1 symbol allocated to PDCCH for reference channel with 1024QAM. |          |          |          |               |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |          |          |          |               |
| Note 3:  | As per Table 4.2-2 in TS 36.211 [4].   |          |          |          |               |
| Note 4:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |          |          |          |               |
| Note 5:  | Given per component carrier per codeword.  |          |          |          |               |

Table A.3.4.2.2-4: Fixed Reference Channel four antenna ports

| Parameter                                 | Unit  | Values   |
|---|---|----------|
| Reference channel                         |   | R.95 TDD |
| Channel bandwidth                         | MHz   | 10       |
| Allocated resource blocks (Note 4)        |   | 3        |
| Allocated subframes per Radio Frame (D+S) |   | 4+2      |
| Modulation                                |   | 16QAM    |
| Target Coding Rate                        |   | 1/2      |
| Information Bit Payload                   |   |          |
| For Sub-Frames 0,4,5,9                    | Bits  | 744      |
| For Sub-Frames 1,6                        | Bits  | 440      |
| Number of Code Blocks                     |   |          |
| For Sub-Frames 0,4,5,9                    | Code blocks   | 1        |
| For Sub-Frames 0,4,5,9                    | Code blocks   | 1        |
| Binary Channel Bits                       |   |          |
| For Sub-Frames 0,4,5,9                    | Bits  | 1536     |
| For Sub-Frames 1,6                        | Bits  | 1248     |
| Max. Throughput averaged over 1 frames    | Mbps  | 0.3856   |
| UE DL Category                            |   | M2       |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |          |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |          |
| Note 3:                                   | As per Table 4.2-2 in TS 36.211 [4].  |          |
| Note 4:                                   | Allocated PRB positions for PDSCH are {3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband. |          |

### A.3.4.3 Reference Measurement Channels for UE-Specific Reference Symbols

#### A.3.4.3.1 Single antenna port (Cell Specific)

The reference measurement channels in Table A.3.4.3.1-1 apply for verifying demodulation performance for UE-specific reference symbols with one cell-specific antenna port.

**Table A.3.4.3.1-1: Fixed Reference Channel for DRS**

| Parameter                                    | Unit  | Value           |                 |                 |                 |                 |          |
|--|---|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
|  |   | R.25 TDD        | R.26 TDD        | R.26-1 TDD      | R.27 TDD        | R.27-1 TDD      | R.28 TDD |
| Reference channel                            |   |                 |                 |                 |                 |                 |          |
| Channel bandwidth                            | MHz   | 10              | 10              | 5               | 10              | 10              | 10       |
| Allocated resource blocks                    |   | 50 <sup>4</sup> | 50 <sup>4</sup> | 25 <sup>4</sup> | 50 <sup>4</sup> | 18 <sup>6</sup> | 1        |
| Uplink-Downlink Configuration (Note 3)       |   | 1               | 1               | 1               | 1               | 1               | 1        |
| Allocated subframes per Radio Frame (D+S)    |   | 3+2             | 3+2             | 3+2             | 3+2             | 3+2             | 3+2      |
| Modulation                                   |   | QPSK            | 16QAM           | 16QAM           | 64QAM           | 64QAM           | 16QAM    |
| Target Coding Rate                           |   | 1/3             | 1/2             | 1/2             | 3/4             | 3/4             | 1/2      |
| Information Bit Payload                      |   |                 |                 |                 |                 |                 |          |
| For Sub-Frames 4,9                           | Bits  | 4392            | 12960           | 5736            | 28336           | 10296           | 224      |
| For Sub-Frames 1,6                           | Bits  | 3240            | 9528            | 4584            | 22920           | 8248            | 176      |
| For Sub-Frame 5                              | Bits  | N/A             | N/A             | N/A             | N/A             | N/A             | N/A      |
| For Sub-Frame 0                              | Bits  | 2984            | 9528            | 3880            | 22152           | 10296           | 224      |
| Number of Code Blocks per Sub-Frame (Note 5) |   |                 |                 |                 |                 |                 |          |
| For Sub-Frames 4,9                           |   | 1               | 3               | 1               | 5               | 2               | 1        |
| For Sub-Frames 1,6                           |   | 1               | 2               | 1               | 4               | 2               | 1        |
| For Sub-Frame 5                              |   | N/A             | N/A             | N/A             | N/A             | N/A             | N/A      |
| For Sub-Frame 0                              |   | 1               | 2               | 1               | 4               | 2               | 1        |
| Binary Channel Bits Per Sub-Frame            |   |                 |                 |                 |                 |                 |          |
| For Sub-Frames 4,9                           | Bits  | 12600           | 25200           | 11400           | 37800           | 13608           | 504      |
| For Sub-Frames 1,6                           | Bits  | 10356           | 20712           | 10212           | 31068           | 11340           | 420      |
| For Sub-Frame 5                              | Bits  | N/A             | N/A             | N/A             | N/A             | N/A             | N/A      |
| For Sub-Frame 0                              | Bits  | 10332           | 20664           | 7752            | 30996           | 13608           | 504      |
| Max. Throughput averaged over 1 frame        | Mbps  | 1.825           | 5.450           | 2.452           | 12.466          | 4.738           | 0.102    |
| UE Category                                  |   | ≥ 1             | ≥ 2             | ≥ 1             | ≥ 2             | ≥ 1             | ≥ 1      |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.  |                 |                 |                 |                 |                 |          |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |                 |                 |                 |                 |                 |          |
| Note 3:                                      | as per Table 4.2-2 in TS 36.211 [4].  |                 |                 |                 |                 |                 |          |
| Note 4:                                      | For R.25, R.26 and R.27, 50 resource blocks are allocated in sub-frames 1, 4, 6, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. For R.26-1, 25 resource blocks are allocated in sub-frames 1, 4, 6, 9 and 17 resource blocks (RB0–RB7 and RB16–RB24) are allocated in sub-frame 0. |                 |                 |                 |                 |                 |          |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |                 |                 |                 |                 |                 |          |
| Note 6:                                      | Localized allocation started from RB #0 is applied.   |                 |                 |                 |                 |                 |          |

The reference measurement channels in Table A.3.4.3.1-2 apply for verifying demodulation performance for UE-specific reference symbols with one cell-specific antenna port.

Table A.3.4.3.1-2: Fixed Reference Channel for DRS

| Parameter                                | Unit  | Value        |            |            |
|--|---|--------------|------------|------------|
|  |   | R.80 TDD     | R.80-1 TDD | R.80-2 TDD |
| Reference channel                        |   | R.80 TDD     | R.80-1 TDD | R.80-2 TDD |
| Channel bandwidth                        | MHz   | 10           | 10         | 10         |
| Allocated resource blocks (Note 4)       |   | 6            | 6          | 6          |
| Uplink-Downlink Configuration (Note 3)   |   | 1            | 1          | 1          |
| Allocated PDSCH subframes                |   | Note 6       | Note 7     | Note 8     |
| Modulation                               |   | QPSK         | QPSK       | QPSK       |
| Target Coding Rate                       |   | 1/3          | 1/3        | 1/3        |
| Information Bit Payload                  |   |              |            |            |
| For Sub-Frames 4,9                       | Bits  | 504          | 504        | 504        |
| For Sub-Frames 1,6                       |   | N/A          | N/A        | N/A        |
| For Sub-Frames 0,5                       | Bits  | 504          | 504        | 504        |
| Number of Code Blocks per Sub-Frame      |   |              |            |            |
| For Sub-Frames 4,9                       | Code blocks   | 1            | 1          | 1          |
| For Sub-Frames 1,6                       | Code blocks   | N/A          | N/A        | N/A        |
| For Sub-Frames 0,5                       | Code blocks   | 1            | 1          | 1          |
| Binary Channel Bits Per Sub-Frame        |   |              |            |            |
| For Sub-Frames 4,9                       | Bits  | 1440         | 1440       | 1440       |
| For Sub-Frames 1,6                       |   | N/A          | N/A        | N/A        |
| For Sub-Frames 0,5                       | Bits  | 1440         | 1440       | 1440       |
| Max. Throughput averaged over one period | kbps  | 6.3          | 12.6       | 25.2       |
| UE DL Category                           |   | M1, $\geq 0$ | $\geq 1$   | $\geq 1$   |
| Note 1:                                  | 2 symbols allocated to PDCCH.   |              |            |            |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |              |            |            |
| Note 3:                                  | as per Table 4.2-2 in TS 36.211 [4].  |              |            |            |
| Note 4:                                  | Allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband.  |              |            |            |
| Note 5:                                  | The allocated PRB positions are {0, 1, 2, 3, 4, 5} within the assigned narrowband. If it is not BL/CE DL subframes, MPDCCH/PDSCH transmission is postponed until the next BL/CE DL subframe. Note the DL subframes in the TDD uplink-downlink configuration are considered as the BL/CE DL subframes. |              |            |            |
| Note 6:                                  | MPDCCH are scheduled at the 0th to 7th BL/CE DL subframes with repetition every period=80ms. The associated PDSCH is scheduled at the 9th to 16th BL/CE DL subframes every 80ms (starting from the 0th subframe).   |              |            |            |
| Note 7:                                  | MPDCCH are scheduled at the 0th to 1th BL/CE DL subframes with repetition every period=40ms. The associated PDSCH is scheduled at the 3th to 6th BL/CE DL subframes every 40ms (starting from the 0th subframe).  |              |            |            |
| Note 8:                                  | MPDCCH are scheduled at the 0th BL/CE DL subframes with repetition every period=20ms. The associated PDSCH is scheduled at the 1th to 2th BL/CE DL subframes every 20ms (starting from the 0th subframe).   |              |            |            |

### A.3.4.3.2 Two antenna ports (Cell Specific)

The reference measurement channels in Table A.3.4.3.2-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports.

Table A.3.4.3.2-1: Fixed Reference Channel for CDM-multiplexed DM RS

| Parameter                                 | Unit | Value           |                 |                 |                 |                 |                 |                 |
|---|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|   |      | R.31 TDD        | R.32 TDD        | R.32-1 TDD      | R.33 TDD        | R.33-1 TDD      | R.34 TDD        | R.86 TDD        |
| Reference channel                         |      | R.31 TDD        | R.32 TDD        | R.32-1 TDD      | R.33 TDD        | R.33-1 TDD      | R.34 TDD        | R.86 TDD        |
| Channel bandwidth                         | MHz  | 10              | 10              | 5               | 10              | 10              | 10              | 10              |
| Allocated resource blocks                 |      | 50 <sup>4</sup> | 50 <sup>4</sup> | 25 <sup>4</sup> | 50 <sup>4</sup> | 18 <sup>6</sup> | 50 <sup>4</sup> | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)    |      | 1               | 1               | 1               | 1               | 1               | 1               | 1               |
| Allocated subframes per Radio Frame (D+S) |      | 3+2             | 3+2             | 3+2             | 3+2             | 3+2             | 3+2             | 3+2             |

| Modulation                                   |  | QPSK  | 16QAM | 16QAM | 64QAM  | 64QAM | 64QAM | QPSK   |
|--|--|-------|-------|-------|--------|-------|-------|--------|
| Target Coding Rate                           |  | 1/3   | 1/2   | 1/2   | 3/4    | 3/4   | 1/2   | 1/3    |
| Information Bit Payload                      |  |       |       |       |        |       |       |        |
| For Sub-Frames 4,9                           | Bits   | 3624  | 11448 | 5736  | 27376  | 9528  | 18336 | 4392   |
| For Sub-Frames 1,6                           |  | 2664  | 7736  | 3112  | 16992  | 7480  | 11832 | 2664   |
| For Sub-Frame 5                              | Bits   | N/A   | N/A   | N/A   | N/A    | N/A   | N/A   | N/A    |
| For Sub-Frame 0                              | Bits   | 2984  | 9528  | 3496  | 22152  | 9528  | 14688 | 3624   |
| Number of Code Blocks per Sub-Frame (Note 5) |  |       |       |       |        |       |       |        |
| For Sub-Frames 4,9                           |  | 1     | 2     | 1     | 5      | 2     | 3     | 1      |
| For Sub-Frames 1,6                           |  | 1     | 2     | 1     | 3      | 2     | 2     | 1      |
| For Sub-Frame 5                              |  | N/A   | N/A   | N/A   | N/A    | N/A   | N/A   | N/A    |
| For Sub-Frame 0                              |  | 1     | 2     | 1     | 4      | 2     | 3     | 1      |
| Binary Channel Bits Per Sub-Frame            |  |       |       |       |        |       |       |        |
| For Sub-Frames 4,9                           | Bits   | 12000 | 24000 | 10800 | 36000  | 12960 | 36000 | 11400  |
| For Sub-Frames 1,6                           |  | 7872  | 15744 | 6528  | 23616  | 10368 | 23616 | 7872   |
| For Sub-Frame 5                              | Bits   | N/A   | N/A   | N/A   | N/A    | N/A   | N/A   | N/A    |
| For Sub-Frame 0                              | Bits   | 9840  | 19680 | 7344  | 29520  | 12960 | 29520 | 9840   |
| Max. Throughput averaged over 1 frame        | Mbps   | 1.556 | 4.79  | 2.119 | 11.089 | 4.354 | 7.502 | 1.7736 |
| UE Category                                  |  | ≥ 1   | ≥ 2   | ≥ 1   | ≥ 2    | ≥ 1   | ≥ 2   | 1bis   |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.   |       |       |       |        |       |       |        |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |       |       |       |        |       |       |        |
| Note 3:                                      | as per Table 4.2-2 in TS 36.211 [4].   |       |       |       |        |       |       |        |
| Note 4:                                      | For R.31, R.32, R.33 ,R.34 and R.86, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.32-1, 25 resource blocks are allocated in sub-frames 4,9 and 17 resource blocks (RB0–RB7 and RB16–RB24) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1, 6. |       |       |       |        |       |       |        |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |       |       |       |        |       |       |        |
| Note 6:                                      | Localized allocation started from RB #0 is applied.  |       |       |       |        |       |       |        |

The reference measurement channels in Table A.3.4.3.2-2 apply with two CRS antenna ports.

**Table A.3.4.3.2-2: Fixed Reference Channel for CDM-multiplexed DM RS**

| Parameter                                    | Unit | Value       |             |
|--|------|-------------|-------------|
|  |      | R.70 TDD    | R.71 TDD    |
| Reference channel                            |      | R.70 TDD    | R.71 TDD    |
| Channel bandwidth                            | MHz  | 10          | 10          |
| Allocated resource blocks                    |      | 50 (Note 4) | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3)       |      | 1           | 1           |
| Allocated subframes per Radio Frame (D+S)    |      | 2+2         | 2+2         |
| Modulation                                   |      | QPSK        | 16QAM       |
| Target Coding Rate                           |      |             |             |
| For Sub-Frames 4,9                           |      | 0.65        | 0.6         |
| For Sub-Frames 1,6                           |      | 0.54        | 0.5         |
| Information Bit Payload                      |      |             |             |
| For Sub-Frames 4,9                           | Bits | 6968        | 12960       |
| For Sub-Frames 1,6                           | Bits | 4264        | 7736        |
| For Sub-Frame 5                              | Bits | N/A         | N/A         |
| For Sub-Frame 0                              | Bits | N/A         | N/A         |
| Number of Code Blocks per Sub-Frame (Note 5) |      |             |             |
| For Sub-Frames 4,9                           |      | 2           | 3           |
| For Sub-Frames 1,6                           |      | 1           | 2           |
| For Sub-Frame 5                              |      | N/A         | N/A         |
| For Sub-Frame 0                              |      | N/A         | N/A         |
| Binary Channel Bits Per Sub-Frame            |      |             |             |
| For Sub-Frames 4,9                           | Bits | 10800       | 21600       |
| For Sub-Frames 1,6                           | Bits | 7872        | 15744       |



|                                       |  |          |          |
|---------------------------------------|--|----------|----------|
| For Sub-Frame 5                       | Bits   | N/A      | N/A      |
| For Sub-Frame 0                       | Bits   | N/A      | N/A      |
| Max. Throughput averaged over 1 frame | Mbps   | 2.2464   | 4.1392   |
| UE Category                           |  | $\geq 1$ | $\geq 2$ |
| Note 1:                               | 3 symbols allocated to PDCCH in normal subframes and 2 symbols allocated to PDCCH in special subframes   |          |          |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |          |          |
| Note 3:                               | As per Table 4.2-2 in TS 36.211 [4].   |          |          |
| Note 4:                               | For R.63, and R.64, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in the DwPTS portion of sub-frames 1,6. |          |          |
| Note 5:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                      |          |          |

#### A.3.4.3.3 Two antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.3-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports.

Table A.3.4.3.3-1: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports

| Parameter  | Unit        | Value       |             |             |             |             |              |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|
|  |             | R.51 TDD    | R.51-1 TDD  | R.76 TDD    | R.51-2 TDD  | R.51-3 TDD  | R.51-4 TDD   | R.X TDD     | R.94 TDD    |
| Reference channel  |             | R.51 TDD    | R.51-1 TDD  | R.76 TDD    | R.51-2 TDD  | R.51-3 TDD  | R.51-4 TDD   | R.X TDD     | R.94 TDD    |
| Channel bandwidth  | MHz         | 10          | 10          | 10          | 5           | 15          | 20           | 10          | 10          |
| Allocated resource blocks  |             | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) | 25 (Note 6) | 75 (Note 7) | 100 (Note 8) | 50 (Note 5) | 24 (Note 9) |
| Uplink-Downlink Configuration (Note 3)   |             | 1           | 1           | 1           | 1           | 1           | 1            | 1           | 1           |
| Allocated subframes per Radio Frame (D+S)  |             | 3+2         | 3+2         | 3+2         | 3+2         | 3+2         | 3+2          | 3+2         | 3+2         |
| Modulation   |             | 16QAM       | 16QAM       | QPSK        | 16QAM       | 16QAM       | 16QAM        | 64QAM       | QPSK        |
| Target Coding Rate   |             | 1/2         | 0.57        |             | 1/2         | 1/2         | 1/2          | 1/2         | 2/3         |
| Information Bit Payload  |             |             |             |             |             |             |              |             |             |
| For Sub-Frames 4,9 (non CSI-RS subframe)   | Bits        | 11448       | N/A         | 6200        | NA          | NA          | NA           | NA          | N/A         |
| For Sub-Frame 4,9  | Bits        | 11448       | 12960       | 6200        | 4968        | 16992       | 22920        | 18336       | 3752        |
| For Sub-Frames 1,6   | Bits        | 7736        | 9144        | 4264        | 3112        | 12216       | 16992        | 11832       | 2856        |
| For Sub-Frame 5  | Bits        | N/A         | N/A         | n/a         | N/A         | N/A         | N/A          | N/A         | N/A         |
| For Sub-Frame 0  | Bits        | 9528        | 10680       | 4968        | 3496        | 14112       | 19848        | 14688       | 3752        |
| Number of Code Blocks (Note 4)   |             |             |             |             |             |             |              |             |             |
| For Sub-Frames 4, 9 (non CSI-RS subframe)  | Code blocks | 2           | N/A         | 2           | N/A         | N/A         | N/A          | N/A         | N/A         |
| For Sub-Frames 4,9   | Code blocks | 2           | 3           | 2           | 1           | 3           | 4            | 3           | 1           |
| For Sub-Frames 1,6   | Code blocks | 2           | 2           | 1           | 1           | 3           | 3            | 3           | 1           |
| For Sub-Frame 5  |             | N/A         | N/A         | N/A         | N/A         | N/A         | N/A          | N/A         | N/A         |
| For Sub-Frame 0  | Code blocks | 2           | 2           | 1           | 1           | 3           | 4            | 3           | 1           |
| Binary Channel Bits  |             |             |             |             |             |             |              |             |             |
| For Sub-Frames 4, 9 (non CSI-RS subframe)  | Bits        | 24000       | N/A         | 11800       | NA          | NA          | NA           | N/A         | N/A         |
| For Sub-Frames 4,9   |             | 22800       | 22800       | 11800       | 10200       | 34200       | 45600        | 34200       | 5472        |
| For Sub-Frames 1,6   |             | 15744       | 15744       | 7872        | 6144        | 24192       | 33792        | 23616       | 4608        |
| For Sub-Frame 5  | Bits        | N/A         | N/A         | N/A         | N/A         | N/A         | N/A          | N/A         | N/A         |
| For Sub-Frame 0  | Bits        | 19680       | 19680       | 9840        | 6912        | 30240       | 42240        | 29520       | 5760        |
| Max. Throughput averaged over 1 frame  | Mbps        | 4.7896      | 5.4888      | 2.5896      | 1.9656      | 7.2528      | 99.672       | 7.502       | 1.697       |
| UE Category  |             | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2         | ≥ 2          | ≥ 2         | 1bis        |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |             |             |             |             |             |             |              |             |             |

|         |   |
|---------|---|
| Note 2: | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |
| Note 3: | as per Table 4.2-2 in TS 36.211 [4].  |
| Note 4: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                   |
| Note 5: | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.  |
| Note 6: | 25 resource blocks are allocated in sub-frames 4,9 and 17 resource blocks (RB0–RB9 and RB18–RB24) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |
| Note 7: | 75 resource blocks are allocated in sub-frames 4,9 and 63 resource blocks (RB0–R31 and RB44–RB74) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |
| Note 8: | 100 resource blocks are allocated in sub-frames 4,9 and 88 resource blocks (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. |
| Note 9: | 24 resource blocks (RB 0-20 and 30-32) are allocated in sub-frames 0, 1, 2, 3, 4, 6, 7, 8, 9  |

The reference measurement channels in Table A3.4.3.3-2 apply for verifying demodulation performance for UE-specific reference symbols with two cell specific antenna ports and two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS in same subframe.

**Table A.3.4.3.3-2: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter                                 | Unit        | Value       |             |             |             |             |             |
|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|   |             | R.52 TDD    | R.52-1 TDD  | R.53 TDD    | R.54 TDD    | R.76A TDD   | R.97 TDD    |
| Reference channel                         |             | R.52 TDD    | R.52-1 TDD  | R.53 TDD    | R.54 TDD    | R.76A TDD   | R.97 TDD    |
| Channel bandwidth                         | MHz         | 10          | 10          | 10          | 10          | 10          | 10          |
| Allocated resource blocks                 |             | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) |
| Uplink-Downlink Configuration (Note 3)    |             | 1           | 1           | 1           | 1           | 1           | 1           |
| Allocated subframes per Radio Frame (D+S) |             | 3+2         | 3+2         | 3+2         | 3+2         | 3+2         | 3+2         |
| Modulation                                |             | 64QAM       | 16QAM       | 64QAM       | 16QAM       | QPSK        | 16QAM       |
| Target Coding Rate                        |             | 1/2         | 0.57        | 1/2         | 1/2         | 1/3         | 1/2         |
| Information Bit Payload                   |             |             |             |             |             |             |             |
| For Sub-Frame 4,9                         | Bits        | 16416       | 12960       | 16416       | 11448       | 3624        | 11448       |
| For Sub-Frames 1,6                        | Bits        | 11832       | 9144        | 11832       | 7736        | 2664        | 6712        |
| For Sub-Frame 5                           | Bits        | n/a         | n/a         | n/a         | n/a         | n/a         | n/a         |
| For Sub-Frame 0                           | Bits        | 14688       | 10680       | 14688       | 9528        | 2984        | 9528        |
| Number of Code Blocks (Note 4)            |             |             |             |             |             |             |             |
| For Sub-Frames 4,9                        | Code blocks | 3           | 3           | 3           | 2           | 1           | 2           |
| For Sub-Frames 1,6                        | Code blocks | 2           | 2           | 2           | 2           | 1           | 2           |
| For Sub-Frame 5                           |             | n/a         | n/a         | n/a         | n/a         | n/a         | n/a         |
| For Sub-Frame 0                           | Code blocks | 3           | 2           | 3           | 2           | 1           | 2           |
| Binary Channel Bits                       |             |             |             |             |             |             |             |
| For Sub-Frames 4,9                        |             | 34200       | 22800       | 33600       | 22800       | 11200       | 22400       |
| For Sub-Frames 1,6                        |             | 23616       | 15744       | 23616       | 15744       | 7544        | 15744       |
| For Sub-Frame 5                           | Bits        | n/a         | n/a         | n/a         | n/a         | n/a         | n/a         |

|   |      |          |          |          |          |        |          |
|---|------|----------|----------|----------|----------|--------|----------|
| For Sub-Frame 0   | Bits | 29520    | 19680    | 29520    | 19680    | 9512   | 19680    |
| Max. Throughput averaged over 1 frame   | Mbps | 7.1184   | 5.4888   | 7.1184   | 4.7896   | 1.5560 | 4.5848   |
| UE Category   |      | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ | 1      | $\geq 2$ |
| <p>Note 1: 2 symbols allocated to PDCCH.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: as per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 5: 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1, 6.</p> |      |          |          |          |          |        |          |

Table A.3.4.3.3-3: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports

| Parameter                                 | Unit        | Value         |               |               |               |               |               |               |
|---|-------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|   |             | R.76-1<br>TDD | R.76-2<br>TDD | R.76-3<br>TDD | R.76-4<br>TDD | R.76-5<br>TDD | R.76-6<br>TDD | R.76-7<br>TDD |
| Reference channel                         |             |               |               |               |               |               |               |               |
| Channel bandwidth                         | MHz         | 5             | 15            | 20            | 5             | 10            | 15            | 20            |
| Allocated resource blocks                 |             | 25 (Note 6)   | 75 (Note 7)   | 100 (Note 8)  | 25 (Note 6)   | 50 (Note 5)   | 75 (Note 7)   | 100 (Note 8)  |
| Uplink-Downlink Configuration (Note 3)    |             | 1             | 1             | 1             | 1             | 1             | 1             | 1             |
| Allocated subframes per Radio Frame (D+S) |             | 3+2           | 3+2           | 3+2           | 3+2           | 3+2           | 3+2           | 3+2           |
| Modulation                                |             | QPSK          | QPSK          | QPSK          | QPSK          | QPSK          | QPSK          | QPSK          |
| Target Coding Rate                        |             |               |               |               |               |               |               |               |
| Information Bit Payload                   |             |               |               |               |               |               |               |               |
| For Sub-Frames 4,9 (non CSI-RS subframe)  | Bits        | NA            | NA            | NA            | NA            | NA            | NA            | NA            |
| For Sub-Frame 4,9                         | Bits        | 2600          | 9144          | 12216         | 3496          | 7992          | 11832         | 15840         |
| For Sub-Frames 1,6                        | Bits        | 1480          | 5736          | 7992          | 1864          | 4776          | 7480          | 10296         |
| For Sub-Frame 5                           | Bits        | n/a           | n/a           | n/a           | n/a           | n/a           | n/a           | n/a           |
| For Sub-Frame 0                           | Bits        | 1736          | 7736          | 10680         | 2344          | 6456          | 9912          | 14112         |
| Number of Code Blocks (Note 4)            |             |               |               |               |               |               |               |               |
| For Sub-Frames 4, 9 (non CSI-RS subframe) | Code blocks | NA            | NA            | NA            | NA            | 2             | NA            | NA            |
| For Sub-Frames 4,9                        | Code blocks | 1             | 2             | 2             | 1             | 2             | 2             | 3             |
| For Sub-Frames 1,6                        | Code blocks | 1             | 1             | 1             | 1             | 1             | 1             | 2             |

|                                       |  |          |          |          |          |          |          |          |
|---------------------------------------|--|----------|----------|----------|----------|----------|----------|----------|
| For Sub-Frame 5                       |  | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      |
| For Sub-Frame 0                       | Code blocks  | 1        | 2        | 2        | 1        | 2        | 2        | 3        |
| Binary Channel Bits                   |  |          |          |          |          |          |          |          |
| For Sub-Frames 4,9                    | Bits   | 5100     | 17100    | 22800    | 5100     | 11800    | 17100    | 22800    |
| For Sub-Frames 1,6                    | Bits   | 3072     | 12096    | 16896    | 3072     | 7872     | 12096    | 16896    |
| For Sub-Frame 5                       | Bits   | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      |
| For Sub-Frame 0                       | Bits   | 3456     | 15120    | 21120    | 3456     | 9840     | 15120    | 21120    |
| Max. Throughput averaged over 1 frame | Mbps   | 0.9896   | 3.7496   | 5.1096   | 1.3064   | 3.1992   | 4.8536   | 6.6384   |
| UE Category                           |  | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ | $\geq 2$ |
| Note 1:                               | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |          |          |          |          |          |          |          |
| Note 2:                               | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |          |          |          |          |          |          |          |
| Note 3:                               | as per Table 4.2-2 in TS 36.211 [4].   |          |          |          |          |          |          |          |
| Note 4:                               | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |          |          |          |          |          |          |          |
| Note 5:                               | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |          |          |          |          |          |          |          |
| Note 6:                               | 25 resource blocks are allocated in sub-frames 4,9 and 17 resource blocks (RB0–RB9 and RB18–RB24) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.  |          |          |          |          |          |          |          |
| Note 7:                               | 75 resource blocks are allocated in sub-frames 4,9 and 63 resource blocks (RB0–R31 and RB44–RB74) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.  |          |          |          |          |          |          |          |
| Note 8:                               | 100 resource blocks are allocated in sub-frames 4,9 and 88 resource blocks (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.  |          |          |          |          |          |          |          |
| Note 9:                               | Given per component carrier per codeword.  |          |          |          |          |          |          |          |

## A.3.4.3.4 Four antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.4-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-1: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter                                    | Unit  | Value          |                |             |                |                |                |                |              |
|--|---|----------------|----------------|-------------|----------------|----------------|----------------|----------------|--------------|
|  |   | R.44<br>TDD    | R.48<br>TDD    | R.66<br>TDD | R.75<br>TDD    | R.75A<br>TDD   | R.cc<br>TDD    | R.61A<br>TDD   | R.102<br>TDD |
| Reference channel                            |   |                |                |             |                |                |                |                |              |
| Channel bandwidth                            | MHz   | 10             | 10             | 20          | 10             | 10             | 10             | 10             | 10           |
| Allocated resource blocks                    |   | 50<br>(Note 4) | 50<br>(Note 4) | 100         | 50<br>(Note 4) | 50<br>(Note 4) | 50<br>(Note 4) | 50<br>(Note 4) | 50 (Note 4)  |
| Uplink-Downlink Configuration (Note 3)       |   | 1              | 1              | 1           |                |                | 1              | 1              | 1            |
| Allocated subframes per Radio Frame (D+S)    |   | 3+2            | 3+2            | 3+2         | 3+2            | 3+2            | 3+2            | 3+2            | 3+2          |
| Modulation                                   |   | 64QAM          | QPSK           | 256QAM      | 16QAM          | 16QAM          | 16QAM          | 16QAM          | 1024QAM      |
| Target Coding Rate                           |   | ½              |                |             | 0.57           | 0.51           |                | 1/2            | 3/4          |
| Information Bit Payload                      |   |                |                |             |                |                |                |                |              |
| For Sub-Frames 4,9 (non CSI-RS subframe)     | Bits  | 18336          | N/A            | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frames 4,9 (CSI-RS subframe)         | Bits  | 16416          | 6200           | 71112       | 25456          | 25456          | 15264          | 11448          | 52752        |
| For Sub-Frames 1,6                           |   | 11832          | 4264           | 48936       | 16992          | 16992          | 9144           | 7736           | 31704        |
| For Sub-Frame 5                              | Bits  | N/A            | N/A            | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frame 0                              | Bits  | 14688          | 4968           | 66592       | 21384          | 21384          | 12576          | 9528           | 43816        |
| Number of Code Blocks per Sub-Frame (Note 5) |   |                |                |             |                |                |                |                |              |
| For Sub-Frames 4,9 (non CSI-RS subframe)     |   | 3              | 2              | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frames 4,9 (CSI-RS subframe)         |   | 3              | 2              | 12          | 5              | 5              | 3              | 2              | 9            |
| For Sub-Frames 1,6                           |   | 2              | 1              | 8           | 3              | 3              | 2              | 2              | 6            |
| For Sub-Frame 5                              |   | N/A            | N/A            | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frame 0                              |   | 3              | 1              | 11          | 4              | 4              | 3              | 2              | 7            |
| Binary Channel Bits Per Sub-Frame            |   |                |                |             |                |                |                |                |              |
| For Sub-Frames 4,9 (non CSI-RS subframe)     | Bits  | 36000          | 12000          | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frames 4,9 (CSI-RS subframe)         | Bits  | 33600          | 11600          | 89600       | 40000          | 44800          | 22400          | 22400          | 64000        |
| For Sub-Frames 1,6                           |   | 23616          | 7872           | 67584       | 27552          | 32352          | 15744          | 15744          | 44280        |
| For Sub-Frame 5                              | Bits  | N/A            | N/A            | N/A         | N/A            | N/A            | N/A            | N/A            | N/A          |
| For Sub-Frame 0                              | Bits  | 29520          | 9840           | 84480       | 35424          | 40224          | 19680          | 19680          | 54120        |
| Max. Throughput averaged over 1 frame        | Mbps  | 7.1184         | 2.5896         | 30.669      | 10.628         | 10.628         | 6.1392         | 6.1392         | 21.2728      |
| UE Category                                  |   | ≥ 2            | ≥ 1            | 11-12       | ≥ 5            | ≥ 5            | ≥ 2            | ≥ 2            | TBD          |
| UE DL Category                               |   | ≥ 6            | ≥ 6            | ≥ 11        | ≥ 6            | ≥ 6            | ≥ 6            | ≥ 6            | 20, ≥ 22     |
| Note 1:                                      | 2 symbols allocated to PDCCH. 1 symbol allocated to PDCCH for reference channel with 1024QAM.   |                |                |             |                |                |                |                |              |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].  |                |                |             |                |                |                |                |              |
| Note 3:                                      | as per Table 4.2-2 in TS 36.211 [4].  |                |                |             |                |                |                |                |              |
| Note 4:                                      | For R.44,R.48, R.75 and R.cc, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.66, 100 resource blocks are allocated in sub-frames 4, 9 and 88 resources blockes (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. |                |                |             |                |                |                |                |              |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |                |                |             |                |                |                |                |              |

The reference measurement channels in Table A.3.4.3.4-2 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-2: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |                 |                 |
|--|--|-----------------|-----------------|-----------------|
|  |  | R.60 TDD        | R.61 TDD        | R.61-1 TDD      |
| Reference channel                            |  | R.60 TDD        | R.61 TDD        | R.61-1 TDD      |
| Channel bandwidth                            | MHz  | 10              | 10              | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> | 50 <sup>4</sup> | 39 <sup>5</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               | 1               | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2             | 4+2             | 4+2             |
| Allocated subframes per Radio Frame          |  | 10              | 10              | 10              |
| Modulation                                   |  | QPSK            | 16QAM           | 16QAM           |
| Target Coding Rate                           |  | 1/2             | 1/2             | 1/2             |
| Information Bit Payload                      |  |                 |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 6200            | 11448           | 8760            |
| For Sub-Frames 1,6                           | Bits   | N/A             | 7736            | 7480            |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | N/A             | 9528            | 8760            |
| Number of Code Blocks per Sub-Frame (Note 6) |  |                 |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 2               | 2               | 2               |
| For Sub-Frames 1,6                           |  | N/A             | 2               | 2               |
| For Sub-Frame 5                              |  | N/A             | N/A             | N/A             |
| For Sub-Frame 0                              |  | N/A             | 2               | 2               |
| Binary Channel Bits Per Sub-Frame            |  |                 |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 11600           | 23200           | 18096           |
| For Sub-Frames 1,6                           | Bits   | N/A             | 15744           | 14976           |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | N/A             | 19680           | 18720           |
| Max. Throughput averaged over 1 frame        | Mbps   | 1.24            | 4.7896          | 4.1240          |
| UE Category                                  |  | ≥ 1             | ≥ 2             | ≥ 1             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |                 |                 |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |                 |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |                 |                 |
| Note 4:                                      | For R. 60 and R.61, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.                                     |                 |                 |                 |
| Note 5:                                      | For R. 61-1, 39 resource blocks (RB0–RB20 and RB30–RB47) are allocated in sub-frame 0, 1, 4, 6 and 9.  |                 |                 |                 |
| Note 6:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |                 |                 |                 |
| Note 7:                                      | Localized allocation started from RB #0 is applied.  |                 |                 |                 |

The reference measurement channels in Table A.3.4.3.4-3 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-3: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter                                 | Unit  | Value    |
|---|---|----------|
| Reference channel                         |   | R.64 TDD |
| Channel bandwidth                         | MHz   | 10       |
| Allocated resource blocks (Note 4)        |   | 6        |
| Uplink-Downlink Configuration (Note 3)    |   | 1        |
| Allocated subframes per Radio Frame (D+S) |   | 4+2      |
| Modulation                                |   | QPSK     |
| Target Coding Rate                        |   | 1/3      |
| Information Bit Payload                   |   |          |
| For Sub-Frames 4,9 (non CSI-RS subframe)  | Bits  | 504      |
| For Sub-Frames 4,9 (CSI-RS subframe)      | Bits  | 504      |
| For Sub-Frames 1,6                        |   | 256      |
| For Sub-Frames 0,5                        | Bits  | 504      |
| Number of Code Blocks per Sub-Frame       |   |          |
| For Sub-Frames 4,9 (non CSI-RS subframe)  | Code blocks   | 1        |
| For Sub-Frames 4,9 (CSI-RS subframe)      | Code blocks   | 1        |
| For Sub-Frames 1,6                        | Code blocks   | 1        |
| For Sub-Frames 0,5                        | Code blocks   | 1        |
| Binary Channel Bits Per Sub-Frame         |   |          |
| For Sub-Frames 4,9 (non CSI-RS subframe)  | Bits  | 1440     |
| For Sub-Frames 4,9 (CSI-RS subframe)      | Bits  | 1352     |
| For Sub-Frames 1,6                        |   | 1152     |
| For Sub-Frames 0,5                        | Bits  | 1440     |
| Max. Throughput averaged over 1 frame     | Mbps  | 0.2528   |
| UE DL Category                            |   | 0        |
| Note 1:                                   | 2 symbols allocated to PDCCH.   |          |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].                          |          |
| Note 3:                                   | as per Table 4.2-2 in TS 36.211 [4].  |          |
| Note 4:                                   | Allocated PRB positions start from {9, 10, ..., 9+N-1}, where N is the number of allocated resource blocks. |          |

The reference measurement channels in Table A.3.4.3.4-4 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-4: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter                                 | Unit | Value       |
|---|------|-------------|
| Reference channel                         |      | R.69 TDD    |
| Channel bandwidth                         | MHz  | 10          |
| Allocated resource blocks                 |      | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3)    |      | 1           |
| Allocated subframes per Radio Frame (D+S) |      | 2+2         |
| Modulation                                |      | QPSK        |
| Target Coding Rate                        |      |             |
| For Sub-Frame 4(CSI-RS subframe)          |      | 0.8         |
| For Sub-Frame 9 (non CSI-RS subframe)     |      | 0.74        |
| For Sub-Frames 1,6                        |      | 0.61        |
| Information Bit Payload                   |      |             |
| For Sub-Frame 4(CSI-RS subframe)          | Bits | 7992        |
| For Sub-Frame 9 (non CSI-RS subframe)     | Bits | 7992        |
| For Sub-Frames 1,6                        | Bits | 4776        |
| For Sub-Frame 5                           | Bits | N/A         |
| For Sub-Frame 0                           | Bits | N/A         |



|  |      |          |
|--|------|----------|
| Number of Code Blocks per Sub-Frame (Note 5)   |      |          |
| For Sub-Frame 4(CSI-RS subframe)   |      | 2        |
| For Sub-Frame 9 (non CSI-RS subframe)  |      | 2        |
| For Sub-Frames 1,6   |      | 1        |
| For Sub-Frame 5  |      | N/A      |
| For Sub-Frame 0  |      | N/A      |
| Binary Channel Bits Per Sub-Frame  |      |          |
| For Sub-Frame 4(CSI-RS subframe)   | Bits | 10000    |
| For Sub-Frame 9 (non CSI-RS subframe)  | Bits | 10800    |
| For Sub-Frames 1,6   | Bits | 7872     |
| For Sub-Frame 5  | Bits | N/A      |
| For Sub-Frame 0  | Bits | N/A      |
| Max. Throughput averaged over 1 frame  | Mbps | 2.5536   |
| UE Category  |      | $\geq 1$ |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: As per Table 4.2-2 in TS 36.211 [4].<br>Note 4: 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in the DwPTS portion of sub-frames 1,6.<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |          |

The reference measurement channels in Table A.3.4.3.4-5 apply for verifying CRI reporting accuracy with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.4-5: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter  | Unit | Value           |
|--|------|-----------------|
| Reference channel  |      | R.44A-1 TDD     |
| Channel bandwidth  | MHz  | 10              |
| Uplink-Downlink Configuration (Note 3)   |      | 2               |
| Allocated resource blocks  |      | 50 <sup>4</sup> |
| Allocated subframes per Radio Frame  |      | 4+2             |
| Modulation   |      | 64QAM           |
| Target Coding Rate   |      | 1/2             |
| Information Bit Payload  |      |                 |
| For Sub-Frames (Non CSI-RS subframe)   | Bits | 18336           |
| For Sub-Frames (CSI-RS subframe)   | Bits | N/A             |
| For Sub-Frame 5  | Bits | N/A             |
| For Sub-Frames 1,6   |      | 11832           |
| For Sub-Frame 0  | Bits | 14688           |
| Number of Code Blocks per Sub-Frame (Note 5)   |      |                 |
| For Sub-Frames (Non CSI-RS subframe)   |      | 3               |
| For Sub-Frames (CSI-RS subframe)   |      | N/A             |
| For Sub-Frame 5  |      | N/A             |
| For Sub-Frames 1,6   |      | 2               |
| For Sub-Frame 0  |      | 3               |
| Binary Channel Bits Per Sub-Frame  |      |                 |
| For Sub-Frames (Non CSI-RS subframe)   | Bits | 36000           |
| For Sub-Frames (CSI-RS subframe)   | Bits | N/A             |
| For Sub-Frame 5  | Bits | N/A             |
| For Sub-Frames 1,6   | Bits | 23616           |
| For Sub-Frame 0  | Bits | 29520           |
| Max. Throughput averaged over 1 frame  | Mbps | 9.336           |
| UE Category  |      | $\geq 2$        |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: As per Table 4.2-2 in TS 36.211 [4]. |      |                 |

|         |   |
|---------|---|
| Note 4: | For R.44A-1, 50 resource blocks are allocated in sub-frames 3, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and and the DwPTS portion of sub-frames 1,6. |
| Note 5: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  |

The reference measurement channels in Table A.3.4.3.4-6 apply with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-6: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter                                 | Unit   | Value       |             |
|---|--|-------------|-------------|
|   |  | R.98 TDD    | R.99 TDD    |
| Reference channel                         |  | R.98 TDD    | R.99 TDD    |
| Channel bandwidth                         | MHz  | 10          | 10          |
| Allocated resource blocks                 |  | 50 (Note 5) | 50 (Note 5) |
| Uplink-Downlink Configuration (Note 3)    |  | 1           | 1           |
| Allocated subframes per Radio Frame (D+S) |  | 3+2         | 3+2         |
| Modulation                                |  | 16QAM       | 16QAM       |
| Target Coding Rate                        |  | 1/2         | 1/2         |
| Information Bit Payload                   |  |             |             |
| For Sub-Frame 4,9                         | Bits   | 22920       | 11448       |
| For Sub-Frames 1,6                        | Bits   | 14112       | 6712        |
| For Sub-Frame 5                           | Bits   | n/a         | n/a         |
| For Sub-Frame 0                           | Bits   | 19080       | 9528        |
| Number of Code Blocks (Note 4)            |  |             |             |
| For Sub-Frames 4,9                        | Code blocks  | 4           | 2           |
| For Sub-Frames 1,6                        | Code blocks  | 3           | 2           |
| For Sub-Frame 5                           |  | n/a         | n/a         |
| For Sub-Frame 0                           | Code blocks  | 4           | 2           |
| Binary Channel Bits                       |  |             |             |
| For Sub-Frames 4,9                        |  | 38400       | 19200       |
| For Sub-Frames 1,6                        |  | 27552       | 13776       |
| For Sub-Frame 5                           | Bits   | n/a         | n/a         |
| For Sub-Frame 0                           | Bits   | 35424       | 17712       |
| Max. Throughput averaged over 1 frame     | Mbps   | 9.3144      | 4.5848      |
| UE Category                               |  | ≥ 2         | ≥ 2         |
| Note 1:                                   | 2 symbols allocated to PDCCH.  |             |             |
| Note 2:                                   | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |             |             |
| Note 3:                                   | as per Table 4.2-2 in TS 36.211 [4].   |             |             |
| Note 4:                                   | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                    |             |             |
| Note 5:                                   | 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1, 6. |             |             |

The reference measurement channels in Table A.3.4.3.4-7 apply with four CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-7: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter | Unit | Value |
|-----------|------|-------|
|-----------|------|-------|

|   |             |             |
|---|-------------|-------------|
| Reference channel   |             | R.100 TDD   |
| Channel bandwidth   | MHz         | 10          |
| Allocated resource blocks   |             | 50 (Note 5) |
| Uplink-Downlink Configuration (Note 3)  |             | 1           |
| Allocated subframes per Radio Frame (D+S)   |             | 3+2         |
| Modulation  |             | 16QAM       |
| Target Coding Rate  |             | 1/2         |
| Information Bit Payload   |             |             |
| For Sub-Frame 4,9   | Bits        | 22920       |
| For Sub-Frames 1,6  | Bits        | 14112       |
| For Sub-Frame 5   | Bits        | n/a         |
| For Sub-Frame 0   | Bits        | 19080       |
| Number of Code Blocks (Note 4)  |             |             |
| For Sub-Frames 4,9  | Code blocks | 4           |
| For Sub-Frames 1,6  | Code blocks | 3           |
| For Sub-Frame 5   |             | n/a         |
| For Sub-Frame 0   | Code blocks | 4           |
| Binary Channel Bits   |             |             |
| For Sub-Frames 4,9  |             | 36800       |
| For Sub-Frames 1,6  |             | 26240       |
| For Sub-Frame 5   | Bits        | n/a         |
| For Sub-Frame 0   | Bits        | 34112       |
| Max. Throughput averaged over 1 frame   | Mbps        | 9.3144      |
| UE Category   |             | ≥ 2         |
| <p>Note 1: 2 symbols allocated to PDCCH.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: as per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 5: 50 resource blocks are allocated in sub-frames 4, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1, 6.</p> |             |             |

## A.3.4.3.5 Eight antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.5-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and eight CSI-RS antenna ports.

**Table A.3.4.3.5-1: Fixed Reference Channel for CDM-multiplexed DM RS with eight CSI-RS antenna ports**

| Parameter                                    | Unit | Value       |             |             |             |             |             |              |
|--|------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
|  |      | R.50 TDD    | R.50-1 TDD  | R.50-2 TDD  | R.50-3 TDD  | R.50-4 TDD  | R.50-5 TDD  | R.50-6 TDD   |
| Reference channel                            |      | R.50 TDD    | R.50-1 TDD  | R.50-2 TDD  | R.50-3 TDD  | R.50-4 TDD  | R.50-5 TDD  | R.50-6 TDD   |
| Channel bandwidth                            | MHz  | 10          | 10          | 10          | 5           | 10          | 15          | 20           |
| Allocated resource blocks                    |      | 50 (Note 4) | 50 (Note 4) | 50 (Note 6) | 25 (Note 7) | 50 (Note 4) | 75 (Note 8) | 100 (Note 9) |
| Uplink-Downlink Configuration (Note 3)       |      | 1           | 1           | 1           | 1           | 1           | 1           | 1            |
| Allocated subframes per Radio Frame (D+S)    |      | 3+2         | 3+2         | 3+2         | 3+2         | 3+2         | 3+2         | 3+2          |
| Modulation                                   |      | QPSK        | QPSK        | QPSK        | 16QAM       | 16QAM       | 16QAM       | 16QAM        |
| Target Coding Rate                           |      | 1/3         | 1/3         | 1/3         | 1/2         | 1/2         | 1/2         | 1/2          |
| Information Bit Payload                      |      |             |             |             |             |             |             |              |
| For Sub-Frames 4,9 (non CSI-RS subframe)     | Bits | 3624        | 3624        | 3624        | N/A         | N/A         | N/A         | N/A          |
| For Sub-Frames 4,9 (CSI-RS subframe)         | Bits | 3624        | 3624        | 3624        | 17568       | 39232       | 61664       | 78704        |
| For Sub-Frames 1,6                           |      | 2664        | 2664        | 3112        | 12216       | 26416       | 42368       | 61664        |
| For Sub-Frame 5                              | Bits | N/A         | N/A         | N/A         | N/A         | N/A         | N/A         | N/A          |
| For Sub-Frame 0                              | Bits | 2984        | 2984        | 3368        | 13536       | 37888       | 57336       | 78704        |
| Number of Code Blocks per Sub-Frame (Note 5) |      |             |             |             |             |             |             |              |
| For Sub-Frames 4,9 (non CSI-RS subframe)     |      | 1           | 1           | 1           | N/A         | N/A         | N/A         | N/A          |

|  |      |       |       |       |                                   |                                   |                                   |                                   |
|--|------|-------|-------|-------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| For Sub-Frames 4,9 (CSI-RS subframe)     |      | 1     | 1     | 1     | 3                                 | 7                                 | 11                                | 13                                |
| For Sub-Frames 1,6                       |      | 1     | 1     | 1     | 2                                 | 5                                 | 7                                 | 11                                |
| For Sub-Frame 5                          |      | N/A   | N/A   | N/A   | N/A                               | N/A                               | N/A                               | N/A                               |
| For Sub-Frame 0                          |      | 1     | 1     | 1     | 3                                 | 7                                 | 10                                | 13                                |
| Binary Channel Bits Per Sub-Frame        |      |       |       |       |                                   |                                   |                                   |                                   |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 12000 | 13200 | 13200 | N/A                               | N/A                               | N/A                               | N/A                               |
| For Sub-Frames 4,9 (CSI-RS subframe)     | Bits | 10400 | 11600 | 11600 | 33600                             | 76800                             | 115200                            | 153600                            |
| For Sub-Frames 1,6                       |      | 7872  | 7872  | 8448  | 22848                             | 55104                             | 84672                             | 118272                            |
| For Sub-Frame 5                          | Bits | N/A   | N/A   | N/A   | N/A                               | N/A                               | N/A                               | N/A                               |
| For Sub-Frame 0                          | Bits | 9840  | 9840  | 10560 | 26112                             | 70848                             | 108864                            | 152064                            |
| Max. Throughput averaged over 1 frame    | Mbps | 1.556 | 1.556 | 1.684 | 7.3104                            | 16.9184                           | 26.54                             | 35.944                            |
| UE Category                              |      | ≥ 1   | ≥ 1   | ≥ 1   | 8                                 | 8                                 | 8                                 | 8                                 |
| UE DL Category                           |      |       |       |       | 14,<br>17,18,19,20,22,23,24,25,26 | 14,<br>17,18,19,20,22,23,24,25,26 | 14,<br>17,18,19,20,22,23,24,25,26 | 14,<br>17,18,19,20,22,23,24,25,26 |

Note 1: 2 symbols allocated to PDCCH.

Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].

Note 3: as per Table 4.2-2 in TS 36.211 [4].

Note 4: 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.

Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 6: 50 resource blocks are allocated in sub-frames 4,9 and 47 resource blocks (RB0–RB23 and RB27–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. In sub-frame 0 and the DwPTS portion of sub-frames 1, 6, PDSCH is rate matched around RB22, RB23 and RB27.

Note 7: 25 resource blocks are allocated in sub-frames 4,9 and 17 resource blocks (RB0–RB9 and RB18–RB24) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.

Note 8: 75 resource blocks are allocated in sub-frames 4,9 and 63 resource blocks (RB0–R31 and RB44–RB74) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.

Note 9: 100 resource blocks are allocated in sub-frames 4,9 and 88 resource blocks (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.

Note 10: Given per component carrier per codeword.

The reference measurement channels in Table A.3.4.3.5-2 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and eight CSI-RS antenna ports.

**Table A.3.4.3.5-2: Fixed Reference Channel for eight antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |               |                 |                 |
|--|--|-----------------|---------------|-----------------|-----------------|
|  |  | R.45<br>TDD     | R.45-1<br>TDD | R.45-2<br>TDD   | R.45A<br>TDD    |
| Reference channel                            |  |                 |               |                 |                 |
| Channel bandwidth                            | MHz  | 10              | 10            | 10              | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> | 39            | 50 <sup>4</sup> | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               | 1             | 1               | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2             | 4+2           | 4+2             | 4+2             |
| Allocated subframes per Radio Frame          |  | 5               | 5             | 10              | 5               |
| Modulation                                   |  | 16QAM           | 16QAM         | 64QAM           | 16QAM           |
| Target Coding Rate                           |  | 1/2             | 1/2           |                 | 1/2             |
| Information Bit Payload                      |  |                 |               |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A           | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 11448           | 8760          | [18336]         | 11448           |
| For Sub-Frames 1,6                           | Bits   | 7736            | 7480          | [11832]         | 7736            |
| For Sub-Frame 5                              | Bits   | N/A             | N/A           | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | 9528            | 8760          | [14688]         | 9528            |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |               |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             | N/A           | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 2               | 2             |                 | 2               |
| For Sub-Frames 1,6                           |  | 2               | 2             |                 | 2               |
| For Sub-Frame 5                              |  | N/A             | N/A           |                 | N/A             |
| For Sub-Frame 0                              |  | 2               | 2             |                 | 2               |
| Binary Channel Bits Per Sub-Frame            |  |                 |               |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A           |                 | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 22400           | 17472         | [33600]         | 23200           |
| For Sub-Frames 1,6                           | Bits   | 15744           | 14976         | [23616]         | 15744           |
| For Sub-Frame 5                              | Bits   | N/A             | N/A           | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | 19680           | 18720         | [29520]         | 19680           |
| Max. Throughput averaged over 1 frame        | Mbps   | 4.7896          | 4.1240        | 7.3296          | 4.7896          |
| UE Category                                  |  | ≥ 2             | ≥ 1           | ≥ 2             | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.   |                 |               |                 |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |               |                 |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |               |                 |                 |
| Note 4:                                      | For R.45 and R.45-2, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.45-1, 39 resource blocks are allocated in sub-frames 0,4,9 and the DwPTS portion of sub-frames 1,6 (RB0–RB20 and RB30–RB47). |                 |               |                 |                 |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |                 |               |                 |                 |
| Note 6:                                      | Localized allocation started from RB #0 is applied.  |                 |               |                 |                 |

The reference measurement channels in Table A.3.4.3.5-3 apply for verifying CRI reporting accuracy with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.5-3: Fixed Reference Channel for eight antenna ports (CSI-RS)**

| Parameter                              | Unit | Value          |                |
|--|------|----------------|----------------|
|  |      | R.44A-2<br>TDD | R.44A-3<br>TDD |
| Reference channel                      |      |                |                |
| Channel bandwidth                      | MHz  | 10             | 10             |
| Uplink-Downlink Configuration (Note 3) |      | 2              | 2              |

|  |  |                 |                 |
|--|--|-----------------|-----------------|
| Allocated resource blocks                    |  | 50 <sup>4</sup> | 50 <sup>4</sup> |
| Allocated subframes per Radio Frame          |  | 4+2             | 3+2             |
| Modulation                                   |  | 64QAM           | 64QAM           |
| Target Coding Rate                           |  | 1/2             | 1/2             |
| Information Bit Payload                      |  |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         | Bits   | 18336           | 18336           |
| For Sub-Frames (CSI-RS subframe)             | Bits   | N/A             | N/A             |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             |
| For Sub-Frames 1,6                           |  | 11832           | 11832           |
| For Sub-Frame 0                              | Bits   | 14688           | 14688           |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         |  | 3               | 3               |
| For Sub-Frames (CSI-RS subframe)             |  | N/A             | N/A             |
| For Sub-Frame 5                              |  | N/A             | N/A             |
| For Sub-Frames 1,6                           |  | 2               | 2               |
| For Sub-Frame 0                              |  | 3               | 3               |
| Binary Channel Bits Per Sub-Frame            |  |                 |                 |
| For Sub-Frames (Non CSI-RS subframe)         | Bits   | 36000           | 36000           |
| For Sub-Frames (CSI-RS subframe)             | Bits   | N/A             | N/A             |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             |
| For Sub-Frames 1,6                           | Bits   | 23616           | 23616           |
| For Sub-Frame 0                              | Bits   | 29520           | 29520           |
| Max. Throughput averaged over 1 frame        | Mbps   | 9.336           | 7.5024          |
| UE Category                                  |  | ≥ 2             | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz  |                 |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |                 |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |                 |
| Note 4:                                      | For R.44A-2, 50 resource blocks are allocated in sub-frames 3, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and and the DwPTS portion of sub-frames 1,6. For R.44A-3, 50 resource blocks are allocated in sub-frames 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and and the DwPTS portion of sub-frames 1,6. |                 |                 |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)   |                 |                 |

Table A.3.4.3.5-4: Fixed Reference Channel for eight antenna ports (CSI-RS)

| Parameter                                    | Unit | Value          |
|--|------|----------------|
| Reference channel                            |      | R.108 TDD      |
| Channel bandwidth                            | MHz  | 10             |
| Uplink-Downlink Configuration (Note 3)       |      | 2              |
| Allocated resource blocks                    |      | 4 <sup>4</sup> |
| Allocated subframes per Radio Frame          |      | 4              |
| Modulation                                   |      | QPSK           |
| Target Coding Rate                           |      | 1/2            |
| Information Bit Payload                      |      |                |
| For Sub-Frames 0,5 (Non CSI-RS subframe)     | Bits | 472            |
| For Sub-Frames 4,9 (CSI-RS subframe)         | Bits | 472            |
| For Sub-Frames 1,6                           |      | N/A            |
| Number of Code Blocks per Sub-Frame (Note 5) |      |                |
| For Sub-Frames 0,5 (Non CSI-RS subframe)     |      | 1              |
| For Sub-Frames 4,9 (CSI-RS subframe)         |      | 1              |
| For Sub-Frames 1,6                           |      | N/A            |
| Binary Channel Bits Per Sub-Frame            |      |                |
| For Sub-Frames 0,5 (Non CSI-RS subframe)     | Bits | 960            |
| For Sub-Frames 4,9 (CSI-RS subframe)         | Bits | 896            |
| For Sub-Frames 1,6                           |      | N/A            |
| Max. Throughput averaged over 1 frame        | Mbps | 0.1888         |
| UE Category                                  |      | ≥ 1            |

|         |  |
|---------|--|
| Note 1: | 2 symbols allocated to PDCCH.  |
| Note 2: | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]  |
| Note 3: | As per Table 4.2-2 in TS 36.211 [4].   |
| Note 4: | Allocated PRB positions for PDSCH are {2, 3, 4, 5} within the assigned narrowband. Allocated PRB positions for MPDCCH are {0, 1} within the assigned narrowband. |
| Note 5: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)                           |

### A.3.4.3.6 Twelve antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.6-1 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and twelve CSI-RS antenna ports.

**Table A.3.4.3.6-1: Fixed Reference Channel for twelve antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |
|--|--|-----------------|
| Reference channel                            |  | R.77 TDD        |
| Channel bandwidth                            | MHz  | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 3+2             |
| Allocated subframes per Radio Frame          |  | 10              |
| Modulation                                   |  | 64QAM           |
| Target Coding Rate                           |  | 1/2             |
| Information Bit Payload                      |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 16416           |
| For Sub-Frames 1,6                           | Bits   | 11832           |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 14688           |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 3               |
| For Sub-Frames 1,6                           |  | 2               |
| For Sub-Frame 5                              |  | N/A             |
| For Sub-Frame 0                              |  | 3               |
| Binary Channel Bits Per Sub-Frame            |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 32400           |
| For Sub-Frames 1,6                           | Bits   | 23616           |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 29520           |
| Max. Throughput averaged over 1 frame        | Mbps   | 7.1184          |
| UE Category                                  |  | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |



|         |  |
|---------|--|
| Note 4: | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. |
| Note 5: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                  |
| Note 6: | Localized allocation started from RB #0 is applied.  |

### A.3.4.3.7 Sixteen antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.7-1 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and sixteen CSI-RS antenna ports.

**Table A.3.4.3.7-1: Fixed Reference Channel for sixteen antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |
|--|--|-----------------|
| Reference channel                            |  | R.78 TDD        |
| Channel bandwidth                            | MHz  | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 3+2             |
| Allocated subframes per Radio Frame          |  | 10              |
| Modulation                                   |  | 16QAM           |
| Target Coding Rate                           |  | 1/2             |
| Information Bit Payload                      |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 9912            |
| For Sub-Frames 1,6                           | Bits   | 7736            |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 9528            |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 2               |
| For Sub-Frames 1,6                           |  | 2               |
| For Sub-Frame 5                              |  | N/A             |
| For Sub-Frame 0                              |  | 2               |
| Binary Channel Bits Per Sub-Frame            |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 20800           |
| For Sub-Frames 1,6                           | Bits   | 15744           |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 19680           |
| Max. Throughput averaged over 1 frame        | Mbps   | 4.4824          |
| UE Category                                  |  | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |
| Note 4:                                      | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |                 |

|         |   |
|---------|---|
| Note 5: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |
| Note 6: | Localized allocation started from RB #0 is applied.   |

### A.3.4.3.8 Twenty-four antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.8-1 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and twenty-four CSI-RS antenna ports.

**Table A.3.4.3.8-1: Fixed Reference Channel for twenty-four antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |                 |
|--|--|-----------------|-----------------|
|  |  | R.88 TDD        | R.88A TDD       |
| Reference channel                            |  | R.88 TDD        | R.88A TDD       |
| Channel bandwidth                            | MHz  | 10              | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 3+2             | 3+2             |
| Allocated subframes per Radio Frame          |  | 10              | 10              |
| Modulation                                   |  | 16QAM           | 16QAM           |
| Target Coding Rate                           |  | 1/2             | 1/2             |
| Information Bit Payload                      |  |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 9912            | 11448           |
| For Sub-Frames 1,6                           | Bits   | 7736            | 7736            |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | 9528            | 9528            |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 2               | 2               |
| For Sub-Frames 1,6                           |  | 2               | 2               |
| For Sub-Frame 5                              |  | N/A             | N/A             |
| For Sub-Frame 0                              |  | 2               | 2               |
| Binary Channel Bits Per Sub-Frame            |  |                 |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 19200           | 22400           |
| For Sub-Frames 1,6                           | Bits   | 15744           | 15744           |
| For Sub-Frame 5                              | Bits   | N/A             | N/A             |
| For Sub-Frame 0                              | Bits   | 19680           | 19680           |
| Max. Throughput averaged over 1 frame        | Mbps   | 4.4824          | 4.7896          |
| UE Category                                  |  | ≥ 2             | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |                 |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |                 |
| Note 4:                                      | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |                 |                 |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |                 |                 |
| Note 6:                                      | Localized allocation started from RB #0 is applied.  |                 |                 |

### A.3.4.3.9 Thirty-two antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.9-1 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and thirty-two CSI-RS antenna ports.

**Table A.3.4.3.9-1: Fixed Reference Channel for thirty-two antenna ports (CSI-RS)**

| Parameter                                    | Unit   | Value           |
|--|--|-----------------|
| Reference channel                            |  | R.89 TDD        |
| Channel bandwidth                            | MHz  | 10              |
| Allocated resource blocks                    |  | 50 <sup>4</sup> |
| Uplink-Downlink Configuration (Note 3)       |  | 1               |
| Allocated subframes per Radio Frame (D+S)    |  | 3+2             |
| Allocated subframes per Radio Frame          |  | 10              |
| Modulation                                   |  | 64QAM           |
| Target Coding Rate                           |  | 1/2             |
| Information Bit Payload                      |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 15264           |
| For Sub-Frames 1,6                           | Bits   | 11832           |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 14688           |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) |  | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     |  | 3               |
| For Sub-Frames 1,6                           |  | 2               |
| For Sub-Frame 5                              |  | N/A             |
| For Sub-Frame 0                              |  | 3               |
| Binary Channel Bits Per Sub-Frame            |  |                 |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits   | N/A             |
| For Sub-Frames 4 and 9 (CSI-RS subframe)     | Bits   | 26400           |
| For Sub-Frames 1,6                           | Bits   | 23616           |
| For Sub-Frame 5                              | Bits   | N/A             |
| For Sub-Frame 0                              | Bits   | 29520           |
| Max. Throughput averaged over 1 frame        | Mbps   | 6.888           |
| UE Category                                  |  | ≥ 2             |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. |                 |
| Note 2:                                      | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                 |
| Note 3:                                      | As per Table 4.2-2 in TS 36.211 [4].   |                 |
| Note 4:                                      | 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.   |                 |
| Note 5:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |                 |
| Note 6:                                      | Localized allocation started from RB #0 is applied.  |                 |

## A.3.5 Reference measurement channels for PDCCH/PCFICH performance requirements

### A.3.5.1 FDD

**Table A.3.5.1-1: Reference Channel FDD**

| Parameter                        | Unit    | Value           |                   |                   |                 |                   |                   |                   |                   |                 |                   |                   |                   |
|----------------------------------|---------|-----------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|
|                                  |         | R.1<br>5<br>FDD | R.15<br>-1<br>FDD | R.15<br>-2<br>FDD | R.1<br>6<br>FDD | R.16<br>-1<br>FDD | R.16<br>-2<br>FDD | R.16<br>-3<br>FDD | R.16<br>-4<br>FDD | R.1<br>7<br>FDD | R.17<br>-1<br>FDD | R.17<br>-2<br>FDD | R.17<br>-3<br>FDD |
| Reference channel                |         |                 |                   |                   |                 |                   |                   |                   |                   |                 |                   |                   |                   |
| Number of transmitter antennas   |         | 1               | 2                 | 2                 | 2               | 2                 | 2                 | 2                 | 2                 | 4               | 4                 | 4                 | 4                 |
| Channel bandwidth                | MHz     | 10              | 10                | 10                | 10              | 10                | 10                | 10                | 10                | 5               | 10                | 10                | 10                |
| Number of OFDM symbols for PDCCH | symbols | 2               | 3                 | 2                 | 2               | 3                 | 3                 | 1                 | 1                 | 2               | 2                 | 2                 | 2                 |
| Aggregation level                | CCE     | 8               | 8                 | 8                 | 4               | 2                 | 4                 | 2                 | 4                 | 2               | 2                 | 1                 | 4                 |
| DCI Format                       |         | 1               | 1                 | 1                 | 2               | 2                 | 2                 | 2                 | 2                 | 2               | 2                 | 2                 | 2                 |
| Cell ID                          |         | 0               | 0                 | 0                 | 0               | 0                 | 0                 | 0                 | 0                 | 0               | 0                 | 0                 | 0                 |
| Payload (without CRC)            | Bits    | 31              | 31                | 31                | 43              | 43                | 43                | 43                | 43                | 42              | 46                | 46                | 46                |

**Table A.3.5.1-2: Void**

### A.3.5.2 TDD

**Table A.3.5.2-1: Reference Channel TDD**

| Parameter                        | Unit    | Value           |                   |                   |                 |                   |                   |                   |                   |                 |                   |                   |                   |
|----------------------------------|---------|-----------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|
|                                  |         | R.1<br>5<br>TDD | R.15<br>-1<br>TDD | R.15<br>-2<br>TDD | R.1<br>6<br>TDD | R.16<br>-1<br>TDD | R.16<br>-2<br>TDD | R.16<br>-3<br>TDD | R.16<br>-4<br>TDD | R.1<br>7<br>TDD | R.17<br>-1<br>TDD | R.17<br>-2<br>TDD | R.17<br>-3<br>TDD |
| Reference channel                |         |                 |                   |                   |                 |                   |                   |                   |                   |                 |                   |                   |                   |
| Number of transmitter antennas   |         | 1               | 2                 | 2                 | 2               | 2                 | 2                 | 2                 | 2                 | 4               | 4                 | 4                 | 4                 |
| Channel bandwidth                | MHz     | 10              | 10                | 10                | 10              | 10                | 10                | 10                | 10                | 5               | 10                | 10                | 10                |
| Number of OFDM symbols for PDCCH | symbols | 2               | 3                 | 2                 | 2               | 3                 | 3                 | 1                 | 1                 | 2               | 2                 | 2                 | 2                 |
| Aggregation level                | CCE     | 8               | 8                 | 8                 | 4               | 2                 | 4                 | 2                 | 4                 | 2               | 2                 | 1                 | 4                 |
| DCI Format                       |         | 1               | 1                 | 1                 | 2               | 2                 | 2                 | 2                 | 2                 | 2               | 2                 | 2                 | 2                 |
| Cell ID                          |         | 0               | 0                 | 0                 | 0               | 0                 | 0                 | 0                 | 0                 | 0               | 0                 | 0                 | 0                 |
| Payload (without CRC)            | Bits    | 34              | 34                | 34                | 46              | 46                | 46                | 46                | 46                | 45              | 49                | 49                | 49                |

**Table A.3.5.2-2: Void**

### A.3.5.3 LAA

**Table A.3.5.3-1: Reference Channel for FS3 with FDD primary cell**

| Parameter                        | Unit    | Value     |
|----------------------------------|---------|-----------|
| Reference channel                |         | R.3 FS3   |
| Number of transmitter antennas   |         | 2         |
| Channel bandwidth                | MHz     | 20        |
| Number of OFDM symbols for PDCCH | symbols | 2         |
| Aggregation level                | CCE     | 4         |
| DCI Format                       |         | Format 2A |
| Cell ID                          |         | 0         |
| Payload (without CRC)            | Bits    | 48        |

**Table A.3.5.3-2: Reference Channel for FS3 with TDD primary cell**

| Parameter                        | Unit    | Value     |
|----------------------------------|---------|-----------|
| Reference channel                |         | R.4 FS3   |
| Number of transmitter antennas   |         | 2         |
| Channel bandwidth                | MHz     | 20        |
| Number of OFDM symbols for PDCCH | symbols | 2         |
| Aggregation level                | CCE     | 4         |
| DCI Format                       |         | Format 2A |
| Cell ID                          |         | 0         |
| Payload (without CRC)            | Bits    | 51        |

## A.3.6 Reference measurement channels for PHICH performance requirements

**Table A.3.6-1: Reference Channel FDD/TDD**

| Parameter  | Unit | Value                |                      |                      |                      |             |
|--|------|----------------------|----------------------|----------------------|----------------------|-------------|
|  |      | R.18                 | R.19                 | R.19-1               | R.20                 | R.24        |
| Reference channel  |      | R.18                 | R.19                 | R.19-1               | R.20                 | R.24        |
| Number of transmitter antennas   |      | 1                    | 2                    | 2                    | 4                    | 1           |
| Channel bandwidth  | MHz  | 10                   | 10                   | 5                    | 5                    | 10          |
| User roles (Note 1)  |      | W I1 I2              | W I1 I2              | W I1 I2              | W I1 I2              | W I1        |
| Resource allocation (Note 2)   |      | (0,0) (0,1)<br>(0,4) | (0,0) (0,1)<br>(0,4) | (0,0) (0,1)<br>(0,4) | (0,0) (0,1)<br>(0,4) | (0,0) (0,1) |
| Power offsets (Note 3)   | dB   | -4 0 -3              | -4 0 -3              | -4 0 -3              | -4 0 -3              | +3 0        |
| Payload (Note 4)   |      | A R R                | A R R                | A R R                | A R R                | A R         |
| Note 1: W=wanted user, I1=interfering user 1, I2=interfering user 2.<br>Note 2: The resource allocation per user is given as (N_group_PHICH, N_seq_PHICH).<br>Note 3: The power offsets (per user) represent the difference of the power of BPSK modulated symbol per PHICH relative to the first interfering user.<br>Note 4: A=fixed ACK, R=random ACK/NACK. |      |                      |                      |                      |                      |             |

## A.3.7 Reference measurement channels for PBCH performance requirements

**Table A.3.7-1: Reference Channel FDD/TDD**

| Parameter                      | Unit | Value |      |      |        |
|--------------------------------|------|-------|------|------|--------|
|                                |      | R.21  | R.22 | R.23 | R.23-1 |
| Reference channel              |      | R.21  | R.22 | R.23 | R.23-1 |
| Number of transmitter antennas |      | 1     | 2    | 4    | 1      |
| Channel bandwidth              | MHz  | 1.4   | 1.4  | 1.4  | 1.4    |

|                       |      |         |         |         |         |
|-----------------------|------|---------|---------|---------|---------|
| Modulation            |      | QPSK    | QPSK    | QPSK    | QPSK    |
| Target coding rate    |      | 40/1920 | 40/1920 | 40/1920 | 40/4416 |
| Payload (without CRC) | Bits | 24      | 24      | 24      | 24      |

## A.3.8 Reference measurement channels for MBMS performance requirements

### A.3.8.1 FDD

**Table A.3.8.1-1: Fixed Reference Channel QPSK R=1/3**

| Parameter                                    | PMCH  |          |   |   |          |    |    |
|--|---|----------|---|---|----------|----|----|
|  | Unit  | Value    |   |   |          |    |    |
| Reference channel                            |   | R.40 FDD |   |   | R.37 FDD |    |    |
| Channel bandwidth                            | MHz   | 1.4      | 3 | 5 | 10       | 15 | 20 |
| Allocated resource blocks                    |   | 6        |   |   | 50       |    |    |
| Allocated subframes per Radio Frame (Note 1) |   | 6        |   |   | 6        |    |    |
| Modulation                                   |   | QPSK     |   |   | QPSK     |    |    |
| Target Coding Rate                           |   | 1/3      |   |   | 1/3      |    |    |
| Information Bit Payload (Note 2)             |   |          |   |   |          |    |    |
| For Sub-Frames 1,2,3,6,7,8                   | Bits  | 408      |   |   | 3624     |    |    |
| For Sub-Frames 0,4,5,9                       | Bits  | N/A      |   |   | N/A      |    |    |
| Number of Code Blocks per Subframe (Note 3)  |   | 1        |   |   | 1        |    |    |
| Binary Channel Bits Per Subframe             |   |          |   |   |          |    |    |
| For Sub-Frames 1,2,3,6,7,8                   | Bits  | 1224     |   |   | 10200    |    |    |
| For Sub-Frames 0,4,5,9                       | Bits  | N/A      |   |   | N/A      |    |    |
| MBMS UE Category                             |   | ≥ 1      |   |   | ≥ 1      |    |    |
| Note 1:                                      | For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331.  |          |   |   |          |    |    |
| Note 2:                                      | 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211.   |          |   |   |          |    |    |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |          |   |   |          |    |    |

**Table A.3.8.1-2: Fixed Reference Channel 16QAM R=1/2**

| Parameter                                    | PMCH  |       |   |   |          |    |    |
|--|---|-------|---|---|----------|----|----|
|  | Unit  | Value |   |   |          |    |    |
| Reference channel                            |   |       |   |   | R.38 FDD |    |    |
| Channel bandwidth                            | MHz   | 1.4   | 3 | 5 | 10       | 15 | 20 |
| Allocated resource blocks                    |   |       |   |   | 50       |    |    |
| Allocated subframes per Radio Frame (Note 1) |   |       |   |   | 6        |    |    |
| Modulation                                   |   |       |   |   | 16QAM    |    |    |
| Target Coding Rate                           |   |       |   |   | 1/2      |    |    |
| Information Bit Payload (Note 2)             |   |       |   |   |          |    |    |
| For Sub-Frames 1,2,3,6,7,8                   | Bits  |       |   |   | 9912     |    |    |
| For Sub-Frames 0,4,5,9                       | Bits  |       |   |   | N/A      |    |    |
| Number of Code Blocks per Subframe (Note 3)  |   |       |   |   | 2        |    |    |
| Binary Channel Bits Per Subframe             |   |       |   |   |          |    |    |
| For Sub-Frames 1,2,3,6,7,8                   | Bits  |       |   |   | 20400    |    |    |
| For Sub-Frames 0,4,5,9                       | Bits  |       |   |   | N/A      |    |    |
| MBMS UE Category                             |   |       |   |   | ≥ 1      |    |    |
| Note 1:                                      | For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331.  |       |   |   |          |    |    |
| Note 2:                                      | 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211.   |       |   |   |          |    |    |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |       |   |   |          |    |    |

**Table A.3.8.1-3: Fixed Reference Channel 64QAM R=2/3**

| Parameter  | PMCH |       |   |            |          |    |    |
|--|------|-------|---|------------|----------|----|----|
|  | Unit | Value |   |            |          |    |    |
| Reference channel  |      |       |   | R.39-1 FDD | R.39 FDD |    |    |
| Channel bandwidth  | MHz  | 1.4   | 3 | 5          | 10       | 15 | 20 |
| Allocated resource blocks  |      |       |   | 25         | 50       |    |    |
| Allocated subframes per Radio Frame(Note1)   |      |       |   | 6          | 6        |    |    |
| Modulation   |      |       |   | 64QAM      | 64QAM    |    |    |
| Target Coding Rate   |      |       |   | 2/3        | 2/3      |    |    |
| Information Bit Payload (Note 2)   |      |       |   |            |          |    |    |
| For Sub-Frames 1,2,3,6,7,8   | Bits |       |   | 9912       | 19848    |    |    |
| For Sub-Frames 0,4,5,9   | Bits |       |   | N/A        | N/A      |    |    |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |       |   | 2          | 4        |    |    |
| Binary Channel Bits Per Subframe   |      |       |   |            |          |    |    |
| For Sub-Frames 1,2,3,6,7,8   | Bits |       |   | 15300      | 30600    |    |    |
| For Sub-Frames 0,4,5,9   | Bits |       |   | N/A        | N/A      |    |    |
| MBMS UE Category   |      |       |   | ≥ 1        | ≥ 2      |    |    |
| Note 1: For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |   |            |          |    |    |

**Table A.3.8.1-4: Fixed Reference Channel for subcarrier spacing 1.25kHz with FeMBMS MBMS/Unicast-mixed cell**

| Parameter   | PMCH |       |            |            |  |  |  |
|---|------|-------|------------|------------|--|--|--|
|   | Unit | Value |            |            |  |  |  |
| Reference channel   |      |       | R.81-1 FDD | R.81-2 FDD |  |  |  |
| Channel bandwidth   | MHz  |       | 10         | 10         |  |  |  |
| Allocated resource blocks   |      |       | 50         | 50         |  |  |  |
| Allocated subframes per Radio Frame(Note1)  |      |       | 8          | 8          |  |  |  |
| Modulation  |      |       | 16QAM      | 64QAM      |  |  |  |
| Target Coding Rate  |      |       | 1/2        | 2/3        |  |  |  |
| Information Bit Payload (Note 2)  |      |       |            |            |  |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |       | 11448      | 25456      |  |  |  |
| For Sub-Frames 0,5  |      |       | N/A        | N/A        |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |       | 3          | 5          |  |  |  |
| Binary Channel Bits Per Subframe  |      |       |            |            |  |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |       | 24000      | 36000      |  |  |  |
| For Sub-Frames 0,5  |      |       | N/A        | N/A        |  |  |  |
| MBMS UE Category  |      |       | ≥ 2        | ≥ 2        |  |  |  |
| Note 1: For FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331 [7].<br>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |            |            |  |  |  |

**Table A.3.8.1-5: Fixed Reference Channel for subcarrier spacing 7.5kHz with FeMBMS MBMS/Unicast-mixed cell**

| Parameter | PMCH |       |  |  |  |  |  |
|-----------|------|-------|--|--|--|--|--|
|           | Unit | Value |  |  |  |  |  |

|   |      |  |  |               |  |  |  |
|---|------|--|--|---------------|--|--|--|
| Reference channel   |      |  |  | R.82-1<br>FDD |  |  |  |
| Channel bandwidth   | MHz  |  |  | 10            |  |  |  |
| Allocated resource blocks   |      |  |  | 50            |  |  |  |
| Allocated subframes per Radio Frame(Note1)  |      |  |  | 8             |  |  |  |
| Modulation  |      |  |  | 16QAM         |  |  |  |
| Target Coding Rate  |      |  |  | 1/2           |  |  |  |
| Information Bit Payload (Note 2)  |      |  |  |               |  |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |  |  | 12960         |  |  |  |
| For Sub-Frames 0,5  | Bits |  |  | N/A           |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |  |  | 3             |  |  |  |
| Binary Channel Bits Per Subframe  |      |  |  |               |  |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |  |  | 25200         |  |  |  |
| For Sub-Frames 0,5  | Bits |  |  | N/A           |  |  |  |
| MBMS UE Category  |      |  |  | ≥ 2           |  |  |  |
| Note 1: For FDD mode, up to 8 subframes (#1/2/3/4/6/7/8/9) are available for MBMS, in line with TS 36.331 [7].<br>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |  |  |               |  |  |  |

**Table A.3.8.1-6: Fixed Reference Channel for subcarrier spacing 1.25kHz with MBMS dedicated cell**

| Parameter   | Unit | PMCH  |               |               |  |  |  |
|---|------|-------|---------------|---------------|--|--|--|
|   |      | Value |               |               |  |  |  |
| Reference channel   |      |       | R.83-1<br>FDD | R.83-2<br>FDD |  |  |  |
| Channel bandwidth   | MHz  |       | 10            | 10            |  |  |  |
| Allocated resource blocks   |      |       | 50            | 50            |  |  |  |
| Allocated subframes per Radio Frame(Note1)  |      |       | 10            | 10            |  |  |  |
| Modulation  |      |       | 16QAM         | 64QAM         |  |  |  |
| Target Coding Rate  |      |       | 1/2           | 2/3           |  |  |  |
| Information Bit Payload (Note 2)  |      |       |               |               |  |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9  | Bits |       | 11448         | 25456         |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |       | 3             | 5             |  |  |  |
| Binary Channel Bits Per Subframe  |      |       |               |               |  |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9  | Bits |       | 24000         | 36000         |  |  |  |
| MBMS UE Category  |      |       | ≥ 2           | ≥ 2           |  |  |  |
| Note 1: For FDD mode, all 10 subframes are available for MBMS, in line with TS 36.331 [7].<br>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |               |               |  |  |  |

**Table A.3.8.1-7: Fixed Reference Channel for subcarrier spacing 7.5kHz with with MBMS dedicated cell**

| Parameter                                  | Unit | PMCH  |               |  |  |  |  |
|--|------|-------|---------------|--|--|--|--|
|  |      | Value |               |  |  |  |  |
| Reference channel                          |      |       | R.84-1<br>FDD |  |  |  |  |
| Channel bandwidth                          | MHz  |       | 10            |  |  |  |  |
| Allocated resource blocks                  |      |       | 50            |  |  |  |  |
| Allocated subframes per Radio Frame(Note1) |      |       | 10            |  |  |  |  |
| Modulation                                 |      |       | 16QAM         |  |  |  |  |



|   |      |  |       |  |  |  |  |
|---|------|--|-------|--|--|--|--|
| Target Coding Rate  |      |  | 1/2   |  |  |  |  |
| Information Bit Payload (Note 2)  |      |  |       |  |  |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9  | Bits |  | 12960 |  |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |  | 3     |  |  |  |  |
| Binary Channel Bits Per Subframe  |      |  |       |  |  |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9  | Bits |  | 25200 |  |  |  |  |
| MBMS UE Category  |      |  | ≥ 2   |  |  |  |  |
| Note 1: For FDD mode, all 10 subframes are available for MBMS, in line with TS 36.331 [7].<br>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |  |       |  |  |  |  |

**Table A.3.8.1-8: Fixed Reference Channel for subcarrier spacing 15kHz with with MBMS dedicated cell**

| Parameter  | Unit | PMCH  |               |               |               |  |  |
|--|------|-------|---------------|---------------|---------------|--|--|
|  |      | Value |               |               |               |  |  |
| Reference channel  |      |       | R.85-1<br>FDD | R.85-2<br>FDD | R.85-3<br>FDD |  |  |
| Channel bandwidth  | MHz  |       | 3             | 5             | 10            |  |  |
| Allocated resource blocks  |      |       | 15            | 25            | 50            |  |  |
| Allocated subframes per Radio Frame(Note1)   |      |       | 10            | 10            | 10            |  |  |
| Modulation   |      |       | QPSK          | 16QAM         | 64QAM         |  |  |
| Target Coding Rate   |      |       | 1/3           | 1/2           | 2/3           |  |  |
| Information Bit Payload (Note 2)   |      |       |               |               |               |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9   | Bits |       | 1064          | 4968          | 19848         |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |       | 1             | 1             | 4             |  |  |
| Binary Channel Bits Per Subframe   |      |       |               |               |               |  |  |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9   | Bits |       | 3060          | 10200         | 30600         |  |  |
| MBMS UE Category   |      |       | ≥ 1           | ≥ 1           | ≥ 2           |  |  |
| Note 1: For FDD mode, all 10 subframes are available for MBMS, in line with TS 36.331 [7].<br>Note 2: 2 OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |               |               |               |  |  |

**Table A.3.8.1-9: Fixed Reference Channel for subcarrier spacing 0.37 kHz with 5G terrestrial broadcast MBMS dedicated cell**

| Parameter  | Unit | PMCH  |                |                |  |  |  |
|--|------|-------|----------------|----------------|--|--|--|
|  |      | Value |                |                |  |  |  |
| Reference channel  |      |       | R.106-1<br>FDD | R.106-2<br>FDD |  |  |  |
| Channel bandwidth  | MHz  |       | 10             | 10             |  |  |  |
| Allocated resource blocks  |      |       | 50             | 50             |  |  |  |
| Allocated slots per 40ms(Note1)  |      |       | 13             | 13             |  |  |  |
| Modulation   |      |       | 64QAM          | 64QAM          |  |  |  |
| Target Coding Rate   |      |       | 0.48           | 0.52           |  |  |  |
| Information Bit Payload (Note 2)   |      |       |                |                |  |  |  |
| For each slot  | Bits |       | 63776          | 63776          |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |       | 11             | 11             |  |  |  |
| Binary Channel Bits Per Subframe   |      |       |                |                |  |  |  |
| For each slot  | Bits |       | 133650         | 121500         |  |  |  |
| MBMS UE Category   |      |       | ≥ 2            | ≥ 2            |  |  |  |
| Note 1: First subframe of every 40ms is allocated for non-MBMS transmission.<br>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4]. |      |       |                |                |  |  |  |

Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

**Table A.3.8.1-10: Fixed Reference Channel for subcarrier spacing 2.5 kHz with 5G terrestrial broadcast MBMS dedicated cell**

| Parameter  | PMCH |       |              |  |  |  |
|--|------|-------|--------------|--|--|--|
|  | Unit | Value |              |  |  |  |
| Reference channel  |      |       | R.107<br>FDD |  |  |  |
| Channel bandwidth  | MHz  |       | 10           |  |  |  |
| Allocated resource blocks  |      |       | 50           |  |  |  |
| Allocated subframes per 40ms(Note1)  |      |       | 39           |  |  |  |
| Modulation   |      |       | 16QAM        |  |  |  |
| Target Coding Rate   |      |       | 0.46         |  |  |  |
| Information Bit Payload (Note 2)   |      |       |              |  |  |  |
| For each subframes   | Bits |       | 9912         |  |  |  |
| Number of Code Blocks per Sub-Frame (Note 3)   |      |       | 2            |  |  |  |
| Binary Channel Bits Per Subframe   |      |       |              |  |  |  |
| For each subframes   | Bits |       | 21600        |  |  |  |
| MBMS UE Category   |      |       | ≥ 2          |  |  |  |
| <p>Note 1: First subframe of every 40ms is allocated for non-MBMS transmission.</p> <p>Note 2: Zero OFDM symbols are reserved for PDCCH; and no CRS allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |       |              |  |  |  |

## A.3.8.2 TDD

**Table A.3.8.2-1: Fixed Reference Channel QPSK R=1/3**

| Parameter  | PMCH |          |   |   |          |    |    |
|--|------|----------|---|---|----------|----|----|
|  | Unit | Value    |   |   |          |    |    |
| Reference channel  |      | R.40 TDD |   |   | R.37 TDD |    |    |
| Channel bandwidth  | MHz  | 1.4      | 3 | 5 | 10       | 15 | 20 |
| Allocated resource blocks  |      | 6        |   |   | 50       |    |    |
| Uplink-Downlink Configuration(Note 1)  |      | 5        |   |   | 5        |    |    |
| Allocated subframes per Radio Frame  |      | 5        |   |   | 5        |    |    |
| Modulation   |      | QPSK     |   |   | QPSK     |    |    |
| Target Coding Rate   |      | 1/3      |   |   | 1/3      |    |    |
| Information Bit Payload (Note 2)   |      |          |   |   |          |    |    |
| For Sub-Frames 3,4,7,8,9   | Bits | 408      |   |   | 3624     |    |    |
| For Sub-Frames 0,1,2,5,6   | Bits | N/A      |   |   | N/A      |    |    |
| Number of Code Blocks per Subframe (Note 3)  |      | 1        |   |   | 1        |    |    |
| Binary Channel Bits Per Subframe   |      |          |   |   |          |    |    |
| For Sub-Frames 3,4,7,8,9   | Bits | 1224     |   |   | 10200    |    |    |
| For Sub-Frames 0,1,2,5,6   | Bits | N/A      |   |   | N/A      |    |    |
| MBMS UE Category   |      | ≥ 1      |   |   | ≥ 1      |    |    |
| <p>Note 1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS.</p> <p>Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |      |          |   |   |          |    |    |

Table A.3.8.2-2: Fixed Reference Channel 16QAM R=1/2

| Parameter                                   | PMCH  |       |   |   |          |    |    |
|---|---|-------|---|---|----------|----|----|
|   | Unit  | Value |   |   |          |    |    |
| Reference channel                           |   |       |   |   | R.38 TDD |    |    |
| Channel bandwidth                           | MHz   | 1.4   | 3 | 5 | 10       | 15 | 20 |
| Allocated resource blocks                   |   |       |   |   | 50       |    |    |
| Uplink-Downlink Configuration(Note 1)       |   |       |   |   | 5        |    |    |
| Allocated subframes per Radio Frame         |   |       |   |   | 5        |    |    |
| Modulation                                  |   |       |   |   | 16QAM    |    |    |
| Target Coding Rate                          |   |       |   |   | 1/2      |    |    |
| Information Bit Payload (Note 2)            |   |       |   |   |          |    |    |
| For Sub-Frames 3,4,7,8,9                    | Bits  |       |   |   | 9912     |    |    |
| For Sub-Frames 0,1,2,5,6                    | Bits  |       |   |   | N/A      |    |    |
| Number of Code Blocks per Subframe (Note 3) |   |       |   |   | 2        |    |    |
| Binary Channel Bits Per Subframe            |   |       |   |   |          |    |    |
| For Sub-Frames 3,4,7,8,9                    | Bits  |       |   |   | 20400    |    |    |
| For Sub-Frames 0,1,2,5,6                    | Bits  |       |   |   | N/A      |    |    |
| MBMS UE Category                            |   |       |   |   | ≥ 1      |    |    |
| Note 1:                                     | For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. |       |   |   |          |    |    |
| Note 2:                                     | 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.   |       |   |   |          |    |    |
| Note 3:                                     | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |   |   |          |    |    |

Table A.3.8.2-3: Fixed Reference Channel 64QAM R=2/3

| Parameter                                    | PMCH  |       |   |           |          |    |    |
|--|---|-------|---|-----------|----------|----|----|
|  | Unit  | Value |   |           |          |    |    |
| Reference channel                            |   |       |   | R.39-1TDD | R.39 TDD |    |    |
| Channel bandwidth                            | MHz   | 1.4   | 3 | 5         | 10       | 15 | 20 |
| Allocated resource blocks                    |   |       |   | 25        | 50       |    |    |
| Uplink-Downlink Configuration(Note 1)        |   |       |   | 5         | 5        |    |    |
| Allocated subframes per Radio Frame          |   |       |   | 5         | 5        |    |    |
| Modulation                                   |   |       |   | 64QAM     | 64QAM    |    |    |
| Target Coding Rate                           |   |       |   | 2/3       | 2/3      |    |    |
| Information Bit Payload (Note 2)             |   |       |   |           |          |    |    |
| For Sub-Frames 3,4,7,8,9                     | Bits  |       |   | 9912      | 19848    |    |    |
| For Sub-Frames 0,1,2,5,6                     | Bits  |       |   | N/A       | N/A      |    |    |
| Number of Code Blocks per Sub-Frame (Note 3) |   |       |   | 2         | 4        |    |    |
| Binary Channel Bits Per Subframe             |   |       |   |           |          |    |    |
| For Sub-Frames 3,4,7,8,9                     | Bits  |       |   | 15300     | 30600    |    |    |
| For Sub-Frames 0,1,2,5,6                     | Bits  |       |   | N/A       | N/A      |    |    |
| MBMS UE Category                             |   |       |   | ≥ 1       | ≥ 2      |    |    |
| Note 1:                                      | For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. |       |   |           |          |    |    |
| Note 2:                                      | 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.   |       |   |           |          |    |    |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |       |   |           |          |    |    |

## A.3.9 Reference measurement channels for sustained downlink data rate provided by lower layers

### A.3.9.1 FDD

**Table A.3.9.1-1: Fixed Reference Channel for sustained data-rate test (FDD 64QAM)**

| Parameter                                      | Unit   | Value      |            |            |             |             |            |             |            |
|--|--|------------|------------|------------|-------------|-------------|------------|-------------|------------|
|  |  | R.31-1 FDD | R.31-2 FDD | R.31-3 FDD | R.31-3A FDD | R.31-3C FDD | R.31-4 FDD | R.31-4B FDD | R.31-5 FDD |
| Reference channel                              |  |            |            |            |             |             |            |             |            |
| Channel bandwidth                              | MHz  | 10         | 10         | 20         | 10          | 15          | 20         | 15          | 15         |
| Allocated resource blocks (Note 8)             |  | Note 5     | Note 6     | Note 7     | Note 6      | Note 10     | Note 7     | Note 11     | Note 9     |
| Allocated subframes per Radio Frame            |  | 10         | 10         | 10         | 10          | 10          | 10         | 10          | 10         |
| Modulation                                     |  | 64QAM      | 64QAM      | 64QAM      | 64QAM       | 64QAM       | 64QAM      | 64QAM       | 64QAM      |
| Coding Rate                                    |  |            |            |            |             |             |            |             |            |
| For Sub-Frame 1,2,3,4,6,7,8,9,                 |  | 0.40       | 0.59       | 0.59       | 0.85        | 0.87        | 0.88       | 0.85        | 0.85       |
| For Sub-Frame 5                                |  | 0.40       | 0.64       | 0.62       | 0.89        | 0.88        | 0.87       | 0.87        | 0.91       |
| For Sub-Frame 0                                |  | 0.40       | 0.63       | 0.61       | 0.90        | 0.91        | 0.90       | 0.88        | 0.88       |
| Information Bit Payload (Note 8)               |  |            |            |            |             |             |            |             |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 10296      | 25456      | 51024      | 36696       | 51024       | 75376      | 55056       | 55056      |
| For Sub-Frame 5                                | Bits   | 10296      | 25456      | 51024      | 35160       | 51024       | 71112      | 52752       | 52752      |
| For Sub-Frame 0                                | Bits   | 10296      | 25456      | 51024      | 36696       | 51024       | 75376      | 55056       | 55056      |
| Number of Code Blocks (Notes 3 and 8)          |  |            |            |            |             |             |            |             |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 2          | 5          | 9          | 6           | 9           | 13         | 9           | 9          |
| For Sub-Frame 5                                | Bits   | 2          | 5          | 9          | 6           | 9           | 12         | 9           | 9          |
| For Sub-Frame 0                                | Bits   | 2          | 5          | 9          | 6           | 9           | 13         | 9           | 9          |
| Binary Channel Bits (Note 8)                   |  |            |            |            |             |             |            |             |            |
| For Sub-Frames 1,2,3,4,6,7,8,9                 | Bits   | 26100      | 43200      | 86400      | 43200       | 58752       | 86400      | 64800       | 64800      |
| For Sub-Frame 5                                | Bits   | 26100      | 39744      | 82080      | 39744       | 57888       | 82080      | 60480       | 60480      |
| For Sub-Frame 0                                | Bits   | 26100      | 40752      | 83952      | 40752       | 56304       | 83952      | 62352       | 62352      |
| Number of layers                               |  | 1          | 2          | 2          | 2           | 2           | 2          | 2           | 2          |
| Max. Throughput averaged over 1 frame (Note 8) | Mbps   | 10.296     | 25.456     | 51.024     | 36.542      | 51.024      | 74.950     | 54.826      | 54.826     |
| UE Categories                                  |  | ≥ 1        | ≥ 2        | ≥ 2        | ≥ 2         | ≥ 3         | ≥ 3        | ≥ 4         | ≥ 3        |
| Note 1:  | 1 symbol allocated to PDCCH for all tests.   |            |            |            |             |             |            |             |            |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |            |            |            |             |             |            |             |            |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                  |            |            |            |             |             |            |             |            |
| Note 4:  | Resource blocks $n_{PRB} = 0..2$ are allocated for SIB transmissions in sub-frame 5 for all bandwidths.  |            |            |            |             |             |            |             |            |
| Note 5:  | Resource blocks $n_{PRB} = 6..14,30..49$ are allocated for the user data in all sub-frames.  |            |            |            |             |             |            |             |            |
| Note 6:  | Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9. |            |            |            |             |             |            |             |            |
| Note 7:  | Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,1,2,3,4,6,7,8,9. |            |            |            |             |             |            |             |            |
| Note 8:  | Given per component carrier per codeword.  |            |            |            |             |             |            |             |            |
| Note 9:  | Resource blocks $n_{PRB} = 4..74$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..74$ in sub-frames 0,1,2,3,4,6,7,8,9. |            |            |            |             |             |            |             |            |
| Note 10:                                       | Resource blocks $n_{PRB} = 4..71$ are allocated for the user data in sub-frames 0,1,2,3,4,5,6,7,8,9.   |            |            |            |             |             |            |             |            |
| Note 11:                                       | Resource blocks $n_{PRB} = 4..74$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..74$ in sub-frames 0,1,2,3,4,6,7,8,9. |            |            |            |             |             |            |             |            |

**Table A.3.9.1-2: Fixed Reference Channel for sustained data-rate test (FDD 64QAM)**

| Parameter  | Unit | Value      |            |            |            |             |             |  |  |
|--|------|------------|------------|------------|------------|-------------|-------------|--|--|
|  |      | R.31-6 FDD | R.31-7 FDD | R.31-8 FDD | R.31-9 FDD | R.31-10 FDD | R.31-1A FDD |  |  |
| Reference channel  |      |            |            |            |            |             |             |  |  |
| Channel bandwidth  | MHz  | 5          | 10         | 15         | 20         | 5           | 20          |  |  |
| Allocated resource blocks (Note 5)   |      | Note 4     | Note 7     | Note 8     | Note 9     | Note 4      | Note 10     |  |  |
| Allocated subframes per Radio Frame  |      | 9          | 10         | 10         | 10         | 9           | 10          |  |  |
| Modulation   |      | 64QAM      | 64QAM      | 64QAM      | 64QAM      | 64QAM       | 64QAM       |  |  |
| Coding Rate  |      |            |            |            |            |             |             |  |  |
| For Sub-Frame 1,2,3,4,6,7,8,9,   |      | 0.85       | 0.78       | 0.77       | 0.79       | 0.78        | 0.41        |  |  |
| For Sub-Frame 5  |      | N/A        | 0.80       | 0.79       | 0.81       | N/A         | 0.41        |  |  |
| For Sub-Frame 0  |      | 0.83       | 0.83       | 0.8        | 0.81       | 0.85        | 0.41        |  |  |
| Information Bit Payload (Note 5)   |      |            |            |            |            |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 18336      | 63776      | 93800      | 128496     | 31704       | 10296       |  |  |
| For Sub-Frame 5  | Bits | N/A        | 59256      | 90816      | 124464     | N/A         | 10296       |  |  |
| For Sub-Frame 0  | Bits | 15840      | 63776      | 93800      | 128496     | 30576       | 10296       |  |  |
| Number of Code Blocks (Notes 3 and 5)  |      |            |            |            |            |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 3          | 11         | 16         | 21         | 6           | 2           |  |  |
| For Sub-Frame 5  | Bits | N/A        | 10         | 15         | 21         | N/A         | 2           |  |  |
| For Sub-Frame 0  | Bits | 3          | 11         | 16         | 21         | 5           | 2           |  |  |
| Binary Channel Bits (Note 5)   |      |            |            |            |            |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9   | Bits | 21600      | 81600      | 122400     | 163200     | 40800       | 25200       |  |  |
| For Sub-Frame 5  | Bits | N/A        | 74976      | 114144     | 154944     | N/A         | 25200       |  |  |
| For Sub-Frame 0  | Bits | 19152      | 76992      | 117792     | 158592     | 36192       | 25200       |  |  |
| Number of layers   |      | 2          | 4          | 4          | 4          | 4           | 1           |  |  |
| Max. Throughput averaged over 1 frame (Note 5)   | Mbps | 17.837     | 63.324     | 93.502     | 128.093    | 28.421      | 10.296      |  |  |
| UE Categories  |      | ≥ 2        | ≥ 6        | ≥ 6        | ≥ 6        | ≥ 6         | ≥ 1         |  |  |
| Note 1: 1 symbol allocated to PDCCH for all tests.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>Note 4: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.<br>Note 5: Given per component carrier per codeword.<br>Note 6: $N_g=1/6$ .<br>Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9.<br>Note 8: Resource blocks $n_{PRB} = 4..74$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..74$ in sub-frames 0,1,2,3,4,6,7,8,9.<br>Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,1,2,3,4,6,7,8,9.<br>Note 10: Resource blocks $n_{PRB} = 8..35$ are allocated for the user data in all sub-frames. |      |            |            |            |            |             |             |  |  |

**Table A.3.9.1-3: Fixed Reference Channel for sustained data-rate test (FDD 256QAM)**

| Parameter                           | Unit | Value    |            |            |            |            |            |            |            |
|-------------------------------------|------|----------|------------|------------|------------|------------|------------|------------|------------|
|                                     |      | R.68 FDD | R.68-1 FDD | R.68-2 FDD | R.68-3 FDD | R.68-4 FDD | R.68-5 FDD | R.68-6 FDD | R.68-7 FDD |
| Reference channel                   |      |          |            |            |            |            |            |            |            |
| Channel bandwidth                   | MHz  | 20       | 15         | 10         | 5          | 10         | 15         | 20         | 5          |
| Allocated resource blocks (Note 4)  |      | Note 5   | Note 6     | Note 7     | Note 8     | Note 7     | Note 6     | Note 5     | Note 8     |
| Allocated subframes per Radio Frame |      | 10       | 10         | 10         | 10         | 10         | 10         | 10         | 10         |
| Modulation                          |      | 256QAM   | 256QAM     | 256QAM     | 256QAM     | 256QAM     | 256QAM     | 256QAM     | 256QAM     |
| Coding Rate                         |      |          |            |            |            |            |            |            |            |

|   |      |        |        |        |        |         |         |         |        |
|---|------|--------|--------|--------|--------|---------|---------|---------|--------|
| For Sub-Frames 3,4,8,9  |      | 0.85   | 0.88   | 0.85   | 0.85   | 0.78    | 0.79    | 0.78    | 0.85   |
| For Sub-Frames 1,2,6,7  |      | 0.74   | 0.74   | 0.74   | 0.77   | 0.78    | 0.79    | 0.78    | 0.77   |
| For Sub-Frame 5   |      | 0.75   | 0.77   | 0.77   | 0.79   | 0.82    | 0.82    | 0.786   | 0.79   |
| For Sub-Frame 0   |      | 0.76   | 0.77   | 0.78   | 0.84   | 0.83    | 0.82    | 0.80    | 0.84   |
| Information Bit Payload (Note 4)  |      |        |        |        |        |         |         |         |        |
| For Sub-Frames 3,4,8,9  | Bits | 97896  | 75376  | 48936  | 24496  | 84760   | 128496  | 169544  | 42368  |
| For Sub-Frames 1,2,6,7  |      | 84760  | 63776  | 42368  | 21384  | 84760   | 128496  | 169544  | 42368  |
| For Sub-Frame 5   | Bits | 81176  | 61664  | 40576  | 19848  | 81176   | 124464  | 161760  | 39232  |
| For Sub-Frame 0   | Bits | 84760  | 63776  | 42368  | 21384  | 84760   | 128496  | 169544  | 39232  |
| Number of Code Blocks (Notes 3 and 4)   |      |        |        |        |        |         |         |         |        |
| For Sub-Frames 3,4,8,9  | Bits | 16     | 13     | 8      | 4      | 14      | 21      | 28      | 7      |
| For Sub-Frames 1,2,6,7  |      | 14     | 11     | 7      | 4      | 14      | 21      | 28      | 7      |
| For Sub-Frame 5   | Bits | 14     | 11     | 7      | 4      | 14      | 21      | 27      | 7      |
| For Sub-Frame 0   | Bits | 14     | 11     | 7      | 4      | 14      | 21      | 28      | 7      |
| Binary Channel Bits (Note 4)  |      |        |        |        |        |         |         |         |        |
| For Sub-Frames 3,4,8,9  | Bits | 115200 | 86400  | 57600  | 28800  | 108800  | 163200  | 217600  | 54400  |
| For Sub-Frames 1,2,6,7  |      | 115200 | 86400  | 57600  | 28800  | 108800  | 163200  | 217600  | 54400  |
| For Sub-Frame 5   | Bits | 109440 | 80640  | 52992  | 25344  | 99968   | 152192  | 206592  | 47744  |
| For Sub-Frame 0   | Bits | 111936 | 83136  | 54336  | 25536  | 102656  | 157056  | 211456  | 48256  |
| Number of layers  |      | 2      | 2      | 2      | 2      | 4       | 4       | 4       | 4      |
| Max. Throughput averaged over 1 frame (Note 4)  | Mbps | 89.656 | 68.205 | 44.816 | 22.475 | 84.4016 | 128.093 | 168.766 | 41.741 |
| UE Categories   |      | 11-12  | 11-12  | 11-12  | 11-12  | 11-12   | 11-12   | 11-12   | 11-12  |
| UE DL Categories  |      | ≥ 11   | ≥ 11   | ≥ 11   | ≥ 11   | 13-14   | 13-14   | 13-14   | 13-14  |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 4: Given per component carrier per codeword.</p> <p>Note 5: Resource blocks <math>n_{PRB} = 4..99</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..99</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 6: Resource blocks <math>n_{PRB} = 4..74</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..74</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 7: Resource blocks <math>n_{PRB} = 3..49</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..49</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 8: Resource blocks <math>n_{PRB} = 2..24</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..24</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> |      |        |        |        |        |         |         |         |        |

Table A.3.9.1-4: Fixed Reference Channel for sustained data-rate test (FDD 1024QAM)

| Parameter                              | Unit | Value     |             |             |             |             |             |             |             |
|--|------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|  |      | R.105 FDD | R.105-1 FDD | R.105-2 FDD | R.105-3 FDD | R.105-4 FDD | R.105-5 FDD | R.105-6 FDD | R.105-7 FDD |
| Reference channel                      |      |           |             |             |             |             |             |             |             |
| Channel bandwidth                      | MHz  | 20        | 15          | 10          | 5           | 20          | 15          | 10          | 5           |
| Allocated resource blocks (Note 4)     |      | Note 5    | Note 6      | Note 7      | Note 8      | Note 7      | Note 6      | Note 5      | Note 8      |
| Allocated subframes per Radio Frame    |      | 10        | 10          | 10          | 10          | 10          | 10          | 10          | 10          |
| Modulation                             |      | 1024QAM   | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     |
| Coding Rate                            |      |           |             |             |             |             |             |             |             |
| For Sub-Frames 3,4,8,9                 |      | 0.76      | 0.75        | 0.73        | 0.76        | 0.81        | 0.79        | 0.81        | 0.78        |
| For Sub-Frames 1,2,6,7                 |      | 0.76      | 0.75        | 0.73        | 0.76        | 0.81        | 0.79        | 0.81        | 0.78        |
| For Sub-Frame 5                        |      | 0.77      | 0.78        | 0.77        | 0.80        | 0.82        | 0.83        | 0.81        | 0.82        |
| For Sub-Frame 0                        |      | 0.79      | 0.78        | 0.78        | 0.86        | 0.83        | 0.82        | 0.86        | 0.87        |
| Information Bit Payload (Note 4)       |      |           |             |             |             |             |             |             |             |
| For Sub-Frames 3,4,8,9                 | Bits | 110136    | 81176       | 52752       | 27376       | 220296      | 161760      | 110136      | 52752       |
| For Sub-Frames 1,2,6,7                 |      | 110136    | 81176       | 52752       | 27376       | 220296      | 161760      | 110136      | 52752       |
| For Sub-Frame 5                        | Bits | 105528    | 78704       | 51024       | 25456       | 211936      | 157432      | 101840      | 48936       |
| For Sub-Frame 0                        | Bits | 110136    | 81176       | 52752       | 27376       | 220296      | 161760      | 110136      | 52752       |
| Number of Code Blocks (Notes 3, and 4) |      |           |             |             |             |             |             |             |             |
| For Sub-Frames 3,4,8,9                 | Bits | 18        | 14          | 9           | 5           | 36          | 27          | 18          | 9           |
| For Sub-Frames 1,2,6,7                 |      | 18        | 14          | 9           | 5           | 36          | 27          | 18          | 9           |
| For Sub-Frame 5                        | Bits | 18        | 13          | 9           | 5           | 35          | 26          | 17          | 8           |
| For Sub-Frame 0                        | Bits | 18        | 14          | 9           | 5           | 36          | 27          | 18          | 9           |
| Binary Channel Bits (Note 4)           |      |           |             |             |             |             |             |             |             |
| For Sub-Frames 3,4,8,9                 | Bits | 144000    | 108000      | 72000       | 36000       | 272000      | 204000      | 136000      | 68000       |
| For Sub-Frames 1,2,6,7                 |      | 144000    | 108000      | 72000       | 36000       | 272000      | 204000      | 136000      | 68000       |
| For Sub-Frame 5                        | Bits | 136800    | 100800      | 66240       | 31680       | 258240      | 190240      | 124960      | 59680       |

|   |      |         |         |         |         |         |         |         |         |
|---|------|---------|---------|---------|---------|---------|---------|---------|---------|
| For Sub-Frame 0   | Bits | 139920  | 103920  | 67920   | 31920   | 264320  | 196320  | 128320  | 60320   |
| Number of layers  |      | 2       | 2       | 2       | 2       | 4       | 4       | 4       | 4       |
| Max. Throughput averaged over 1 frame (Note 4)  | Mbps | 109.68  | 80.93   | 52.58   | 27.18   | 219.46  | 161.33  | 109.31  | 52.37   |
| UE DL Categories  |      | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 4: Given per component carrier per codeword.</p> <p>Note 5: Resource blocks <math>n_{PRB} = 4..99</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..99</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 6: Resource blocks <math>n_{PRB} = 4..74</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..74</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 7: Resource blocks <math>n_{PRB} = 3..49</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..49</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 8: Resource blocks <math>n_{PRB} = 2..24</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..24</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> |      |         |         |         |         |         |         |         |         |

### A.3.9.2 TDD

**Table A.3.9.2-1: Fixed Reference Channel for sustained data-rate test (TDD 64QAM)**

| Parameter                                      | Unit      | Value      |            |            |             |            |             |            |             |            |
|--|-----------|------------|------------|------------|-------------|------------|-------------|------------|-------------|------------|
|  |           | R.31-1 TDD | R.31-2 TDD | R.31-3 TDD | R.31-3A TDD | R.31-4 TDD | R.31-4A TDD | R.31-5 TDD | R.31-5A TDD | R.31-6 TDD |
| Reference channel                              |           |            |            |            |             |            |             |            |             |            |
| Channel bandwidth                              | MHz       | 10         | 10         | 20         | 15          | 20         | 20          | 15         | 15          | 10         |
| Allocated resource blocks                      |           | Note 6     | Note 7     | Note 8     | Note 9      | Note 8     | Note 8      | Note 11    | Note 11     | Note 7     |
| Uplink-Downlink Configuration (Note 3)         |           | 5          | 5          | 5          | 1           | 1          | 2           | 1          | 2           | 1          |
| Number of HARQ Processes per component carrier | Processes | 15         | 15         | 15         | 7           | 7          | 10          | 7          | 10          | 7          |
| Allocated subframes per Radio Frame (D+S)      |           | 8+1        | 8+1        | 8+1        | 4           | 4          | 6+2         | 4          | 6+2         | 4          |
| Modulation                                     |           | 64QAM      | 64QAM      | 64QAM      | 64QAM       | 64QAM      | 64QAM       | 64QAM      | 64QAM       | 64QAM      |
| Target Coding Rate                             |           |            |            |            |             |            |             |            |             |            |
| For Sub-Frames 4,9                             |           | 0.40       | 0.59       | 0.59       | 0.87        | 0.88       | 0.88        | 0.85       | 0.85        | 0.85       |
| For Sub-Frames 3,8                             |           | 0.40       | 0.59       | 0.59       | N/A         | N/A        | 0.88        | N/A        | 0.85        | N/A        |
| For Sub-Frame 7                                |           | 0.40       | 0.59       | 0.59       | N/A         | N/A        | N/A         | N/A        | N/A         | N/A        |
| For Sub-Frames 0                               |           | 0.40       | 0.62       | 0.61       | 0.90        | 0.90       | 0.90        | 0.88       | 0.88        | 0.90       |



|   |      |       |        |        |        |        |        |        |        |        |
|---|------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| For Sub-Frames 1                                |      | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 5                                |      | 0.40  | 0.64   | 0.62   | 0.88   | 0.87   | 0.87   | 0.87   | 0.87   | 0.88   |
| For Sub-Frames 6                                |      | 0.40  | 0.60   | 0.60   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| Information Bit Payload                         |      |       |        |        |        |        |        |        |        |        |
| For Sub-Frames 4,9                              | Bits | 10296 | 25456  | 51024  | 51024  | 75376  | 75376  | 55056  | 55056  | 36696  |
| For Sub-Frames 3,8                              | Bits | 10296 | 25456  | 51024  | 0      | 0      | 75376  | 0      | 55056  | 0      |
| For Sub-Frame 7                                 | Bits | 10296 | 25456  | 51024  | 0      | 0      | N/A    | 0      | N/A    | 0      |
| For Sub-Frame 0                                 | Bits | 10296 | 25456  | 51024  | 51024  | 75376  | 75376  | 55056  | 55056  | 36696  |
| For Sub-Frame 1                                 | Bits | 0     | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frame 5                                 | Bits | 10296 | 25456  | 51024  | 51024  | 71112  | 71112  | 52752  | 52752  | 35160  |
| For Sub-Frame 6                                 | Bits | 10296 | 25456  | 51024  | 0      | 0      | 0      | 0      | 0      | 0      |
| Number of Code Blocks per Sub-Frame (Note 4)    |      |       |        |        |        |        |        |        |        |        |
| For Sub-Frames 4,9                              |      | 2     | 5      | 9      | 9      | 13     | 13     | 9      | 9      | 6      |
| For Sub-Frames 3,8                              |      | 2     | 5      | 9      | N/A    | N/A    | 13     | N/A    | 9      | N/A    |
| For Sub-Frame 7                                 |      | 2     | 5      | 9      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 0                                 |      | 2     | 5      | 9      | 9      | 13     | 13     | 9      | 9      | 6      |
| For Sub-Frame 1                                 |      | N/A   | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 5                                 |      | 2     | 5      | 9      | 9      | 12     | 12     | 9      | 9      | 6      |
| For Sub-Frame 6                                 | Bits | 2     | 5      | 9      | n/a    | N/A    | N/A    | N/A    | N/A    | N/A    |
| Binary Channel Bits Per Sub-Frame               |      |       |        |        |        |        |        |        |        |        |
| For Sub-Frames 4,9                              | Bits | 26100 | 43200  | 86400  | 58752  | 86400  | 86400  | 64800  | 64800  | 43200  |
| For Sub-Frames 3,8                              | Bits | 26100 | 43200  | 86400  | 0      | 0      | 86400  | 0      | 64800  | 0      |
| For Sub-Frame 7                                 | Bits | 26100 | 43200  | 86400  | 0      | 0      | 86400  | 0      | 64800  | 0      |
| For Sub-Frame 0                                 | Bits | 26100 | 41184  | 84384  | 56736  | 84384  | 84384  | 62784  | 62784  | 41184  |
| For Sub-Frame 1                                 | Bits | 0     | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frame 5                                 | Bits | 26100 | 40176  | 82512  | 58320  | 82512  | 82512  | 60912  | 60912  | 40176  |
| For Sub-Frame 6                                 | Bits | 26100 | 42768  | 85968  | N/A    | N/A    | 0      | N/A    | 0      | N/A    |
| Number of layers                                |      | 1     | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      |
| Max. Throughput averaged over 1 frame (Note 10) | Mbps | 8.237 | 20.365 | 40.819 | 20.409 | 29.724 | 52.337 | 25.330 | 38.309 | 14.525 |
| UE Category                                     |      | ≥ 1   | ≥ 2    | ≥ 2    | ≥ 2    | ≥ 3    | ≥ 3    | ≥ 3    | ≥ 3    | ≥ 2    |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
- Note 3: As per Table 4.2-2 in TS 36.211 [4].
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks  $n_{PRB} = 0..2$  are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks  $n_{PRB} = 6..14,30..49$  are allocated for the user data in all subframes.
- Note 7: Resource blocks  $n_{PRB} = 3..49$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..49$  in the available downlink sub-frames according to uplink downlink configurations used .
- Note 8: Resource blocks  $n_{PRB} = 4..99$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..99$  in sub-frames 0,3,4,6,7,8,9.
- Note 9: Resource blocks  $n_{PRB} = 4..71$  are allocated for the user data in all sub-frames
- Note10: Given per component carrier per codeword.
- Note11: Resource blocks  $n_{PRB} = 4..74$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..74$  in other downlink sub-frames.

**Table A.3.9.2-1A: Fixed Reference Channel for sustained data-rate test (TDD 64QAM)**

| Parameter                                      | Unit      | Value      |            |            |             |             |             |             |  |
|--|-----------|------------|------------|------------|-------------|-------------|-------------|-------------|--|
|  |           | R.31-7 TDD | R.31-8 TDD | R.31-9 TDD | R.31-1A TDD | R.31-10 TDD | R.31-11 TDD | R.31-12 TDD |  |
| Reference channel                              |           |            |            |            |             |             |             |             |  |
| Channel bandwidth                              | MHz       | 10         | 15         | 20         | 20          | 10          | 15          | 20          |  |
| Allocated resource blocks                      |           | Note 7     | Note 11    | Note 12    | Note 13     | Note 14     | Note 15     | Note 16     |  |
| Uplink-Downlink Configuration (Note 3)         |           | 1          | 1          | 1          | 5           | 1           | 1           | 1           |  |
| Number of HARQ Processes per component carrier | Processes | 7          | 7          | 7          | 15          | 7           | 7           | 7           |  |
| Allocated subframes per Radio Frame (D+S)      |           | 4          | 4          | 4          | 8+1         | 4           | 4           | 4           |  |
| Modulation                                     |           | 64QAM      | 64QAM      | 64QAM      | 64QAM       | 64QAM       | 64QAM       | 64QAM       |  |
| Target Coding Rate                             |           |            |            |            |             |             |             |             |  |
| For Sub-Frames 4,9                             |           | 0.78       | 0.77       | 0.79       | 0.41        | 0.85        | 0.84        | 0.85        |  |
| For Sub-Frames 3,8                             |           | N/A        | N/A        | N/A        | 0.41        | N/A         | N/A         | N/A         |  |
| For Sub-Frame 7                                |           | N/A        | N/A        | N/A        | 0.41        | N/A         | N/A         | N/A         |  |
| For Sub-Frames 0                               |           | 0.82       | 0.79       | 0.81       | 0.41        | 0.75        | 0.76        | 0.74        |  |
| For Sub-Frames 1                               |           | N/A        | N/A        | N/A        | N/A         | N/A         | N/A         | N/A         |  |
| For Sub-Frames 5                               |           | 0.79       | 0.79       | 0.80       | 0.41        | 0.75        | 0.76        | 0.75        |  |
| For Sub-Frames 6                               |           | N/A        | N/A        | N/A        | 0.41        | N/A         | N/A         | N/A         |  |
| Information Bit Payload                        |           |            |            |            |             |             |             |             |  |
| For Sub-Frames 4,9                             | Bits      | 63776      | 93800      | 128496     | 10296       | 110136      | 161760      | 220296      |  |
| For Sub-Frames 3,8                             | Bits      | 0          | 0          | 0          | 10296       | N/A         | N/A         | N/A         |  |
| For Sub-Frame 7                                | Bits      | 0          | 0          | 0          | 10296       | N/A         | N/A         | N/A         |  |
| For Sub-Frame 0                                | Bits      | 63776      | 93800      | 128496     | 10296       | 87936       | 137792      | 187712      |  |
| For Sub-Frame 1                                | Bits      | 0          | 0          | 0          | 0           | 0           | 0           | 0           |  |
| For Sub-Frame 5                                | Bits      | 59256      | 90816      | 124464     | 10296       | 81176       | 128496      | 181656      |  |
| For Sub-Frame 6                                | Bits      | 0          | 0          | 0          | 10296       | 0           | 0           | 0           |  |
| Number of Code Blocks per Sub-Frame (Note 4)   |           |            |            |            |             |             |             |             |  |
| For Sub-Frames 4,9                             |           | 11         | 16         | 21         | 2           | 18          | 27          | 36          |  |
| For Sub-Frames 3,8                             |           | N/A        | N/A        | N/A        | 2           | N/A         | N/A         | N/A         |  |
| For Sub-Frame 7                                |           | N/A        | N/A        | N/A        | 2           | N/A         | N/A         | N/A         |  |
| For Sub-Frame 0                                |           | 11         | 16         | 21         | 2           | 15          | 23          | 31          |  |
| For Sub-Frame 1                                |           | N/A        | N/A        | N/A        | N/A         | N/A         | N/A         | N/A         |  |
| For Sub-Frame 5                                |           | 10         | 15         | 21         | 2           | 14          | 21          | 30          |  |
| For Sub-Frame 6                                | Bits      | N/A        | N/A        | N/A        | 2           | N/A         | N/A         | N/A         |  |
| Binary Channel Bits Per Sub-Frame              |           |            |            |            |             |             |             |             |  |
| For Sub-Frames 4,9                             | Bits      | 81600      | 122400     | 163200     | 25200       | 129600      | 194400      | 259200      |  |
| For Sub-Frames 3,8                             | Bits      | 0          | 0          | 0          | 25200       | 0           | 0           | 0           |  |
| For Sub-Frame 7                                | Bits      | 0          | 0          | 0          | 25200       | 0           | 0           | 0           |  |
| For Sub-Frame 0                                | Bits      | 77856      | 118656     | 159456     | 25200       | 118080      | 181440      | 253440      |  |
| For Sub-Frame 1                                | Bits      | 0          | 0          | 0          | 0           | 0           | 0           | 0           |  |

|   |      |        |        |        |       |                                |                                |                                |  |
|---|------|--------|--------|--------|-------|--------------------------------|--------------------------------|--------------------------------|--|
| For Sub-Frame 5                                 | Bits | 75840  | 115008 | 155808 | 25200 | 109440                         | 169920                         | 241920                         |  |
| For Sub-Frame 6                                 | Bits | 0      | 0      | 0      | 25200 | 0                              | 0                              | 0                              |  |
| Number of layers                                |      | 4      | 4      | 4      | 1     | 8                              | 8                              | 8                              |  |
| Max. Throughput averaged over 1 frame (Note 10) | Mbps | 25.058 | 37.222 | 50.996 | 8.237 | 77.877                         | 117.96                         | 161.99                         |  |
| UE Category                                     |      | ≥ 6    | ≥ 6    | ≥ 6    | ≥ 1   | 8                              | 8                              | 8                              |  |
| UE DL Category                                  |      |        |        |        |       | 14, 17,18,19,20,22,23,24,25,26 | 14, 17,18,19,20,22,23,24,25,26 | 14, 17,18,19,20,22,23,24,25,26 |  |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
- Note 3: As per Table 4.2-2 in TS 36.211 [4].
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: The first RBG, i.e. resource blocks  $n_{PRB} = 0..2$  for 10MHz channel bandwidth,  $n_{PRB} = 0..3$  for 15MHz and 20MHz channel bandwidths are allocated for SIB transmissions in sub-frame 5.
- Note 6: Void
- Note 7: Resource blocks  $n_{PRB} = 3..49$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..49$  in other available downlink sub-frames according to uplink downlink configurations used .
- Note 8: Void
- Note 9: Void
- Note10: Given per component carrier per codeword.
- Note11: Resource blocks  $n_{PRB} = 4..74$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..74$  in other downlink sub-frames.
- Note 12: Resource blocks  $n_{PRB} = 4..99$  are allocated for the user data in sub-frame 5, and resource blocks  $n_{PRB} = 0..99$  in other downlink sub-frames.
- Note 13: Resource blocks  $n_{PRB} = 8..35$  are allocated for the user data in all sub-frames.
- Note 14: 84 resource blocks  $n_{PRB} = 4..43$  and  $n_{PRB} = 56..99$  are allocated for the user data in sub-frame 5, and 88 resource blocks  $n_{PRB} = 0..43$  and  $n_{PRB} = 56..99$  are allocated for the user data in sub-frame 0, and 100 resource blocks  $n_{PRB} = 0..99$  in other downlink sub-frames.
- Note 15: 59 resource blocks  $n_{PRB} = 4..31$  and  $n_{PRB} = 44..74$  are allocated for the user data in sub-frame 5, and 63 resource blocks  $n_{PRB} = 0..31$  and  $n_{PRB} = 44..74$  are allocated for the user data in sub-frame 0, and 75 resource blocks  $n_{PRB} = 0..74$  in other downlink sub-frames.
- Note 16: 38 resource blocks  $n_{PRB} = 3..20$  and  $n_{PRB} = 30..49$  are allocated for the user data in sub-frame 5, and 41 resource blocks  $n_{PRB} = 0..20$  and  $n_{PRB} = 30..49$  are allocated for the user data in sub-frame 0, and 50 resource blocks  $n_{PRB} = 0..49$  in other available downlink sub-frames according to uplink downlink configurations used.

**Table A.3.9.2-2: Fixed Reference Channel for sustained data-rate test (TDD 256QAM)**

| Parameter                                      | Unit      | Value    |            |            |            |            |
|--|-----------|----------|------------|------------|------------|------------|
|  |           | R.68 TDD | R.68-1 TDD | R.68-2 TDD | R.68-3 TDD | R.68-4 TDD |
| Reference channel                              |           |          |            |            |            |            |
| Channel bandwidth                              | MHz       | 20       | 15         | 10         | 20         | 15         |
| Allocated resource blocks                      | PRB       | Note 6   | Note 7     | Note 8     | Note 6     | Note 7     |
| Uplink-Downlink Configuration (Note 3)         |           | 1        | 1          | 1          | [2]        | [2]        |
| Number of HARQ Processes per component carrier | Processes | 7        | 7          | 7          | [10]       | [10]       |
| Allocated subframes per Radio Frame (D+S)      |           | 4+2      | 4+2        | 4+2        | [6+2]      | [6+2]      |
| Modulation                                     |           | 256QAM   | 256QAM     | 256QAM     | 256QAM     | 256QAM     |
| Target Coding Rate                             |           |          |            |            |            |            |
| For Sub-Frame 0                                |           | 0.76     | 0.77       | 0.78       | 0.76       | 0.77       |
| For Sub-Frame 1                                |           | N/A      | N/A        | N/A        | N/A        | N/A        |
| For Sub-Frames 3                               |           | N/A      | N/A        | N/A        | 0.74       | 0.79       |
| For Sub-Frames 4                               |           | 0.74     | 0.79       | 0.74       | 0.74       | 0.79       |
| For Sub-Frame 5                                |           | 0.74     | 0.76       | 0.76       | 0.74       | 0.76       |
| For Sub-Frame 6                                |           | N/A      | N/A        | N/A        | [N/A]      | [N/A]      |
| For Sub-Frame 7                                |           | N/A      | N/A        | N/A        | [N/A]      | [N/A]      |
| For Sub-Frames 8                               |           | N/A      | N/A        | N/A        | 0.85       | 0.88       |
| For Sub-Frames 9                               |           | 0.85     | 0.88       | 0.85       | 0.85       | 0.88       |
| Information Bit Payload                        |           |          |            |            |            |            |
| For Sub-Frame 0                                | Bits      | 84760    | 63776      | 42368      | 84760      | 63776      |
| For Sub-Frame 1                                | Bits      | 0        | 0          | 0          | 0          | 0          |
| For Sub-Frames 3                               | Bits      | N/A      | N/A        | N/A        | 84760      | 63776      |

|   |      |        |        |        |          |          |  |
|---|------|--------|--------|--------|----------|----------|--|
| For Sub-Frames 4  | Bits | 84760  | 63776  | 42368  | 84760    | 63776    |  |
| For Sub-Frame 5   | Bits | 81176  | 61664  | 40576  | 81176    | 61664    |  |
| For Sub-Frame 6   | Bits | 0      | 0      | 0      | [0]      | [0]      |  |
| For Sub-Frame 7   |      | N/A    | N/A    | N/A    | [N/A]    | [N/A]    |  |
| For Sub-Frames 8  | Bits | N/A    | N/A    | N/A    | 97896    | 75376    |  |
| For Sub-Frames 9  | Bits | 97896  | 75376  | 48936  | 97896    | 75376    |  |
| Number of Code Blocks per Sub-Frame (Note 4)  |      |        |        |        |          |          |  |
| For Sub-Frame 0   |      | 14     | 11     | 7      | 14       | 11       |  |
| For Sub-Frame 1   |      | N/A    | N/A    | N/A    | N/A      | N/A      |  |
| For Sub-Frames 3  |      | N/A    | N/A    | N/A    | 14       | 11       |  |
| For Sub-Frames 4  |      | 14     | 11     | 7      | 14       | 11       |  |
| For Sub-Frame 5   |      | 14     | 11     | 7      | 14       | 11       |  |
| For Sub-Frame 6   |      | N/A    | N/A    | N/A    | [N/A]    | [11]     |  |
| For Sub-Frame 7   |      | N/A    | N/A    | N/A    | [N/A]    | [11]     |  |
| For Sub-Frames 8  |      | N/A    | N/A    | N/A    | 16       | 13       |  |
| For Sub-Frames 9  |      | 16     | 13     | 8      | 16       | 13       |  |
| Binary Channel Bits Per Sub-Frame   |      |        |        |        |          |          |  |
| For Sub-Frame 0   | Bits | 112512 | 83712  | 54912  | 112512   | 83712    |  |
| For Sub-Frame 1   | Bits | 0      | 0      | 0      | 0        | 0        |  |
| For Sub-Frames 3  | Bits | N/A    | N/A    | N/A    | 115200   | 86400    |  |
| For Sub-Frames 4  | Bits | 115200 | 86400  | 57600  | 115200   | 86400    |  |
| For Sub-Frame 5   |      | 110016 | 81216  | 53568  | 110016   | 81216    |  |
| For Sub-Frame 6   | Bits | 0      | 0      | 0      | [0]      | [0]      |  |
| For Sub-Frame 7   |      | N/A    | N/A    | N/A    | [N/A]    | [N/A]    |  |
| For Sub-Frames 8  | Bits | N/A    | N/A    | N/A    | 115200   | 86400    |  |
| For Sub-Frames 9  | Bits | 115200 | 86400  | 57600  | 115200   | 86400    |  |
| Number of layers  |      | 2      | 2      | 2      | 2        | 2        |  |
| Max. Throughput averaged over 1 frame (Note 5)  | Mbps | 34.859 | 26.459 | 17.425 | [53.125] | [40.374] |  |
| UE Categories   |      | 11-12  | 11-12  | 11-12  | 11-12    | 11-12    |  |
| UE DL Categories  |      | ≥ 11   | ≥ 11   | ≥ 11   | ≥ 11     | ≥ 11     |  |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: As per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 5: Given per component carrier per codeword.</p> <p>Note 6: Resource blocks <math>n_{PRB} = 4..99</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..99</math> in other downlink sub-frames.</p> <p>Note 7: Resource blocks <math>n_{PRB} = 4..74</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..74</math> in other downlink sub-frames.</p> <p>Note 8: Resource blocks <math>n_{PRB} = 3..49</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..49</math> in the available downlink sub-frames according to uplink downlink configurations used.</p> |      |        |        |        |          |          |  |

**Table A.3.9.2-3: Fixed Reference Channel for sustained data-rate test (TDD 256QAM)**

| Parameter                              | Unit      | Value      |            |            |            |            |             |
|--|-----------|------------|------------|------------|------------|------------|-------------|
|  |           | R.68-5 TDD | R.68-6 TDD | R.68-7 TDD | R.68-8 TDD | R.68-9 TDD | R.68-10 TDD |
| Reference channel                      |           |            |            |            |            |            |             |
| Channel bandwidth                      | MHz       | 10         | 15         | 20         | 10         | 15         | 20          |
| Allocated resource blocks              | PRB       | Note 8     | Note 7     | Note 6     | Note 10    | Note 11    | Note 12     |
| Uplink-Downlink Configuration (Note 3) |           | 1          | 1          | 1          | 1          | 1          | 1           |
| Number of HARQ Processes               | Processes | 7          | 7          | 7          | 7          | 7          | 7           |

|   |      |        |        |        |        |        |        |
|---|------|--------|--------|--------|--------|--------|--------|
| s per component carrier                   |      |        |        |        |        |        |        |
| Allocated subframes per Radio Frame (D+S) |      | 4+2    | 4+2    | 4+2    | 4      | 4      | 4      |
| Modulation                                |      | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding Rate                        |      |        |        |        |        |        |        |
| For Sub-Frame 0                           |      | 0.82   | 0.82   | 0.80   | 0.70   | 0.70   | 0.70   |
| For Sub-Frame 1                           |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 3                          |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 4                          |      | 0.78   | 0.79   | 0.78   | 0.77   | 0.76   | 0.77   |
| For Sub-Frame 5                           |      | 0.81   | 0.82   | 0.78   | 0.70   | 0.70   | 0.69   |
| For Sub-Frame 6                           |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 7                           |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 8                          |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 9                          |      | 0.78   | 0.79   | 0.78   | 0.77   | 0.76   | 0.77   |
| Information Bit Payload                   |      |        |        |        |        |        |        |
| For Sub-Frame 0                           | Bits | 84760  | 128496 | 169544 | 110136 | 169544 | 236160 |
| For Sub-Frame 1                           | Bits | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frames 3                          | Bits | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 4                          | Bits | 84760  | 128496 | 169544 | 133208 | 195816 | 266440 |
| For Sub-Frame 5                           | Bits | 81176  | 124464 | 161760 | 101840 | 157432 | 220296 |
| For Sub-Frame 6                           | Bits | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frame 7                           |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |

|  |      |        |        |        |        |        |        |
|--|------|--------|--------|--------|--------|--------|--------|
| For Sub-Frames 8                             | Bits | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 9                             | Bits | 84760  | 128496 | 169544 | 133208 | 195816 | 266440 |
| Number of Code Blocks per Sub-Frame (Note 4) |      |        |        |        |        |        |        |
| For Sub-Frame 0                              |      | 14     | 21     | 28     | 18     | 28     | 39     |
| For Sub-Frame 1                              |      | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frames 3                             |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 4                             |      | 14     | 21     | 28     | 22     | 32     | 44     |
| For Sub-Frame 5                              |      | 14     | 21     | 27     | 17     | 26     | 36     |
| For Sub-Frame 6                              |      | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frame 7                              |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 8                             |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 9                             |      | 14     | 21     | 28     | 22     | 32     | 44     |
| Binary Channel Bits Per Sub-Frame            |      |        |        |        |        |        |        |
| For Sub-Frame 0                              | Bits | 103808 | 158208 | 212608 | 157440 | 241920 | 337920 |
| For Sub-Frame 1                              | Bits | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frames 3                             | Bits | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 4                             | Bits | 108800 | 163200 | 217600 | 172800 | 259200 | 345600 |
| For Sub-Frame 5                              |      | 101120 | 153344 | 207744 | 145920 | 226560 | 322560 |
| For Sub-Frame 6                              | Bits | 0      | 0      | 0      | 0      | 0      | 0      |
| For Sub-Frame 7                              |      | N/A    | N/A    | N/A    | N/A    | N/A    | N/A    |

|  |      |        |        |        |                                |                                |                                |
|--|------|--------|--------|--------|--------------------------------|--------------------------------|--------------------------------|
| For Sub-Frames 8   | Bits | N/A    | N/A    | N/A    | N/A                            | N/A                            | N/A                            |
| For Sub-Frames 9   | Bits | 108800 | 163200 | 217600 | 172800                         | 259200                         | 345600                         |
| Number of layers   |      | 4      | 4      | 4      | 8                              | 8                              | 8                              |
| Max. Throughput averaged over 1 frame (Note 5)   | Mbps | 33.546 | 50.995 | 67.039 | 95.678                         | 143.722                        | 197.867                        |
| UE Categories  |      | 11-12  | 11-12  | 11-12  | 8                              | 8                              | 8                              |
| UE DL Categories   |      | 13-14  | 13-14  | 13-14  | 14, 17,18,19,20,22,23,24,25,26 | 14, 17,18,19,20,22,23,24,25,26 | 14, 17,18,19,20,22,23,24,25,26 |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: As per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 5: Given per component carrier per codeword.</p> <p>Note 6: Resource blocks <math>n_{PRB} = 4..99</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..99</math> in other downlink sub-frames.</p> <p>Note 7: Resource blocks <math>n_{PRB} = 4..74</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..74</math> in other downlink sub-frames.</p> <p>Note 8: Resource blocks <math>n_{PRB} = 3..49</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..49</math> in the available downlink sub-frames according to uplink downlink configurations used.</p> <p>Note 9: The first RBG, i.e. resource blocks <math>n_{PRB} = 0..2</math> for 10MHz channel bandwidth, <math>n_{PRB} = 0..3</math> for 15MHz and 20MHz channel bandwidths are allocated for SIB transmissions in sub-frame 5.</p> <p>Note 10: 84 resource blocks <math>n_{PRB} = 4..43</math> and <math>n_{PRB} = 56..99</math> are allocated for the user data in sub-frame 5, and 88 resource blocks <math>n_{PRB} = 0..43</math> and <math>n_{PRB} = 56..99</math> are allocated for the user data in sub-frame 0, and 100 resource blocks <math>n_{PRB} = 0..99</math> in other downlink sub-frames.</p> <p>Note 11: 59 resource blocks <math>n_{PRB} = 4..31</math> and <math>n_{PRB} = 44..74</math> are allocated for the user data in sub-frame 5, and 63 resource blocks <math>n_{PRB} = 0..31</math> and <math>n_{PRB} = 44..74</math> are allocated for the user data in sub-frame 0, and 75 resource blocks <math>n_{PRB} = 0..74</math> in other downlink sub-frames.</p> <p>Note 12: 38 resource blocks <math>n_{PRB} = 3..20</math> and <math>n_{PRB} = 30..49</math> are allocated for the user data in sub-frame 5, and 41 resource blocks <math>n_{PRB} = 0..20</math> and <math>n_{PRB} = 30..49</math> are allocated for the user data in sub-frame 0, and 50 resource blocks <math>n_{PRB} = 0..49</math> in other available downlink sub-frames according to uplink downlink configurations used.</p> |      |        |        |        |                                |                                |                                |

**Table A.3.9.2-4: Fixed Reference Channel for sustained data-rate test (TDD 1024QAM)**

| Parameter                                      | Unit      | Value     |             |             |             |             |             |
|--|-----------|-----------|-------------|-------------|-------------|-------------|-------------|
|  |           | R.105 TDD | R.105-1 TDD | R.105-2 TDD | R.105-3 TDD | R.105-4 TDD | R.105-5 TDD |
| Reference channel                              |           | R.105 TDD | R.105-1 TDD | R.105-2 TDD | R.105-3 TDD | R.105-4 TDD | R.105-5 TDD |
| Channel bandwidth                              | MHz       | 20        | 15          | 10          | 20          | 15          | 10          |
| Allocated resource blocks                      | PRB       | Note 6    | Note 7      | Note 8      | Note 6      | Note 7      | Note 8      |
| Uplink-Downlink Configuration (Note 3)         |           | 1         | 1           | 1           | 1           | 1           | 1           |
| Number of HARQ Processes per component carrier | Processes | 7         | 7           | 7           | 7           | 7           | 7           |
| Allocated subframes per Radio Frame (D+S)      |           | 4+2       | 4+2         | 4+2         | 4+2         | 4+2         | 4+2         |
| Modulation                                     |           | 1024QAM   | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     | 1024QAM     |
| Target Coding Rate                             |           |           |             |             |             |             |             |
| For Sub-Frame 0                                |           | 0.78      | 0.78        | 0.80        | 0.83        | 0.82        | 0.85        |
| For Sub-Frame 1                                |           | N/A       | N/A         | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frames 3                               |           | N/A       | N/A         | N/A         | N/A         | N/A         | N/A         |
| For Sub-Frames 4                               |           | 0.76      | 0.75        | 0.76        | 0.81        | 0.79        | 0.81        |
| For Sub-Frame 5                                |           | 0.77      | 0.78        | 0.76        | 0.82        | 0.82        | 0.81        |

|  |  |         |         |         |         |         |         |
|--|--|---------|---------|---------|---------|---------|---------|
| For Sub-Frame 6                                |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frame 7                                |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 8                               |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 9                               |  | 0.76    | 0.75    | 0.76    | 0.81    | 0.79    | 0.81    |
| Information Bit Payload                        |  |         |         |         |         |         |         |
| For Sub-Frame 0                                | Bits   | 110136  | 81176   | 55056   | 220296  | 161760  | 110136  |
| For Sub-Frame 1                                | Bits   | 0       | 0       | 0       | 0       | 0       | 0       |
| For Sub-Frames 3                               | Bits   | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 4                               | Bits   | 110136  | 81176   | 55056   | 220296  | 161760  | 110136  |
| For Sub-Frame 5                                | Bits   | 105528  | 78704   | 51024   | 211936  | 157432  | 101840  |
| For Sub-Frame 6                                | Bits   | 0       | 0       | 0       | 0       | 0       | 0       |
| For Sub-Frame 7                                |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 8                               | Bits   | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 9                               | Bits   | 110136  | 81176   | 55056   | 220296  | 161760  | 110136  |
| Number of Code Blocks per Sub-Frame (Note 4)   |  |         |         |         |         |         |         |
| For Sub-Frame 0                                |  | 18      | 14      | 9       | 36      | 27      | 18      |
| For Sub-Frame 1                                |  | N/A     | N/A     | N/A     | 0       | 0       | 0       |
| For Sub-Frames 3                               |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 4                               |  | 18      | 14      | 9       | 36      | 27      | 18      |
| For Sub-Frame 5                                |  | 18      | 13      | 9       | 35      | 26      | 17      |
| For Sub-Frame 6                                |  | N/A     | N/A     | N/A     | 0       | 0       | 0       |
| For Sub-Frame 7                                |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 8                               |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 9                               |  | 18      | 14      | 9       | 36      | 27      | 18      |
| Binary Channel Bits Per Sub-Frame              |  |         |         |         |         |         |         |
| For Sub-Frame 0                                | Bits   | 140640  | 104640  | 68640   | 265760  | 197760  | 129760  |
| For Sub-Frame 1                                | Bits   | 0       | 0       | 0       | 0       | 0       | 0       |
| For Sub-Frames 3                               | Bits   | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 4                               | Bits   | 144000  | 108000  | 72000   | 272000  | 204000  | 136000  |
| For Sub-Frame 5                                |  | 137520  | 101520  | 66960   | 259680  | 191680  | 126400  |
| For Sub-Frame 6                                | Bits   | 0       | 0       | 0       | 0       | 0       | 0       |
| For Sub-Frame 7                                |  | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 8                               | Bits   | N/A     | N/A     | N/A     | N/A     | N/A     | N/A     |
| For Sub-Frames 9                               | Bits   | 144000  | 108000  | 72000   | 272000  | 204000  | 136000  |
| Number of layers                               |  | 2       | 2       | 2       | 4       | 4       | 4       |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps   | 43.5936 | 32.2232 | 20.928  | 87.2824 | 64.2712 | 43.2248 |
| UE DL Categories                               |  | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 | 20, ≥22 |
| Note 1:  | 1 symbol allocated to PDCCH for all tests.   |         |         |         |         |         |         |
| Note 2:  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |         |         |         |         |         |         |
| Note 3:  | As per Table 4.2-2 in TS 36.211 [4].   |         |         |         |         |         |         |
| Note 4:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  |         |         |         |         |         |         |
| Note 5:  | Given per component carrier per codeword.  |         |         |         |         |         |         |
| Note 6:  | Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in other downlink sub-frames.  |         |         |         |         |         |         |
| Note 7:  | Resource blocks $n_{PRB} = 4..74$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..74$ in other downlink sub-frames.  |         |         |         |         |         |         |
| Note 8:  | Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in the available downlink sub-frames according to uplink downlink configurations used. |         |         |         |         |         |         |

### A.3.9.3 FDD (EPDCCH scheduling)

**Table A.3.9.3-1: Fixed Reference Channel for sustained data-rate test with EPDCCH scheduling (FDD)**

| Parameter                          | Unit | Value       |             |             |              |              |             |              |
|------------------------------------|------|-------------|-------------|-------------|--------------|--------------|-------------|--------------|
|                                    |      | R.31E-1 FDD | R.31E-2 FDD | R.31E-3 FDD | R.31E-3A FDD | R.31E-3C FDD | R.31E-4 FDD | R.31E-4B FDD |
| Reference channel                  |      |             |             |             |              |              |             |              |
| Channel bandwidth                  | MHz  | 10          | 10          | 20          | 10           | 15           | 20          | 15           |
| Allocated resource blocks (Note 8) |      | Note 5      | Note 6      | Note 7      | Note 6       | Note 9       | Note 7      | Note 10      |



|   |      |        |        |        |        |        |        |        |
|---|------|--------|--------|--------|--------|--------|--------|--------|
| Allocated subframes per Radio Frame   |      | 10     | 10     | 10     | 10     | 10     | 10     | 10     |
| Modulation  |      | 64QAM  | 64QAM  | 64QAM  | 64QAM  | 64QAM  | 64QAM  | 64QAM  |
| Coding Rate (subframes with PDCCH USS monitoring)   |      |        |        |        |        |        |        |        |
| For Sub-Frame 1,2,3,4,6,7,8,9,  |      | 0.3972 | 0.5926 | 0.5933 | 0.8533 | 0.8725 | 0.8763 | 0.8533 |
| For Sub-Frame 5   |      | 0.3972 | 0.6441 | 0.6246 | 0.8889 | 0.8855 | 0.8702 | 0.8762 |
| For Sub-Frame 0   |      | 0.3972 | 0.6282 | 0.6106 | 0.9046 | 0.9105 | 0.9018 | 0.8868 |
| Coding Rate (subframes with EPDCCH USS monitoring)  |      |        |        |        |        |        |        |        |
| For Sub-Frame 1,2,3,4,6,7,8,9,  |      | 0.4114 | 0.6047 | 0.5993 | 0.8707 | 0.8855 | 0.8851 | 0.8649 |
| For Sub-Frame 5   |      | 0.4114 | 0.6584 | 0.6312 | 0.9086 | 0.8990 | 0.8794 | 0.8889 |
| For Sub-Frame 0   |      | 0.4114 | 0.6418 | 0.6170 | 0.9242 | 0.9246 | 0.9112 | 0.8993 |
| Information Bit Payload (Note 8)  |      |        |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 10296  | 25456  | 51024  | 36696  | 51024  | 75376  | 55056  |
| For Sub-Frame 5   | Bits | 10296  | 25456  | 51024  | 35160  | 51024  | 71112  | 52752  |
| For Sub-Frame 0   | Bits | 10296  | 25456  | 51024  | 36696  | 51024  | 75376  | 55056  |
| Number of Code Blocks (Notes 3 and 8)   |      |        |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 2      | 5      | 9      | 6      | 9      | 13     | 9      |
| For Sub-Frame 5   | Bits | 2      | 5      | 9      | 6      | 9      | 12     | 9      |
| For Sub-Frame 0   | Bits | 2      | 5      | 9      | 6      | 9      | 13     | 9      |
| Binary Channel Bits (Note 8) (subframes with PDCCH USS monitoring)  |      |        |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 26100  | 43200  | 86400  | 43200  | 58752  | 86400  | 64800  |
| For Sub-Frame 5   | Bits | 26100  | 39744  | 82080  | 39744  | 57888  | 82080  | 60480  |
| For Sub-Frame 0   | Bits | 26100  | 40752  | 83952  | 40752  | 56304  | 83952  | 62352  |
| Binary Channel Bits (Note 8) (subframes with EPDCCH USS monitoring)   |      |        |        |        |        |        |        |        |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits | 25200  | 42336  | 85536  | 42336  | 57888  | 85536  | 63936  |
| For Sub-Frame 5   | Bits | 25200  | 38880  | 81216  | 38880  | 57024  | 81216  | 59616  |
| For Sub-Frame 0   | Bits | 25200  | 39888  | 83088  | 39888  | 55440  | 83088  | 61488  |
| Number of layers  |      | 1      | 2      | 2      | 2      | 2      | 2      | 2      |
| Max. Throughput averaged over 1 frame (Note 8)  | Mbps | 10.296 | 25.456 | 51.024 | 36.542 | 51.024 | 74.950 | 54.826 |
| UE Categories   |      | ≥ 1    | ≥ 2    | ≥ 2    | ≥ 2    | ≥ 3    | ≥ 3    | ≥ 4    |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211.</p> <p>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> <p>Note 4: Resource blocks <math>n_{PRB} = 0..2</math> are allocated for SIB transmissions in sub-frame 5 for all bandwidths.</p> <p>Note 5: Resource blocks <math>n_{PRB} = 6..14,30..49</math> are allocated for the user data in all sub-frames.</p> <p>Note 6: Resource blocks <math>n_{PRB} = 3..49</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..49</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 7: Resource blocks <math>n_{PRB} = 4..99</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..99</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> <p>Note 8: Given per component carrier per codeword.</p> <p>Note 9: Resource blocks <math>n_{PRB} = 4..71</math> are allocated for the user data in sub-frames 0,1,2,3,4,5,6,7,8,9.</p> <p>Note 10: Resource blocks <math>n_{PRB} = 4..74</math> are allocated for the user data in sub-frame 5, and resource blocks <math>n_{PRB} = 0..74</math> in sub-frames 0,1,2,3,4,6,7,8,9.</p> |      |        |        |        |        |        |        |        |

A.3.9.4 TDD (EPDCCH scheduling)

Table A.3.9.4-1: Fixed Reference Channel for sustained data-rate with EPDCCH scheduling (TDD)

| Parameter                 | Unit | Value       |             |             |              |             |
|---------------------------|------|-------------|-------------|-------------|--------------|-------------|
| Reference channel         |      | R.31E-1 TDD | R.31E-2 TDD | R.31E-3 TDD | R.31E-3A TDD | R.31E-4 TDD |
| Channel bandwidth         | MHz  | 10          | 10          | 20          | 15           | 20          |
| Allocated resource blocks |      | Note 6      | Note 7      | Note 8      | Note 9       | Note 8      |

|  |           |        |        |        |        |        |
|--|-----------|--------|--------|--------|--------|--------|
| Uplink-Downlink Configuration (Note 3)   |           | 5      | 5      | 5      | 1      | 1      |
| Number of HARQ Processes per component carrier   | Processes | 15     | 15     | 15     | 7      | 7      |
| Allocated subframes per Radio Frame (D+S)  |           | 8+1    | 8+1    | 8+1    | 4      | 4      |
| Coding Rate (subframes with PDCCH USS monitoring)  |           |        |        |        |        |        |
| For Sub-Frames 4,9   |           | 0.3972 | 0.5926 | 0.5933 | 0.8725 | 0.8763 |
| For Sub-Frames 3,7,8   |           | 0.3972 | 0.5926 | 0.5933 | N/A    | N/A    |
| For Sub-Frames 1   |           | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 5   |           | 0.3972 | 0.6372 | 0.6213 | 0.8790 | 0.8656 |
| For Sub-Frames 6   |           | 0.3972 | 0.5986 | 0.5963 | N/A    | N/A    |
| For Sub-Frames 0   |           | 0.3972 | 0.6216 | 0.6075 | 0.9036 | 0.8972 |
| Coding Rate (subframes with EPDCCH USS monitoring)   |           |        |        |        |        |        |
| For Sub-Frames 4,9   |           | 0.4114 | 0.6047 | 0.5993 | 0.8856 | 0.8851 |
| For Sub-Frames 3,7,8   |           | 0.4114 | 0.6047 | 0.5993 | N/A    | N/A    |
| For Sub-Frames 1   |           | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frames 5   |           | 0.4114 | 0.6512 | 0.6279 | 0.8922 | 0.8748 |
| For Sub-Frames 6   |           | 0.4114 | 0.6109 | 0.6024 | N/A    | N/A    |
| For Sub-Frames 0   |           | 0.4114 | 0.6349 | 0.6138 | 0.9175 | 0.9065 |
| Information Bit Payload  |           |        |        |        |        |        |
| For Sub-Frames 4,9   | Bits      | 10296  | 25456  | 51024  | 51024  | 75376  |
| For Sub-Frames 3,7,8   | Bits      | 10296  | 25456  | 51024  | N/A    | N/A    |
| For Sub-Frame 1  | Bits      | 0      | 0      | 0      | N/A    | N/A    |
| For Sub-Frame 5  | Bits      | 10296  | 25456  | 51024  | 51024  | 71112  |
| For Sub-Frame 6  | Bits      | 10296  | 25456  | 51024  | N/A    | N/A    |
| For Sub-Frame 0  | Bits      | 10296  | 25456  | 51024  | 51024  | 75376  |
| Number of Code Blocks per Sub-Frame (Note 4)   |           |        |        |        |        |        |
| For Sub-Frames 4,9   |           | 2      | 5      | 9      | 9      | 13     |
| For Sub-Frames 3,7,8   |           | 2      | 5      | 9      | N/A    | N/A    |
| For Sub-Frame 1  |           | N/A    | N/A    | N/A    | N/A    | N/A    |
| For Sub-Frame 5  |           | 2      | 5      | 9      | 9      | 12     |
| For Sub-Frame 6  | Bits      | 2      | 5      | 9      | N/A    | N/A    |
| For Sub-Frame 0  |           | 2      | 5      | 9      | 9      | 13     |
| Binary Channel Bits per Sub-Frame (subframes with PDCCH USS monitoring)  |           |        |        |        |        |        |
| For Sub-Frames 4,9   | Bits      | 26100  | 43200  | 86400  | 58752  | 86400  |
| For Sub-Frames 3,7,8   | Bits      | 26100  | 43200  | 86400  | N/A    | N/A    |
| For Sub-Frame 1  | Bits      | 0      | 0      | 0      | N/A    | N/A    |
| For Sub-Frame 5  | Bits      | 26100  | 40176  | 82512  | 58320  | 82512  |
| For Sub-Frame 6  | Bits      | 26100  | 42768  | 85968  | N/A    | N/A    |
| For Sub-Frame 0  | Bits      | 26100  | 41184  | 84384  | 56736  | 84384  |
| Binary Channel Bits per Sub-Frame (subframes with EPDCCH USS monitoring)   |           |        |        |        |        |        |
| For Sub-Frames 4,9   | Bits      | 25200  | 42336  | 85536  | 57888  | 85536  |
| For Sub-Frames 3,7,8   | Bits      | 25200  | 42336  | 85536  | N/A    | N/A    |
| For Sub-Frame 1  | Bits      | 0      | 0      | 0      | N/A    | N/A    |
| For Sub-Frame 5  | Bits      | 25200  | 39312  | 81648  | 57456  | 81648  |
| For Sub-Frame 6  | Bits      | 25200  | 41904  | 85104  | N/A    | N/A    |
| For Sub-Frame 0  | Bits      | 25200  | 40320  | 83520  | 55872  | 83520  |
| Number of layers   |           | 1      | 2      | 2      | 2      | 2      |
| Max. Throughput averaged over 1 frame (Note 10)  | Mbps      | 8.237  | 20.365 | 40.819 | 20.409 | 29.724 |
| UE Category  |           | ≥ 1    | ≥ 2    | ≥ 2    | ≥ 2    | ≥ 3    |
| <p>Note 1: 1 symbol allocated to PDCCH for all tests.</p> <p>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].</p> <p>Note 3: As per Table 4.2-2 in TS 36.211 [4].</p> <p>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).</p> |           |        |        |        |        |        |

|         |  |
|---------|--|
| Note 5: | Resource blocks $n_{PRB} = 0..2$ are allocated for SIB transmissions in sub-frame 5 for all bandwidths.  |
| Note 6: | Resource blocks $n_{PRB} = 6..14,30..49$ are allocated for the user data in all subframes.   |
| Note 7: | Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,6,7,8,9. |
| Note 8: | Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,6,7,8,9. |
| Note 9: | Resource blocks $n_{PRB} = 4..71$ are allocated for the user data in all sub-frames  |
| Note10: | Given per component carrier per codeword.  |

### A.3.9.5 LAA

**Table A.3.9.5-1: Fixed Reference Channel for sustained data-rate test (FS3 64QAM)**

| Parameter                                      | Unit  | Value   |         |         |          |          |          |
|--|---|---------|---------|---------|----------|----------|----------|
|  |   | R.5 FS3 | R.6 FS3 | R.7 FS3 | R.8 FS3  | R.9 FS3  | R.10 FS3 |
| Reference channel                              |   |         |         |         |          |          |          |
| Channel bandwidth                              | MHz   | 20      | 20      | 20      | 20       | 20       | 20       |
| Allocated resource blocks                      |   | 100     | 100     | 100     | 100      | 100      | 100      |
| Modulation                                     |   | 64QAM   | 64QAM   | 64QAM   | 64QAM    | 64QAM    | 64QAM    |
| Coding Rate                                    |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 0.89    | 0.89    | 0.90    | 0.80     | 0.80     | 0.81     |
| For Sub-Frames 1,2,3,4,6,7,8                   |   | 0.88    | 0.88    | 0.88    | 0.79     | 0.79     | 0.79     |
| For Sub-Frame 5                                |   | 0.89    | 0.89    | 0.89    | 0.80     | 0.80     | 0.80     |
| For Sub-Frame 9                                |   | N/A     | 0.77    | 0.88    | N/A      | 0.82     | 0.79     |
| Information Bit Payload (Note 7)               |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 75376   | 75376   | 36696   | 128496   | 128496   | 61664    |
| For Sub-Frames 1,2,3,4,6,7,8                   | Bits  | 75376   | 75376   | 75376   | 128496   | 128496   | 128496   |
| For Sub-Frame 5                                | Bits  | 75376   | 75376   | 75376   | 128496   | 128496   | 128496   |
| For Sub-Frame 9                                | Bits  | N/A     | 55056   | 75376   | N/A      | 110136   | 128496   |
| Number of Code Blocks (Notes 3 and 6)          |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 13      | 13      | 6       | 21       | 21       | 11       |
| For Sub-Frames 1,2,3,4,6,7,8                   |   | 13      | 13      | 13      | 21       | 21       | 21       |
| For Sub-Frame 5                                |   | 13      | 13      | 13      | 21       | 21       | 21       |
| For Sub-Frame 9                                |   | N/A     | 9       | 13      | N/A      | 18       | 21       |
| Binary Channel Bits (Note 7)                   |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 85536   | 85536   | 40800   | 161472   | 161472   | 76800    |
| For Sub-Frames 1,2,3,4,6,7,8                   | Bits  | 86400   | 86400   | 86400   | 163200   | 163200   | 163200   |
| For Sub-Frame 5                                | Bits  | 85536   | 85536   | 85536   | 161472   | 161472   | 161472   |
| For Sub-Frame 9                                | Bits  | N/A     | 72000   | 86400   | N/A      | 134400   | 163200   |
| Number of layers                               |   | 2       | 2       | 2       | 4        | 4        | 4        |
| Max. Throughput averaged over 1 frame (Note 7) | Mbps  | 67.8384 | 73.3440 | 71.5080 | 115.6464 | 126.6600 | 121.8128 |
| UE Categories                                  |   | ≥ 5     | ≥ 5     | ≥ 5     | ≥ 5      | ≥ 5      | ≥ 5      |
| Note 1:  | 1 symbol allocated to PDCCH for all tests.  |         |         |         |          |          |          |
| Note 2:  | Reference signal and synchronization signals are allocated as per TS 36.211 [4]. PBCH and SIBs are not allocated in FS3 cell.   |         |         |         |          |          |          |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of $L = 24$ Bits is attached to each Code Block (otherwise $L = 0$ Bit).                                     |         |         |         |          |          |          |
| Note 4:  | For R.5 FS3 and R.8 FS3, burst consists of 9 full subframes. Between two consecutive bursts, there is one subframe gap.   |         |         |         |          |          |          |
| Note 5:  | For R.6 FS3 and R.9 FS3, burst consists of 9 full subframes and 1 ending partial subframe that has 12 OFDM symbols. Between two consecutive bursts, there is 2 OFDM symbol gap. |         |         |         |          |          |          |
| Note 6:  | For R.7 FS3 and R.10 FS3, burst consists of 1 initial partial subframe and 9 full subframes. Between two consecutive bursts, there is 7 OFDM symbol gap.                        |         |         |         |          |          |          |
| Note 7:  | Given per component carrier per codeword.   |         |         |         |          |          |          |

**Table A.3.9.5-2: Fixed Reference Channel for sustained data-rate test (FS3 256QAM)**

| Parameter                 | Unit | Value    |          |          |          |          |          |
|---------------------------|------|----------|----------|----------|----------|----------|----------|
|                           |      | R.11 FS3 | R.12 FS3 | R.13 FS3 | R.14 FS3 | R.15 FS3 | R.16 FS3 |
| Reference channel         |      |          |          |          |          |          |          |
| Channel bandwidth         | MHz  | 20       | 20       | 20       | 20       | 20       | 20       |
| Allocated resource blocks |      | 100      | 100      | 100      | 100      | 100      | 100      |
| Modulation                |      | 256QAM   | 256QAM   | 256QAM   | 256QAM   | 256QAM   | 256QAM   |

|  |   |         |         |         |          |          |          |
|--|---|---------|---------|---------|----------|----------|----------|
| Coding Rate                                    |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 0.75    | 0.75    | 0.81    | 0.79     | 0.79     | 0.77     |
| For Sub-Frame 3,4,8                            |   | 0.85    | 0.85    | 0.85    | 0.78     | 0.78     | 0.78     |
| For Sub-Frame 1,2,6,7                          |   | 0.75    | 0.74    | 0.74    | 0.78     | 0.78     | 0.78     |
| For Sub-Frame 5                                |   | 0.75    | 0.75    | 0.75    | 0.79     | 0.79     | 0.79     |
| For Sub-Frame 9                                |   | N/A     | 0.79    | 0.85    | N/A      | 0.74     | 0.78     |
| Information Bit Payload (Note 7)               |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 84760   | 84760   | 43816   | 169544   | 169544   | 78704    |
| For Sub-Frame 3,4,8                            | Bits  | 97896   | 97896   | 97896   | 169544   | 169544   | 169544   |
| For Sub-Frame 1,2,6,7                          | Bits  | 84760   | 84760   | 84760   | 169544   | 169544   | 169544   |
| For Sub-Frame 5                                | Bits  | 84760   | 84760   | 84760   | 169544   | 169544   | 169544   |
| For Sub-Frame 9                                | Bits  | N/A     | 75376   | 97896   | N/A      | 133208   | 169544   |
| Number of Code Blocks (Notes 3 and 6)          |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 14      | 14      | 8       | 28       | 28       | 13       |
| For Sub-Frame 3,4,8                            |   | 16      | 16      | 16      | 28       | 28       | 28       |
| For Sub-Frame 1,2,6,7                          |   | 14      | 14      | 14      | 28       | 28       | 28       |
| For Sub-Frame 5                                |   | 14      | 14      | 14      | 28       | 28       | 28       |
| For Sub-Frame 9                                |   | N/A     | 13      | 16      | N/A      | 21       | 28       |
| Binary Channel Bits (Note 7)                   |   |         |         |         |          |          |          |
| For Sub-Frame 0                                |   | 114048  | 114048  | 54400   | 215296   | 215296   | 102400   |
| For Sub-Frame 3,4,8                            | Bits  | 115200  | 115200  | 115200  | 217600   | 217600   | 217600   |
| For Sub-Frame 1,2,6,7                          | Bits  | 115200  | 115200  | 115200  | 217600   | 217600   | 217600   |
| For Sub-Frame 5                                | Bits  | 114048  | 114048  | 114048  | 215296   | 215296   | 215296   |
| For Sub-Frame 9                                | Bits  | N/A     | 96000   | 115200  | N/A      | 179200   | 217600   |
| Number of layers                               |   | 2       | 2       | 2       | 4        | 4        | 4        |
| Max. Throughput averaged over 1 frame (Note 7) | Mbps  | 80.2248 | 87.7624 | 85.9200 | 152.5896 | 165.9104 | 160.4600 |
| UE DL Categories                               |   | ≥ 11    | ≥ 11    | ≥ 11    | ≥ 11     | ≥ 11     | ≥ 11     |
| Note 1:  | 1 symbol allocated to PDCCH for all tests.  |         |         |         |          |          |          |
| Note 2:  | Reference signal and synchronization signals are allocated as per TS 36.211 [4]. PBCH and SIBs are not allocated in FS3 cell.   |         |         |         |          |          |          |
| Note 3:  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |         |         |         |          |          |          |
| Note 4:  | For R.11 FS3 and R.14 FS3, burst consists of 9 full subframes. Between two consecutive bursts, there is one subframe gap.   |         |         |         |          |          |          |
| Note 5:  | For R.12 FS3 and R.15 FS3, burst consists of 9 full subframes and 1 ending partial subframe that has 12 OFDM symbols. Between two consecutive bursts, there is 2 OFDM symbol gap. |         |         |         |          |          |          |
| Note 6:  | For R.13 FS3 and R.16 FS3, burst consists of 1 initial partial subframe and 9 full subframes. Between two consecutive bursts, there is 7 OFDM symbol gap.                         |         |         |         |          |          |          |
| Note 7:  | Given per component carrier per codeword.   |         |         |         |          |          |          |

## A.3.10 Reference Measurement Channels for EPDCCH performance requirements

### A.3.10.1 FDD

Table A.3.10.1-1: Reference Channel FDD

| Parameter                        | Unit    | Value    |          |          |          |          |            |
|----------------------------------|---------|----------|----------|----------|----------|----------|------------|
|                                  |         | R.55 FDD | R.56 FDD | R.57 FDD | R.58 FDD | R.59 FDD | R.55-1 FDD |
| Reference channel                |         |          |          |          |          |          |            |
| Number of transmitter antennas   |         | 2        | 2        | 2        | 2        | 2        | 2          |
| Channel bandwidth                | MHz     | 10       | 10       | 10       | 10       | 10       | 10         |
| Number of OFDM symbols for PDCCH | symbols | 2        | 2        | 1        | 1        | 1        | 2          |
| Aggregation level                | ECCE    | 4        | 16       | 2        | 8        | 2        | 4          |
| DCI Format                       |         | 2A       | 2A       | 2C       | 2C       | 2D       | 2C         |

## A.3.10.2 TDD

**Table A.3.10.2-1: Reference Channel TDD**

| Parameter                        | Unit    | Value    |          |          |          |          |          |
|----------------------------------|---------|----------|----------|----------|----------|----------|----------|
|                                  |         | R.55 TDD | R.56 TDD | R.57 TDD | R.58 TDD | R.59 TDD | R.55 TDD |
| Reference channel                |         |          |          |          |          |          |          |
| Number of transmitter antennas   |         | 2        | 2        | 2        | 2        | 2        | 2        |
| Channel bandwidth                | MHz     | 10       | 10       | 10       | 10       | 10       | 10       |
| Number of OFDM symbols for PDCCH | symbols | 2        | 2        | 1        | 1        | 1        | 2        |
| Aggregation level                | CCE     | 4        | 16       | 2        | 8        | 2        | 4        |
| DCI Format                       |         | 2A       | 2A       | 2C       | 2C       | 2D       | 2C       |

## A.3.11 Reference Measurement Channels for MPDCCH performance requirements

### A.3.11.1 FDD and half-duplex FDD

**Table A.3.11.1-1: Reference Channel FDD and half-duplex FDD**

| Parameter                            | Unit    | Value           | Value                | Value           |
|--------------------------------------|---------|-----------------|----------------------|-----------------|
| Reference channel                    |         | R.82 FDD        | R.83 FDD             | R.96 FDD        |
| Number of transmitter antennas       |         | 2               | 2                    | 2               |
| Channel bandwidth                    | MHz     | 10              | 10                   | 10              |
| OFDM starting symbol (startSymbolLC) | symbols | 2               | 2                    | 2               |
| Aggregation level                    | ECCE    | 16              | 24                   | 4               |
| DCI Format                           |         | 6-1A            | 6-1B                 | 6-1A            |
| Payload (without CRC)                | Bits    | 29              | 18                   | 29              |
| PRB allocation                       |         | 8-th ~11-th PRB | As specified in Test | 8-th ~11-th PRB |

### A.3.11.2 TDD

**Table A.3.11.2-1: Reference Channel TDD**

| Parameter                            | Unit    | Value           | Value                | Value           |
|--------------------------------------|---------|-----------------|----------------------|-----------------|
| Reference channel                    |         | R.82 TDD        | R.83 TDD             | R.96 TDD        |
| Number of transmitter antennas       |         | 2               | 2                    | 2               |
| Channel bandwidth                    | MHz     | 10              | 10                   | 10              |
| OFDM starting symbol (startSymbolLC) | symbols | 2               | 2                    | 2               |
| Aggregation level                    | ECCE    | 16              | 24                   | 4               |
| DCI Format                           |         | 6-1A            | 6-1B                 | 6-1A            |
| Payload (without CRC)                | Bits    | 32              | 18                   | 32              |
| PRB allocation                       |         | 8-th ~11-th PRB | As specified in Test | 8-th ~11-th PRB |

## A.3.12 Reference measurement channels for NPDSCH performance requirements

### A.3.12.1 In-band

#### A.3.12.1.2 Two-antenna transmission

**Table A.3.12.1.2-1: NPDSCH Reference Channel with 2 TX Antennas for FDD**

| Parameter  | Unit | Value      | Value        |
|--|------|------------|--------------|
| Reference channel  |      | R.NB.5 FDD | R.NB.5-1 FDD |
| Carrier Type   |      | Anchor     | Non-anchor   |
| Channel bandwidth  | KHz  | 200        | 200          |
| Allocated subframes per Radio Frame  |      | Note 2     | Note 2       |
| Modulation   |      | QPSK       | QPSK         |
| $I_{TBS}/I_{SF}$   |      | 4/0        | 4/0          |
| Target Coding Rate   |      | 1/3        | 1/3          |
| Coding Rate  |      | 0.4        | 0.4          |
| Information Bit Payload  |      |            |              |
| For Sub-Frames 1,2,3,6,7,8   | Bits | 56         | 56           |
| For Sub-Frame 0,5  | Bits | N/A        | 56           |
| For Sub-Frame 4,9  | Bits | Note 3     | 56           |
| Number of Code Blocks  |      |            |              |
| For Sub-Frames 1,2,3,6,7,8   |      | 1          | 1            |
| For Sub-Frame 0,5  | Bits | N/A        | 1            |
| For Sub-Frame 4,9  | Bits | Note 4     | 1            |
| Binary Channel Bits  |      |            |              |
| For Sub-Frames 1,2,3,6,7,8   | Bits | 200        | 200          |
| For Sub-Frame 0,5  | Bits | N/A        | 200          |
| For Sub-Frame 4,9  | Bits | Note 5     | 200          |
| Max. Averaged Throughput   | Bps  | Note 6     | Note 6       |
| UE Category  |      | NB1,NB2    | NB1,NB2      |
| <p>Note 1: For in-band, the first 3 symbols are used for LTE PDCCH and the number of LTE CRS ports is 4.</p> <p>Note 2: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 3: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 56.</p> <p>Note 4: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 1.</p> <p>Note 5: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 200.</p> <p>Note 6: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the <math>i^{\text{th}}</math> NPDSCH scheduling period.</p> |      |            |              |

**Table A.3.12.1.2-2: NPDSCH Reference Channel with 2 TX Antennas for TDD**

| Parameter                              | Unit | Value      | Value        |
|--|------|------------|--------------|
| Reference channel                      |      | R.NB.5 TDD | R.NB.5-1 TDD |
| Carrier Type                           |      | Anchor     | Non-anchor   |
| Channel bandwidth                      | KHz  | 200        | 200          |
| Uplink-Downlink Configuration (Note 7) |      | 4          | 4            |
| Allocated subframes per Radio Frame    |      | Note 2     | Note 2       |
| Modulation                             |      | QPSK       | QPSK         |
| $I_{TBS}/I_{SF}$                       |      | 4/0        | 4/0          |
| Target Coding Rate                     |      | 1/3        | 1/3          |

|  |      |         |         |
|--|------|---------|---------|
| Coding Rate  |      | 0.4     | 0.4     |
| Information Bit Payload  |      |         |         |
| For Sub-Frames 1,6,7,8   | Bits | 56      | 56      |
| For Sub-Frame 5  | Bits | N/A     | Note 3  |
| For Sub-Frame 9  |      | N/A     | 56      |
| For Sub-Frame 0  | Bits | Note 3  | Note 3  |
| For Sub-Frame 4  |      | Note 3  | 56      |
| Number of Code Blocks  |      |         |         |
| For Sub-Frames 1,6,7,8   |      | 1       | 1       |
| For Sub-Frame 5  | Bits | N/A     | Note 4  |
| For Sub-Frame 9  |      | N/A     | 1       |
| For Sub-Frame 0  | Bits | Note 4  | Note 4  |
| For Sub-Frame 4  |      | Note 4  | 1       |
| Binary Channel Bits  |      |         |         |
| For Sub-Frames 1,6,7,8   | Bits | 200     | 200     |
| For Sub-Frame 5  | Bits | N/A     | Note 5  |
| For Sub-Frame 9  |      | N/A     | 200     |
| For Sub-Frame 0  | Bits | Note 5  | Note 5  |
| For Sub-Frame 4  |      | Note 5  | 200     |
| Max. Averaged Throughput   | Bps  | Note 6  | Note 6  |
| UE Category  |      | NB1,NB2 | NB1,NB2 |
| <p>Note 1: For in-band, the first 3 symbols are used for LTE PDCCH and the number of LTE CRS ports is 4.</p> <p>Note 2: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 3: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 56.</p> <p>Note 4: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 1.</p> <p>Note 5: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 200.</p> <p>Note 6: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the <math>i^{\text{th}}</math> NPDSCH scheduling period.</p> <p>Note 7: As per Table 4.2-2 in TS 36.211 [4].</p> |      |         |         |

### A.3.12.2 Standalone/Guard-band

#### A.3.12.2.1 Single-antenna transmission

**Table A.3.12.2.1-1: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB1 and NB2 for FDD**

| Parameter                           | Unit | Value      | Value        |
|-------------------------------------|------|------------|--------------|
| Reference channel                   |      | R.NB.6 FDD | R.NB.6-1 FDD |
| Carrier Type                        |      | Anchor     | Non-anchor   |
| Channel bandwidth                   | KHz  | 200        | 200          |
| Allocated subframes per Radio Frame |      | Note 1     | Note 1       |
| Modulation                          |      | QPSK       | QPSK         |
| $I_{\text{TBS}}/I_{\text{SF}}$      |      | 9/3        | 6/3          |
| Target Coding Rate                  |      | 1/2        | 1/3          |
| Coding Rate                         |      | 0.5        | 0.33         |
| Information Bit Payload             |      |            |              |
| For Sub-Frames 1,2,3,6,7,8          | Bits | 616        | 392          |
| For Sub-Frame 0,5                   | Bits | N/A        | 392          |
| For Sub-Frame 4,9                   | Bits | Note 2     | 392          |
| Number of Code Blocks               |      |            |              |
| For Sub-Frames 1,2,3,6,7,8          |      | 1          | 1            |
| For Sub-Frame 0,5                   | Bits | N/A        | 1            |
| For Sub-Frame 4,9                   | Bits | Note 3     | 1            |

|  |      |         |         |
|--|------|---------|---------|
| Binary Channel Bits  |      |         |         |
| For Sub-Frames 1,2,3,6,7,8   | Bits | 320     | 320     |
| For Sub-Frame 0,5  | Bits | N/A     | 320     |
| For Sub-Frame 4,9  | Bits | Note 4  | 320     |
| Max. Average Throughput  | Bps  | Note 5  | Note 5  |
| UE Category  |      | NB1,NB2 | NB1,NB2 |
| <p>Note 1: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 2: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 616.</p> <p>Note 3: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 1.</p> <p>Note 4: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 320.</p> <p>Note 5: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the <math>i^{\text{th}}</math> NPDSCH scheduling period.</p> |      |         |         |

**Table A.3.12.2.1-1a: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB1 and NB2 for TDD**

| Parameter   | Unit | Value      | Value        |
|---|------|------------|--------------|
| Reference channel   |      | R.NB.6 TDD | R.NB.6-1 TDD |
| Carrier Type  |      | Anchor     | Non-anchor   |
| Channel bandwidth   | KHz  | 200        | 200          |
| Uplink-Downlink Configuration (Note 7)  |      | 4          | 4            |
| Allocated subframes per Radio Frame   |      | Note 1     | Note 1       |
| Modulation  |      | QPSK       | QPSK         |
| $I_{\text{TBS}}/I_{\text{SF}}$  |      | 9/3        | 6/3          |
| Target Coding Rate  |      | 1/2        | 1/3          |
| Coding Rate   |      | 0.5        | 0.33         |
| Information Bit Payload   |      |            |              |
| For Sub-Frames 1,6,7,8  | Bits | 616        | 392          |
| For Sub-Frame 5   | Bits | N/A        | Note 3       |
| For Sub-Frame 9   |      | N/A        | 392          |
| For Sub-Frame 0   | Bits | Note 2     | Note 3       |
| For Sub-Frame 4   |      | Note 2     | 392          |
| Number of Code Blocks   |      |            |              |
| For Sub-Frames 1,6,7,8  |      | 1          | 1            |
| For Sub-Frame 5   | Bits | N/A        | Note 4       |
| For Sub-Frame 9   |      | N/A        | 1            |
| For Sub-Frame 0   | Bits | Note 4     | Note 4       |
| For Sub-Frame 4   |      | Note 4     | 1            |
| Binary Channel Bits   |      |            |              |
| For Sub-Frames 1,6,7,8  | Bits | 320        | 320          |
| For Sub-Frame 5   | Bits | N/A        | Note 5       |
| For Sub-Frame 9   |      | N/A        | 320          |
| For Sub-Frame 0   | Bits | Note 5     | Note 5       |
| For Sub-Frame 4   |      | Note 5     | 320          |
| Max. Average Throughput   | Bps  | Note 6     | Note 6       |
| UE Category   |      | NB1,NB2    | NB1,NB2      |
| <p>Note 1: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 2: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 616.</p> <p>Note 3: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 392.</p> <p>Note 4: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 1.</p> <p>Note 5: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 320.</p> <p>Note 6: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay,</p> |      |            |              |



NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the  $i^{\text{th}}$  NPDSCH scheduling period.

Note 7: As per Table 4.2-2 in TS 36.211 [4].

**Table A.3.12.2.1-2: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB2 for FDD**

| Parameter   | Unit | Value      | Value      |
|---|------|------------|------------|
| Reference channel   |      | R.NB.7 FDD | R.NB.8 FDD |
| Carrier Type  |      | Non-anchor | Non-anchor |
| Channel bandwidth   | KHz  | 200        | 200        |
| Allocated subframes per Radio Frame   |      | Note 1     | Note 1     |
| Modulation  |      | QPSK       | QPSK       |
| $T_{\text{BS}}/I_{\text{SF}}$   |      | 9/5        | 6/7        |
| Target Coding Rate  |      | 1/2        | 1/3        |
| Coding Rate   |      | 0.5        | 0.32       |
| Information Bit Payload   |      |            |            |
| For Sub-Frames 1,2,3,6,7,8  | Bits | 936        | 1032       |
| For Sub-Frame 0,5   | Bits | 936        | 1032       |
| For Sub-Frame 4,9   | Bits | 936        | 1032       |
| Number of Code Blocks   |      |            |            |
| For Sub-Frames 1,2,3,6,7,8  |      | 1          | 1          |
| For Sub-Frame 0,5   | Bits | 1          | 1          |
| For Sub-Frame 4,9   | Bits | 1          | 1          |
| Binary Channel Bits   |      |            |            |
| For Sub-Frames 1,2,3,6,7,8  | Bits | 320        | 320        |
| For Sub-Frame 0,5   | Bits | 320        | 320        |
| For Sub-Frame 4,9   | Bits | 320        | 320        |
| Max. Average Throughput   | Bps  | Note 2     | Note 2     |
| UE Category   |      | NB2        | NB2        |
| <p>Note 1: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 2: Maximum Average Throughput equals to sum of <math>TB(i)</math> divided by sum of <math>T(i)</math>, where <math>TB(i)</math> is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and <math>T(i)</math> is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the <math>i^{\text{th}}</math> NPDSCH scheduling period.</p> |      |            |            |

**Table A.3.12.2.1-2a: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB2 for TDD**

| Parameter                              | Unit | Value      | Value |
|--|------|------------|-------|
| Reference channel                      |      | R.NB.7 TDD |       |
| Carrier Type                           |      | Non-anchor |       |
| Channel bandwidth                      | KHz  | 200        |       |
| Uplink-Downlink Configuration (Note 7) |      | 4          |       |
| Allocated subframes per Radio Frame    |      | Note 1     |       |
| Modulation                             |      | QPSK       |       |
| $T_{\text{BS}}/I_{\text{SF}}$          |      | 9/5        |       |
| Target Coding Rate                     |      | 1/2        |       |
| Coding Rate                            |      | 0.5        |       |
| Information Bit Payload                |      |            |       |
| For Sub-Frames 1,6,7,8                 | Bits | 936        |       |
| For Sub-Frame 0,5                      | Bits | Note 2     |       |
| For Sub-Frame 4,9                      | Bits | 936        |       |
| Number of Code Blocks                  |      |            |       |
| For Sub-Frames 1,2,3,6,7,8             |      | 1          |       |
| For Sub-Frame 0,5                      | Bits | Note 3     |       |
| For Sub-Frame 4,9                      | Bits | 1          |       |
| Binary Channel Bits                    |      |            |       |

|  |      |        |  |
|--|------|--------|--|
| For Sub-Frames 1,2,3,6,7,8   | Bits | 320    |  |
| For Sub-Frame 0,5  | Bits | Note 4 |  |
| For Sub-Frame 4,9  | Bits | 320    |  |
| Max. Average Throughput  | Bps  | Note 5 |  |
| UE Category  |      | NB2    |  |
| <p>Note 1: It shall depend on the specific NPDSCH scheduling.</p> <p>Note 2: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 936.</p> <p>Note 3: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 1.</p> <p>Note 4: N/A when <math>n_f \bmod 2 = 0</math>, otherwise 320.</p> <p>Note 5: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over <math>i^{\text{th}}</math> NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the <math>i^{\text{th}}</math> NPDSCH scheduling period.</p> |      |        |  |

### A.3.13 Reference measurement channels for NPDCCH performance requirements

#### A.3.13.1 Half-duplex FDD

**Table A.3.13.1-1: NPDCCH Reference Channel for Category NB1 UE**

| Parameter             | Unit | Value      |            |
|-----------------------|------|------------|------------|
|                       |      | R.NB.3 FDD | R.NB.4 FDD |
| Reference channel     |      | R.NB.3 FDD | R.NB.4 FDD |
| Number of NRS ports   |      | 1          | 2          |
| Channel bandwidth     | MHz  | 0.2        | 0.2        |
| Aggregation level     | NCCE | 2          | 2          |
| DCI Format            |      | N1         | N1         |
| Payload (without CRC) | Bits | 23         | 23         |

#### A.3.13.2 TDD

**Table A.3.13.2-1: NPDCCH Reference Channel for Category NB1 UE**

| Parameter             | Unit | Value      |            |
|-----------------------|------|------------|------------|
|                       |      | R.NB.3 TDD | R.NB.4 TDD |
| Reference channel     |      | R.NB.3 TDD | R.NB.4 TDD |
| Number of NRS ports   |      | 1          | 2          |
| Channel bandwidth     | MHz  | 0.2        | 0.2        |
| Aggregation level     | NCCE | 2          | 2          |
| DCI Format            |      | N1         | N1         |
| Payload (without CRC) | Bits | 23         | 23         |

### A.3.14 Reference measurement channels for NPBCH performance requirements for Cat NB1 UEs

**Table A.3.14-1: NPBCH Reference Channel for Category NB1 UE**

| Parameter                      | Unit | Value   |         |
|--------------------------------|------|---------|---------|
|                                |      | R.NB.1  | R.NB.2  |
| Reference channel              |      | R.NB.1  | R.NB.2  |
| Number of transmitter antennas |      | 1       | 2       |
| Channel bandwidth              | KHz  | 200     | 200     |
| Modulation                     |      | QPSK    | QPSK    |
| Target coding rate             |      | 50/1600 | 50/1600 |

|                       |      |    |    |
|-----------------------|------|----|----|
| Payload (without CRC) | Bits | 34 | 34 |
|-----------------------|------|----|----|

## A.3.15 Reference Measurement Channels for LAA SCell with frame structure Type-3

### A.3.15.1 Multi-antenna transmission (Common Reference Symbols)

#### A.3.15.1.1 Four antenna ports

**Table A.3.15.1.1-2: Reference Channel with four CRS ports**

| Parameter                                | Unit   | Value                           |
|--|--|---------------------------------|
| Reference channel                        |  | R.1 FS3                         |
| Channel bandwidth                        | MHz  | 20                              |
| Allocated resource blocks (Note 4)       |  | 100                             |
| Allocated subframes per Radio Frame      |  | 10                              |
| Modulation                               |  | 64QAM                           |
| Target Coding Rate                       |  | 0.6                             |
| Information Bit Payload (Note 4)         |  |                                 |
| For Sub-Frames 1,4,6,9                   | Bits   | {46888,15840,24496,37888,19848} |
| For Sub-Frames 2, 7                      |  | {46888,15840,24496,37888,19848} |
| For Sub-Frames 3, 8                      |  | {46888,15840,24496,37888,19848} |
| For Sub-Frame 5                          | Bits   | {46888,15840,24496,37888,19848} |
| For Sub-Frame 0                          | Bits   | {46888,15840,24496,37888,19848} |
| Number of Code Blocks<br>(Notes 3 and 4) |  |                                 |
| For Sub-Frames 1,4,6,,9                  |  | {8,3,4,7,4}                     |
| For Sub-Frames 2,7                       |  | {8,3,4,7,4}                     |
| For Sub-Frames 3, 8                      |  | {8,3,4,7,4}                     |
| For Sub-Frame 5                          |  | {8,3,4,7,4}                     |
| For Sub-Frame 0                          |  | {8,3,4,7,4}                     |
| Binary Channel Bits (Note 4)             |  |                                 |
| For Sub-Frames 1,4,6,9                   | Bits   | {76800,26400,43200,62400,33600} |
| For Sub-Frames 2, 7                      |  | {76800,26400,43200,62400,33600} |
| For Sub-Frames 3, 8                      |  | {76800,26400,43200,62400,33600} |
| For Sub-Frame 5                          | Bits   | {75936,26400,43200,61536,33600} |
| For Sub-Frame 0 (Note 5)                 | Bits   | {75936,26400,43200,61536,33600} |
| UE Category                              |  | ≥ 5                             |
| Note 1:                                  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. |                                 |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                                 |
| Note 3:                                  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                            |                                 |
| Note 4:                                  | Given per component carrier per codeword.  |                                 |
| Note 5:                                  | For {a1,a2,a3,a4,a5}, a1, a2, a3, a4 and a5 stand for the setup when the number of OFDM sybmols is 14, 6, 9, 12, 7, respectively.                                  |                                 |

### A.3.15.2 Reference Measurement Channel for UE-Specific Reference Symbols

#### A.3.15.2.1 Two antenna ports (CSI-RS)

The reference measurement channels in Table A.3.15.2.1-1 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports for LAA SCell.

**Table A.3.15.2.1-1: Reference Channel with two CRS ports**

| Parameter | Unit | Value |
|-----------|------|-------|
|-----------|------|-------|

| Reference channel                        |  | R.2 FS3                           |
|--|--|-----------------------------------|
| Channel bandwidth                        | MHz  | 20                                |
| Allocated resource blocks (Note 4)       |  | 100                               |
| Allocated subframes per Radio Frame      |  | 10                                |
| Modulation                               |  | 16QAM                             |
| Target Coding Rate                       |  | 1/2                               |
| Information Bit Payload (Note 4)         |  |                                   |
| For Sub-Frames 1,4,6,9                   | Bits   | {22920,7480,12960,19080,10296}    |
| For Sub-Frames 2, 7                      |  | {22920,7480,12960,19080,10296}    |
| For Sub-Frames 3, 8                      |  | {22920,7480,12960,19080,10296}    |
| For Sub-Frame 5                          | Bits   | {19848, 6712, 11448, 16992, 9144} |
| For Sub-Frame 0                          | Bits   | {19848, 6712, 11448, 16992, 9144} |
| Number of Code Blocks<br>(Notes 3 and 4) |  |                                   |
| For Sub-Frames 1,4,6,9                   |  | {4,2,3,4,2}                       |
| For Sub-Frames 2,7                       |  | {4,2,3,4,2}                       |
| For Sub-Frames 3, 8                      |  | {4, 2, 3, 4, 2}                   |
| For Sub-Frame 5                          |  | {4, 2, 2, 3, 2}                   |
| For Sub-Frame 0                          |  | {4, 2, 2, 3, 2}                   |
| Binary Channel Bits (Note 4)             |  |                                   |
| For Sub-Frames 1,4,6,9                   | Bits   | {48000,15200,25600,38400,20000}   |
| For Sub-Frames 2, 7                      |  | {47200,15200,25600,38400,20000}   |
| For Sub-Frames 3, 8                      |  | {46400,15200,25600,38400,20000}   |
| For Sub-Frame 5                          | Bits   | {42240,13376,22528,33792,17600}   |
| For Sub-Frame 0 (Note 5) (Note 6)        | Bits   | {42240,13376,22528,33792,17600}   |
| UE Category                              |  | ≥ 5                               |
| Note 1:                                  | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.     |                                   |
| Note 2:                                  | Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].   |                                   |
| Note 3:                                  | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).                                |                                   |
| Note 4:                                  | Given per component carrier per codeword.  |                                   |
| Note 5:                                  | For TM9, 100 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 88 resource blocks (RB0-RB43,RB56-RB99) are allocated in subframe 0 and subframe 5 |                                   |
| Note 6:                                  | For {a1,a2,a3,a4,a5}, a1, a2, a3, a4 and a5 stand for the setup when the number of OFDM symbols is 14, 6, 9, 12, 7, respectively                                       |                                   |

Table A.3.15-2: Void

## A.3.16 Reference measurement channels for Slot-PDSCH and Subslot-PDSCH performance requirements

### A.3.16.1 FDD

Table A.3.16.1-1: Fixed Reference Channel Slot-PDSCH (Cell-Specific Reference Signals)

| Parameter                           | Unit |              |
|-------------------------------------|------|--------------|
| Reference channel                   |      | R.sTTI.1 FDD |
| Channel bandwidth                   | MHz  | 10           |
| Allocated resource blocks           |      | 50           |
| Allocated subframes per Radio Frame |      | 8            |
| Modulation                          |      | 16QAM        |
| Target Coding Rate                  |      | 1/2          |
| Information Bit Payload             |      |              |
| For Sub-Frames 1,2,3,4,6,7,8,9      |      |              |
| Slot index 0                        | Bits | 11448        |
| Slot index 1                        | Bits | 14112        |

|                                       |   |        |
|---------------------------------------|---|--------|
| For Sub-Frames 0,5                    |   | N/A    |
| Number of Code Blocks                 |   |        |
| For Sub-Frames 1,2,3,4,6,7,8,9        |   |        |
| Slot index 0                          |   | 2      |
| Slot index 1                          |   | 4      |
| For Sub-Frame 0,5                     |   | N/A    |
| Binary Channel Bits                   |   |        |
| For Sub-Frames 1,2,3,4,6,7,8,9        |   |        |
| Slot index 0                          | Bits  | 22400  |
| Slot index 1                          | Bits  | 28288  |
| For Sub-Frame 0,5                     |   | N/A    |
| Max. Throughput averaged over 1 frame | Mbps  | 20.448 |
| UE Category                           |   | ≥2     |
| Note 1:                               | For an information bit payload first transmitted at slot 0, any retransmission happens only on slot 0. For an information bit payload first transmitted at slot 1, any retransmission happens on only slot 1. |        |

Table A.3.16.1-2: Fixed Reference Channel Subslot-PDSCH (Cell-Specific Reference Signals)

| Parameter                             | Unit   |              |
|---------------------------------------|--|--------------|
| Reference channel                     |  | R.sTTI.2 FDD |
| Channel bandwidth                     | MHz  | 10           |
| Allocated resource blocks             |  | 50           |
| Allocated subframes per Radio Frame   |  | 8            |
| Modulation                            |  | 16QAM        |
| Target Coding Rate                    |  | 0.45         |
| Information Bit Payload               |  |              |
| For Sub-Frames 1,2,3,4,6,7,8,9        |  |              |
| Subslot index 1                       | Bits   | 5160         |
| Subslot index 2                       | Bits   | 3880         |
| Subslot index 3                       | Bits   | 2664         |
| Subslot index 4                       | Bits   | 3880         |
| Subslot index 5                       | Bits   | 5160         |
| For Sub-Frames 0,5                    |  | N/A          |
| Number of Code Blocks                 |  |              |
| For Sub-Frames 1,2,3,4,6,7,8,9        |  |              |
| Subslot index 1                       |  | 1            |
| Subslot index 2                       |  | 1            |
| Subslot index 3                       |  | 1            |
| Subslot index 4                       |  | 1            |
| Subslot index 5                       |  | 1            |
| For Sub-Frame 0,5                     |  | N/A          |
| Binary Channel Bits                   |  |              |
| For Sub-Frames 1,2,3,4,6,7,8,9        |  |              |
| Subslot index 1                       | Bits   | 12032        |
| Subslot index 2                       | Bits   | 8832         |
| Subslot index 3                       | Bits   | 5888         |
| Subslot index 4                       | Bits   | 8832         |
| Subslot index 5                       | Bits   | 12288        |
| For Sub-Frame 0,5                     |  | N/A          |
| Max. Throughput averaged over 1 frame | Mbps   | 16.5952      |
| UE Category                           |  | ≥2           |
| Note 1:                               | For an information bit payload first transmitted at subslot 1, any retransmission happens only on subslots 1 and 5. For an information bit payload first transmitted at subslot 2, any retransmission happens only on subslots 2 and 4. For an information bit payload first transmitted at subslot 3, any retransmission happens only on subslot 3. For an information bit payload first transmitted at subslot 4, any retransmission happens only on subslots 2 and 4. For an information bit payload first transmitted at subslot 5, any retransmission happens only on subslots 1 and 5. |              |

Table A.3.16.1-3: Fixed Reference Channel Slot-PDSCH (User-Specific Reference Signals)

| Parameter                             | Unit  |              |
|---------------------------------------|---|--------------|
| Reference channel                     |   | R.sTTI.3 FDD |
| Channel bandwidth                     | MHz   | 10           |
| Allocated resource blocks             |   | 50           |
| Allocated subframes per Radio Frame   |   | 8            |
| Modulation                            |   | QPSK         |
| Target Coding Rate                    |   | 1/3          |
| Information Bit Payload               |   |              |
| For Sub-Frames 1,3,4,6,8,9            |   |              |
| Slot index 0                          | Bits  | 3624         |
| Slot index 1                          | Bits  | 4392         |
| For Sub-Frames 2,7                    |   |              |
| Slot index 0                          | Bits  | 2856         |
| Slot index 1                          | Bits  | 4392         |
| For Sub-Frames 0,5                    |   | N/A          |
| Number of Code Blocks                 |   |              |
| For Sub-Frames 1,3,4,6,8,9            |   |              |
| Slot index 0                          |   | 1            |
| Slot index 1                          |   | 1            |
| For Sub-Frames 2,7                    |   |              |
| Slot index 0                          |   | 1            |
| Slot index 1                          |   | 1            |
| For Sub-Frame 0,5                     |   | N/A          |
| Binary Channel Bits                   |   |              |
| For Sub-Frames 1,3,4,6,8,9            |   |              |
| Slot index 0                          | Bits  | 10000        |
| Slot index 1                          | Bits  | 13360        |
| For Sub-Frames 2,7                    |   |              |
| Slot index 0                          | Bits  | 9600         |
| Slot index 1                          | Bits  | 13360        |
| For Sub-Frame 0,5                     |   | N/A          |
| Max. Throughput averaged over 1 frame | Mbps  | 6.2592       |
| UE Category                           |   | ≥2           |
| Note 1:                               | For an information bit payload first transmitted at slot 0, any retransmission happens only on slot 0. For an information bit payload first transmitted at slot 1, any retransmission happens only on slot 1. |              |

Table A.3.16.1-4: Fixed Reference Channel Subslot-PDSCH (User-Specific Reference Signals)

| Parameter                           | Unit |              |
|-------------------------------------|------|--------------|
| Reference channel                   |      | R.sTTI.4 FDD |
| Channel bandwidth                   | MHz  | 10           |
| Allocated resource blocks           |      | 50           |
| Allocated subframes per Radio Frame |      | 8            |
| Modulation                          |      | QPSK         |
| Target Coding Rate                  |      | 1/3          |
| Information Bit Payload             |      |              |
| For Sub-Frames 1,3,4,6,8,9          |      |              |
| Subslot index 1                     | Bits | 1736         |
| Subslot index 2                     | Bits | 1192         |
| Subslot index 3                     | Bits | 776          |
| Subslot index 4                     | Bits | 1192         |
| Subslot index 5                     | Bits | 1736         |
| For Sub-Frames 2,7                  |      |              |
| Subslot index 1                     | Bits | 1736         |
| Subslot index 2                     | Bits | 1192         |
| Subslot index 3                     | Bits | 776          |
| Subslot index 4                     | Bits | 1192         |
| Subslot index 5                     | Bits | 1736         |
| For Sub-Frames 0,5                  |      | N/A          |
| Number of Code Blocks               |      |              |

|                                       |  |        |
|---------------------------------------|--|--------|
| For Sub-Frames 1,3,4,6,8,9            |  |        |
| Subslot index 1                       |  | 1      |
| Subslot index 2                       |  | 1      |
| Subslot index 3                       |  | 1      |
| Subslot index 4                       |  | 1      |
| Subslot index 5                       |  | 1      |
| For Sub-Frames 2,7                    |  |        |
| Subslot index 1                       |  | 1      |
| Subslot index 2                       |  | 1      |
| Subslot index 3                       |  | 1      |
| Subslot index 4                       |  | 1      |
| Subslot index 5                       |  | 1      |
| For Sub-Frame 0,5                     |  | N/A    |
| Binary Channel Bits                   |  |        |
| For Sub-Frames 1,3,4,6,8,9            |  |        |
| Subslot index 1                       | Bits   | 4960   |
| Subslot index 2                       | Bits   | 4032   |
| Subslot index 3                       | Bits   | 2688   |
| Subslot index 4                       | Bits   | 4032   |
| Subslot index 5                       | Bits   | 5088   |
| For Sub-Frames 2,7                    |  |        |
| Subslot index 1                       | Bits   | 4960   |
| Subslot index 2                       | Bits   | 3696   |
| Subslot index 3                       | Bits   | 2688   |
| Subslot index 4                       | Bits   | 4032   |
| Subslot index 5                       | Bits   | 5088   |
| For Sub-Frame 0,5                     |  | N/A    |
| Max. Throughput averaged over 1 frame | Mbps   | 5.3056 |
| UE Category                           |  | ≥2     |
| Note 1:                               | For an information bit payload first transmitted at subslot 1, any retransmission happens only on subslots 1 and 5. For an information bit payload first transmitted at subslot 2, any retransmission happens only on subslots 2 and 4. For an information bit payload first transmitted at subslot 3, any retransmission happens only on subslot 3. For an information bit payload first transmitted at subslot 4, any retransmission happens only on subslots 2 and 4. For an information bit payload first transmitted at subslot 5, any retransmission happens only on subslots 1 and 5. |        |
| Note 2:                               | In any retransmission, no information bit payloads are scheduled at subslot #n when information bit payloads are not scheduled at subslot #(n-1).  |        |

### A.3.16.2 TDD

**Table A.3.16.2-1: Fixed Reference Channel Slot-PDSCH (Cell-Specific Reference Signals)**

| Parameter                               | Unit |              |
|---|------|--------------|
| Reference channel                       |      | R.sTTI.1 TDD |
| Channel bandwidth                       | MHz  | 10           |
| Allocated resource blocks               |      | 50           |
| Uplink-Downlink Configuration           |      | 1            |
| Allocated subframes per Radio Frame (D) |      | 2            |
| Modulation                              |      | 16QAM        |
| Target Coding Rate                      |      | 1/2          |
| Information Bit Payload                 |      |              |
| For Sub-Frames 4,9                      |      |              |
| Slot index 0                            | Bits | 11448        |
| Slot index 1                            | Bits | 14112        |
| For Sub-Frames 0,1,5,6                  |      | N/A          |
| Number of Code Blocks                   |      |              |
| For Sub-Frames 4,9                      |      |              |
| Slot index 0                            |      | 2            |
| Slot index 1                            |      | 4            |

|                                       |   |       |
|---------------------------------------|---|-------|
| For Sub-Frames 0,1,5,6                |   | N/A   |
| Binary Channel Bits                   |   |       |
| For Sub-Frames 4,9                    |   |       |
| Slot index 0                          | Bits  | 22400 |
| Slot index 1                          | Bits  | 28288 |
| For Sub-Frame 0,1,5,6                 |   | N/A   |
| Max. Throughput averaged over 1 frame | Mbps  | 5.112 |
| UE Category                           |   | ≥2    |
| Note 1:                               | For an information bit payload first transmitted at slot 0, any retransmission happens only on slot 0. For an information bit payload first transmitted at slot 1, any retransmission happens only on slot 1. |       |

**Table A.3.16.2-2: Fixed Reference Channel Slot-PDSCH (User-Specific Reference Signals)**

| Parameter                               | Unit  |              |
|---|---|--------------|
| Reference channel                       |   | R.sTTI.2 TDD |
| Channel bandwidth                       | MHz   | 10           |
| Allocated resource blocks               |   | 50           |
| Uplink-Downlink Configuration           |   | 1            |
| Allocated subframes per Radio Frame (D) |   | 2            |
| Modulation                              |   | QPSK         |
| Target Coding Rate                      |   | 1/3          |
| Information Bit Payload                 |   |              |
| For Sub-Frames 4,9                      |   |              |
| Slot index 0                            | Bits  | 2856         |
| Slot index 1                            | Bits  | 4392         |
| For Sub-Frames 0,1,5,6                  |   | N/A          |
| Number of Code Blocks                   |   |              |
| For Sub-Frames 4,9                      |   |              |
| Slot index 0                            |   | 1            |
| Slot index 1                            |   | 1            |
| For Sub-Frames 0,1,5,9                  |   | N/A          |
| Binary Channel Bits                     |   |              |
| For Sub-Frames 4,9                      |   |              |
| Slot index 0                            | Bits  | 9600         |
| Slot index 1                            | Bits  | 13360        |
| For Sub-Frame 0,1,5,6                   |   | N/A          |
| Max. Throughput averaged over 1 frame   | Mbps  | 1.4496       |
| UE Category                             |   | ≥2           |
| Note 1:                                 | For an information bit payload first transmitted at slot 0, any retransmission happens only on slot 0. For an information bit payload first transmitted at slot 1, any retransmission happens only on slot 1. |              |

## A.3.17 Reference measurement channels for SPDCCH performance requirements

### A.3.17.1 FDD

**Table A.3.17.1-1: Reference Channel FDD**

| Parameter                      | Unit | R.sTTI.10 FDD | R.sTTI.11 FDD |
|--------------------------------|------|---------------|---------------|
| Reference channel              |      | 4             | 2             |
| Number of transmitter antennas |      | 10            | 10            |
| Channel bandwidth              | MHz  | 2             | 8             |
| Aggregation level              | SCCE | 7-1C          | 7-1F          |
| DCI Format                     |      | 0             | 0             |
| Cell ID                        |      | 32            | 28            |
| Payload (without CRC)          | Bits |               |               |



## A.3.17.2 TDD

**Table A.3.17.2-1: Reference Channel TDD**

| Parameter                      | Unit |               |               |
|--------------------------------|------|---------------|---------------|
| Reference channel              |      | R.sTTI.10 TDD | R.sTTI.11 TDD |
| Number of transmitter antennas |      | 4             | 2             |
| Channel bandwidth              | MHz  | 10            | 10            |
| Aggregation level              | SCCE | 2             | 8             |
| DCI Format                     |      | 7-1C          | 7-1F          |
| Cell ID                        |      | 0             | 0             |
| Payload (without CRC)          | Bits | 34            | 30            |

## A.4 CSI reference measurement channels

This section defines the DL signal applicable to the reporting of channel status information (Clause 9.2, 9.3 and 9.5).

In Table A.4-1 are specified the reference channels. Table A.4-13 specifies the mapping of CQI index to modulation coding scheme, which complies with the CQI definition specified in Section 7.2.3 of [6].

**Table A.4-0: Void**

**Table A.4-1: CSI reference measurement channels**

| RMC Name          | Duplex     | CH-BW | Alloc. RB-s | UL/DL Config | Alloc. SF-s | MCS Scheme | Nr. HARQ Proc.   | Max. nr HARQ Trans. | Notes       |
|-------------------|------------|-------|-------------|--------------|-------------|------------|------------------|---------------------|-------------|
| <b>1 CRS Port</b> |            |       |             |              |             |            |                  |                     |             |
| RC.1 FDD          | FDD        | 10    | 50          | -            |             | MCS.1      | 8                | 1                   |             |
| RC.1A FDD         | FDD        | 10    | 50          |              |             | MCS.1A     | 8                | 1                   |             |
| RC.1 TDD          | TDD        | 10    | 50          | Note 3       |             | MCS.1      | 10               | 1                   |             |
| RC.1A TDD         | TDD        | 20    | 100         | Note 3       |             | MCS.1B     | 10               | 1                   |             |
| RC.3 FDD          | FDD        | 10    | 6           | -            |             | MCS.10     | 8                | 1                   |             |
| RC.3 TDD          | TDD        | 10    | 6           | Note 3       |             | MCS.10     | 10 or 7 (Note 9) | 1                   |             |
| RC.4 FDD          | FDD        | 10    | 15          | -            |             | MCS.15     | 8                | 1                   | Note 6      |
| RC.4 TDD          | TDD        | 10    | 15          | Note 3       |             | MCS.15     | 10               | 1                   | Note 6      |
| RC.5 FDD          | FDD        | 10    | 3           | -            |             | MCS.17     | 8                | 1                   |             |
| RC.5 TDD          | TDD        | 10    | 3           | Note 3       |             | MCS.17     | 10               | 1                   |             |
| RC.14 FDD         | FDD        | 5     | 25          | -            |             | MCS.14     | 8                | 1                   |             |
| RC.15 FDD         | FDD        | 5     | 15          | -            |             | MCS.15     | 8                | 1                   | Note 6      |
| RC.16 FDD         | FDD/HD-FDD | 10    | 2           |              |             | MCS.20     | 8                | 1                   | Note 8,10   |
| RC.16 TDD         | TDD        | 10    | 2           | Note 3       |             | MCS.20     | 10               | 1                   | Note 8      |
| RC.23FDD          | FDD/HD-FDD | 10    | 3           |              |             | MCS.28     | 8                | 1                   | Note 12, 13 |
| RC.23 TDD         | TDD        | 10    | 3           |              |             | MCS.28     | 10               | 1                   | Note 12     |
| RC.25 FDD         | FDD/HD-FDD | 10    | 3           |              |             | MCS.28     | 8                | 1                   | Note 14, 20 |
| RC.25 TDD         | TDD        | 10    | 3           |              |             | MCS.28     | 10               | 1                   | Note 12, 15 |
| RC.31 FDD         | FDD/HD-FDD | 10    | 3           |              |             | MCS.40     | 8                | 1                   | Note 12, 13 |

|                            |                |    |     |        |  |                            |                     |    |                |  |
|----------------------------|----------------|----|-----|--------|--|----------------------------|---------------------|----|----------------|--|
| RC.31<br>TDD               | TDD            | 10 | 3   |        |  | MCS.40                     | 10                  | 1  | Note 12        |  |
| RC.32<br>FDD               | FDD/HD-<br>FDD | 10 | 3   |        |  | MCS.41                     | 8                   | 1  | Note 12,<br>13 |  |
| RC.32<br>TDD               | TDD            | 10 | 3   |        |  | MCS.41                     | 10                  | 1  | Note 12        |  |
| RC.30<br>FDD               | FDD            | 10 | 50  |        |  | MCS.38                     | 8                   | 1  |                |  |
| RC.30<br>TDD               | TDD            | 20 | 100 |        |  | MCS.39                     | 10                  | 1  |                |  |
| <b>2 CRS Ports</b>         |                |    |     |        |  |                            |                     |    |                |  |
| RC.2 FDD                   | FDD            | 10 | 50  | -      |  | MCS.2                      | 8                   | 1  |                |  |
| RC.2A<br>FDD               | FDD            | 20 | 100 |        |  | MCS.2A                     | 8                   | 1  |                |  |
| RC.2 TDD                   | TDD            | 10 | 50  | Note 3 |  | MCS.2                      | 10 or 7<br>(Note 9) | 1  |                |  |
| RC.4A<br>FDD               | FDD            | 20 | 15  | -      |  | MCS.16                     | 8                   | 1  | Note 6         |  |
| RC.6 FDD                   | FDD            | 10 | 15  | -      |  | MCS.16                     | 8                   | 1  | Note 6         |  |
| RC.6 TDD                   | TDD            | 10 | 15  | Note 3 |  | MCS.16                     | 7                   | 1  | Note 6         |  |
| <b>4 CRS Ports</b>         |                |    |     |        |  |                            |                     |    |                |  |
| RC.17<br>FDD               | FDD            | 10 | 50  | -      |  | MCS.18                     | 8                   | 1  |                |  |
| RC.17<br>TDD               | TDD            | 10 | 50  | Note 3 |  | MCS.18                     | 7                   | 1  |                |  |
| RC.21<br>FDD               | FDD            | 10 | 50  | -      |  | MCS.26                     | 8                   | 1  |                |  |
| RC.21<br>TDD               | TDD            | 10 | 50  | Note 3 |  | MCS.26                     | 7                   | 1  |                |  |
| <b>1 CRS Port + CSI-RS</b> |                |    |     |        |  |                            |                     |    |                |  |
| RC.8 FDD                   | FDD            | 10 | 6   | -      |  | Non<br>CSI-RS              | MCS.11              | 8  | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.12              |    |                |  |
| RC.8A<br>FDD               | FDD            | 10 | 6   | -      |  | Non<br>CSI-RS              | MCS.11A             | 8  | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.12A             |    |                |  |
| RC.8 TDD                   | TDD            | 10 | 6   | Note 3 |  | Non<br>CSI-RS              | MCS.11              | 10 | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.12              |    |                |  |
| RC.8A<br>TDD               | TDD            | 20 | 8   | Note 3 |  | Non<br>CSI-RS              | MCS.11B             | 10 | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.12B             |    |                |  |
| RC.9 FDD                   | FDD            | 10 | 50  | -      |  | Non<br>CSI-RS              | MCS.3               | 8  | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.4               |    |                |  |
| RC.9A<br>FDD               | FDD            | 20 | 100 | -      |  | Non<br>CSI-RS              | MCS.3A              | 8  | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.4A              |    |                |  |
| RC.9B<br>FDD               | FDD            | 10 | 50  | -      |  | Non<br>CSI-RS,<br>rank 1/2 | MCS.3               | 8  | 1              |  |
|                            |                |    |     |        |  | Non<br>CSI-RS,<br>rank 3/4 | MCS.30              |    |                |  |
|                            |                |    |     |        |  | 4 CSI-RS,<br>rank 1/2      | MCS.29              |    |                |  |
|                            |                |    |     |        |  | 4 CSI-RS,<br>rank 3/4      | MCS.31              |    |                |  |
| RC.9 TDD                   | TDD            | 10 | 50  | Note 3 |  | Non<br>CSI-RS              | MCS.3               | 7  | 1              |  |
|                            |                |    |     |        |  | 2 CSI-RS                   | MCS.4               |    |                |  |
| RC.9B<br>TDD               | TDD            | 10 | 50  | Note 3 |  | Non<br>CSI-RS,<br>rank 1/2 | MCS.3               | 7  | 1              |  |

|                                     |     |    |    |        |                         |        |    |   |         |
|-------------------------------------|-----|----|----|--------|-------------------------|--------|----|---|---------|
|                                     |     |    |    |        | Non CSI-RS, rank 3/4    | MCS.30 |    |   |         |
|                                     |     |    |    |        | 4 CSI-RS, rank 1/2      | MCS.29 |    |   |         |
|                                     |     |    |    |        | 4 CSI-RS, rank 3/4      | MCS.31 |    |   |         |
| <b>2 CRS Port + CSI-RS</b>          |     |    |    |        |                         |        |    |   |         |
| RC.7 FDD                            | FDD | 10 | 50 | -      | Non CSI-RS              | MCS.5  | 8  | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.7  |    |   |         |
| RC.7 TDD                            | TDD | 10 | 50 | Note 3 | Non CSI-RS              | MCS.5  | 10 | 1 |         |
|                                     |     |    |    |        | 8 CSI-RS                | MCS.8  |    |   |         |
| RC.11 FDD                           | FDD | 10 | 50 | -      | Non CSI-RS              | MCS.5  | 8  | 1 |         |
|                                     |     |    |    |        | 2 CSI-RS                | MCS.6  |    |   |         |
| RC.11 TDD                           | TDD | 10 | 50 | Note 3 | Non CSI-RS              | MCS.5  | 10 | 1 |         |
|                                     |     |    |    |        | 2 CSI-RS                | MCS.6  |    |   |         |
| RC.18 FDD                           | FDD | 10 | 6  | -      | Non CSI-RS              | MCS.13 | 8  | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.19 |    |   |         |
| RC.18 TDD                           | TDD | 10 | 6  | Note 3 | Non CSI-RS              | MCS.13 | 7  | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.19 |    |   |         |
| RC.17 TDD                           | TDD | 10 | 6  | Note 3 | 4 ZP-CSI-RS             | MCS.21 | 10 | 1 |         |
| RC.18 TDD                           | TDD | 10 | 6  | Note 3 | 4 ZP-CSI-RS             | MCS.22 | 10 | 1 |         |
| RC.19 TDD                           | TDD | 10 | 41 | Note3  | 4 ZP-CSI-RS             | MCS.23 | 10 | 1 | Note 11 |
| RC.20 TDD                           | TDD | 10 | 50 | Note3  | Non CSI-RS              | MCS.24 | 10 | 1 |         |
|                                     |     |    |    |        | 2 CSI-RS, 4 ZP-CSI-RS   | MCS.25 |    |   |         |
| RC.22 FDD                           | FDD | 10 | 50 | -      | Non CSI-RS              | MCS.5  | 8  | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.27 |    |   |         |
| RC.22 TDD                           | TDD | 10 | 50 | Note 3 | Non CSI-RS              | MCS.5  | 10 | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.27 |    |   |         |
| RC.23 TDD                           | TDD | 10 | 50 | Note 3 | Non CSI-RS              | MCS.9  | 10 | 1 | Rank 4  |
|                                     |     |    |    |        | 4 CSI-RS                | MCS.32 |    |   |         |
| <b>1 CRS Port + CSI-RS + CSI-IM</b> |     |    |    |        |                         |        |    |   |         |
| RC.13 FDD                           | FDD | 10 | 50 | -      | Non CSI-RS/IM           | MCS.3  | 8  | 1 |         |
|                                     |     |    |    |        | CSI-RS/IM               | N/A    |    |   |         |
| RC.13 TDD                           | TDD | 10 | 50 | Note 3 | Non CSI-RS/IM           | MCS.3  | 10 | 1 |         |
|                                     |     |    |    |        | CSI-RS/IM               | N/A    |    |   |         |
| <b>2 CRS Port + CSI-RS + CSI-IM</b> |     |    |    |        |                         |        |    |   |         |
| RC.10 FDD                           | FDD | 10 | 50 | -      | Non CSI-RS              | MCS.5  | 8  | 1 |         |
|                                     |     |    |    |        | 4 CSI-RS, 1 CSI process | MCS.8  |    |   |         |
| RC.10 TDD                           | TDD | 10 | 50 | Note 3 | Non CSI-RS              | MCS.5  | 10 | 1 |         |
|                                     |     |    |    |        | 8 CSI-RS, 1 CSI process | MCS.9  |    |   |         |
| RC.12 FDD                           | FDD | 10 | 6  | -      | Non CSI-RS/IM           | MCS.13 | 8  | 1 |         |

|                  |     |    |    |        |               |  |    |   |                              |
|------------------|-----|----|----|--------|---------------|--|----|---|------------------------------|
|                  |     |    |    |        | CSI-RS/IM     | N/A  |    |   |                              |
| RC.12<br>TDD     | TDD | 10 | 6  | Note 3 | Non CSI-RS/IM | MCS.13   | 10 | 1 |                              |
|                  |     |    |    |        | CSI-RS/IM     | N/A  |    |   |                              |
| <b>Short TTI</b> |     |    |    |        |               |  |    |   |                              |
| RC.26<br>FDD     | FDD | 10 | 50 | -      | -             | MCS.32-1<br>MCS.32-2                                     | 8  | 1 | Note 2                       |
| RC.27<br>FDD     | FDD | 10 | 50 | -      | Non CSI-RS    | MCS.33-1<br>MCS.33-2                                     | 8  | 1 | Note 2                       |
|                  | FDD | 10 | 50 | -      | 2 CSI-RS      | MCS.34-1<br>MCS.34-2                                     | 8  | 1 | Note 2                       |
| RC.28<br>FDD     | FDD | 10 | 50 | -      | -             | MCS.35-1<br>MCS.35-2<br>MCS.35-3<br>MCS.35-4<br>MCS.35-5 | 16 | 1 | Note 2<br>Note 17<br>Note 18 |
| RC.29<br>FDD     | FDD | 10 | 50 | -      | Non CSI-RS    | MCS.36-1<br>MCS.36-2<br>MCS.36-3<br>MCS.36-4<br>MCS.36-5 | 16 | 1 | Note 2<br>Note 17<br>Note 19 |
|                  | FDD | 10 | 50 | -      | 2 CSI-RS      | MCS.37-1<br>MCS.37-2<br>MCS.37-3<br>MCS.37-4<br>MCS.37-5 | 16 | 1 | Note 2<br>Note 17<br>Note 19 |
| RC.26<br>TDD     | TDD | 10 | 50 | -      | -             | MCS.32-1<br>MCS.32-2                                     | 10 | 1 | Note 5                       |
| RC.27<br>TDD     | TDD | 10 | 50 | -      | Non CSI-RS    | MCS.33-1<br>MCS.33-2                                     | 16 | 1 | Note 5                       |
|                  | TDD | 10 | 50 | -      | 2 CSI-RS      | MCS.34-1<br>MCS.34-2                                     | 16 | 1 | Note 5                       |

- Note 1: 3 symbols allocated to PDCCH.
- Note 2: For FDD only subframes 1, 2, 3, 4, 6, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead.
- Note 3: TDD UL-DL configuration as specified in the individual tests.
- Note 4: For TDD when UL-DL configuration 1 is used only subframes 4 and 9 are allocated to avoid PBCH and synchronization signal overhead.
- Note 5: For TDD when UL-DL configuration 2 is used only subframes 3, 4, 8, and 9 are allocated to avoid PBCH and synchronization signal overhead.
- Note 6: Centered within the Transmission Bandwidth Configuration (Figure 5.6-1).
- Note 7: Only subframes 2, 3, 4, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead.
- Note 8: Allocate PDSCH on 5th and 6th PRBs within a subband.
- Note 9: The number of HARQ processes is 10 for TDD UL/DL configuration 2 and 7 for TDD UL/DL configuration 1.
- Note 10: The downlink subframes are scheduled at the 1st, 2nd, 8th, 9th, 16th, 17th, 18th, 24th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled.(starting from 0th subframe)
- Note 11: 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in subframe 0 and 5 in RC.19 TDD.
- Note 12: Allocate PDSCH on 3th, 4th and 5th PRBs within a narrowband. Allocate MPDCCH on the 0th and 1st PRBs within a narrowband.
- Note 13: The PDSCH subframes are scheduled at the 0th and 1st subframes every 10ms. Information bit payload is available if downlink subframe is scheduled (starting from 0th subframe). MPDCCH subframes are scheduled at the 8th and 9th subframes every 10ms.
- Note 14: The downlink subframes are scheduled at the 0th to 4th subframes every 20ms. Information bit payload is scheduled at the 4th subframe (starting from 0th subframe). MPDCCH and Information bit payload are not scheduled in the radio frames where systemInformation1-BR is scheduled and  $N_{PDSCH}^{SIB1-BR} = 4$  with the set of frames and subframes for SIB1-BR defined in TS 36.211 [16] Table 6.4.1-2.
- Note 15: Information bit payload is scheduled at the 8th subframe every 20ms (starting from 0th subframe).
- Note 16: 2 symbols allocated for PDCCH.
- Note 17: No PDSCH is scheduled in subslot index 0.
- Note 18: Subslot-PDSCH is scheduled in subslots 2, 3, and 4.
- Note 19: Subslot-PDSCH is scheduled in subslots 1 and 5.
- Note 20: Allocate PDSCH on 3th, 4th and 5th PRBs within a narrowband. Allocate MPDCCH on the 0th, 1st, 2nd and 3rd PRBs within a narrowband.

Table A.4-1a: Void  
Table A.4-1b: Void  
Table A.4-1c: Void  
Table A.4-1d: Void  
Table A.4-1e: Void  
Table A.4-2: Void  
Table A.4-2a: Void  
Table A.4-2b: Void  
Table A.4-2c: Void  
Table A.4-2d: Void  
Table A.4-2e: Void  
Table A.4-3: Void  
Table A.4-3a: Void  
Table A.4-3b: Void  
Table A.4-3c: Void  
Table A.4-3d: Void  
Table A.4-3e: Void  
Table A.4-3f: Void  
Table A.4-3g: Void  
Table A.4-3h: Void  
Table A.4-3i: Void  
Table A.4-3j: Void  
Table A.4-3k: Void  
Table A.4-3l: Void  
Table A.4-3m: Void  
Table A.4-4: Void  
Table A.4-4a: Void  
Table A.4-4b: Void  
Table A.4-5: Void  
Table A.4-5a: Void

**Table A.4-5b: Void**

**Table A.4-6: Void**

**Table A.4-6a: Void**

**Table A.4-6b: Void**

**Table A.4-6c: Void**

**Table A.4-6d: Void**

**Table A.4-6e: Void**

**Table A.4-6f: Void**

**Table A.4-7: Void**

**Table A.4-8: Void**

**Table A.4-9: Void**

**Table A.4-10: Void**

**Table A.4-11: Void**

**Table A.4-12: Void**

Table A.4-13: Mapping of CQI Index to Modulation coding scheme (MCS)

| CQI Index          |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes     |  |
|--------------------|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--|
| Target Coding Rate |     |                | 0OR  | 0.0762 | 0.1172 | 0.1885 | 0.3008 | 0.4385 | 0.5879 | 0.3691 | 0.4785 | 0.6016 | 0.4551 | 0.5537 | 0.6504 | 0.7539 | 0.8525 | 0.9258 |           |  |
| Modulation         |     |                | 0OR  | QPSK   |        |        |        |        |        | 16QAM  |        |        | 64QAM  |        |        |        |        |        |           |  |
| MCS Scheme         | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |
| MCS.1              | 50  | 6300           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 16     | 18     | 21     | 23     | 25     | 27     | 27     |           |  |
| MCS.2              | 50  | 6000           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     |           |  |
| MCS.2A             | 100 | 12000          | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     |           |  |
| MCS.3              | 50  | 5700           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 10     | 13     | 15     | 17     | 19     | 21     | 23     | 25     | 26     |           |  |
| MCS.3A             | 100 | 11400          | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 17     | 19     | 21     | 23     | 25     | 26     |           |  |
| MCS.4              | 50  | 5600           | DTX  | 0      | 0      | 2      | 4      | 6      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 23     | 25     | 26     |           |  |
| MCS.4A             | 100 | 11200          | DTX  | 0      | 0      | 2      | 4      | 6      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 23     | 25     | 26     |           |  |
| MCS.5              | 50  | 5400           | DTX  | 0      | 0      | 2      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 23     | 24     | 25     |           |  |
| MCS.6              | 50  | 5300           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 22     | 24     | 25     |           |  |
| MCS.7              | 50  | 5200           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 18     | 20     | 22     | 24     | 25     |           |  |
| MCS.8              | 50  | 5000           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 13     | 17     | 18     | 20     | 22     | 23     | 24     |           |  |
| MCS.9              | 50  | 4800           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 13     | 17     | 18     | 20     | 22     | 23     | 24     |           |  |
| MCS.10             | 6   | 756            | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 16     | 19     | 21     | 23     | 25     | 27     | 27     |           |  |
| MCS.11             | 6   | 684            | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 14     | 17     | 20     | 21     | 23     | 25     | 27     |           |  |
| MCS.12             | 6   | 672            | DTX  | 0      | 0      | 1      | 4      | 6      | 8      | 10     | 12     | 14     | 17     | 19     | 21     | 23     | 25     | 26     |           |  |
| MCS.13             | 6   | 648            | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 22     | 24     | 25     |           |  |
| MCS.14             | 25  | 3150           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 16     | 18     | 21     | 23     | 25     | 27     | 27     |           |  |
| MCS.15             | 15  | 1890           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 16     | 18     | 21     | 23     | 25     | 27     | 27     |           |  |
| MCS.16             | 15  | 1800           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     |           |  |
| MCS.17             | 3   | 378            | DTX  | 0      | 1      | 2      | 5      | 7      | 9      | 12     | 13     | 16     | 19     | 21     | 23     | 25     | 27     | 27     |           |  |
| MCS.18             | 50  | 5800           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 17     | 20     | 22     | 23     | 26     | 27     |           |  |
| MCS.19             | 6   | 624            | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 18     | 20     | 22     | 24     | 25     |           |  |
| MCS.20             | 2   | 252            | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 16     | 19     | 21     | 23     | 23     | 23     | 23     |           |  |
| MCS.21             | 6   | 696            | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 21     | 24     | 25     | 27     |           |  |
| MCS.22             | 6   | 624            | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 15     | 19     | 20     | 22     | 24     | 24     |           |  |
| MCS.23             | 41  | 4264           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 15     | 18     | 20     | 22     | 24     | 24     |           |  |
| MCS.24             | 50  | 5400           | DTX  | 0      | 0      | 2      | 3      | 5      | 7      | 10     | 12     | 14     | 15     | 19     | 21     | 23     | 24     | 25     |           |  |
| MCS.25             | 50  | 5100           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 8      | 12     | 13     | 15     | 18     | 20     | 22     | 23     | 24     |           |  |
| MCS.26             | 50  | 5800           | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     |           |  |
| MCS.27             | CW0 | 50             | 4600 | DTX    | 0      | 0      | 1      | 3      | 5      | 6      | 10     | 11     | 13     | 17     | 18     | 19     | 21     | 23     | 23        |  |
|                    | CW1 | 50             | 4600 | DTX    | 0      | 0      | 1      | 3      | 5      | 6      | 10     | 11     | 13     | 17     | 18     | 19     | 21     | 22     | 23        |  |
| MCS.29             | 50  | 5500           | DTX  | 0      | 0      | 2      | 3      | 5      | 7      | 10     | 12     | 14     | 15     | 19     | 21     | 23     | 24     | 25     |           |  |
| MCS.30             | 50  | 10200          | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 8      | 12     | 14     | 15     | 18     | 20     | 22     | 23     | 24     |           |  |
| MCS.31             | 50  | 9800           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 8      | 11     | 13     | 14     | 18     | 20     | 21     | 23     | 23     |           |  |
| MCS.32             | 50  | 4600           | DTX  | 0      | 0      | 1      | 3      | 5      | 6      | 10     | 11     | 13     | 17     | 18     | 19     | 21     | 22     | 23     | 2Layer1CW |  |

Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6].  
 Note 2: 3 symbols allocated to PDCCH.  
 Note 3: Sub-frame#0 and #5 are not used for the corresponding requirement except for [MCS.23]. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

**Table A.4-14: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)**

| CQI Index                  |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes |
|----------------------------|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Target Spectral Efficiency |     |                | OOO  | 0.1523 | 0.3770 | 0.8770 | 1.4766 | 1.9141 | 2.4063 | 2.7305 | 3.3223 | 3.9023 | 4.5234 | 5.1152 | 5.5547 | 6.2266 | 6.9141 | 7.4063 |       |
| MCS Scheme                 | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | Notes |
| MCS.1A                     | 50  | 6300           | DTX  | 0      | 1      | 3      | 5      | 7      | 10     | 11     | 14     | 16     | 18     | 20     | 22     | 24     | 26     | 26     |       |
| MCS.1B                     | 100 | 12600          | DTX  | 0      | 1      | 3      | 5      | 7      | 10     | 11     | 14     | 15     | 18     | 20     | 22     | 24     | 26     | 26     |       |

Note 1: Mapping between Imcs and CQI Index according to Tables 7.1.7.1-1A, 7.1.7.2.1-1 and 7.2.3-2 in TS 36.213 [6].  
 Note 2: 3 symbols allocated to PDCCH.  
 Note 3: Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

**Table A.4-15: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)**

| CQI Index                  |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes |
|----------------------------|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Target Spectral Efficiency |     |                | OOO  | 0.1523 | 0.3770 | 0.8770 | 1.4766 | 1.9141 | 2.4063 | 2.7305 | 3.3223 | 3.9023 | 4.5234 | 5.1152 | 5.5547 | 6.2266 | 6.9141 | 7.4063 |       |
| MCS Scheme                 | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        | Notes |
| MCS.11A                    | 6   | 684            | DTX  | 0      | 1      | 3      | 5      | 7      | 8      | 10     | 13     | 14     | 16     | 18     | 20     | 22     | 24     | 25     |       |
| MCS.12A                    | 6   | 672            | DTX  | 0      | 1      | 3      | 5      | 6      | 8      | 10     | 12     | 14     | 16     | 18     | 20     | 22     | 24     | 25     |       |
| MCS.11B                    | 8   | 912            | DTX  | 0      | 1      | 3      | 5      | 7      | 9      | 10     | 13     | 14     | 16     | 18     | 19     | 22     | 24     | 26     |       |
| MCS.12B                    | 8   | 896            | DTX  | 0      | 1      | 3      | 5      | 6      | 8      | 10     | 12     | 14     | 16     | 18     | 19     | 22     | 24     | 25     |       |

Note 1: Mapping between Imcs and CQI Index according to Tables 7.1.7.1-1A, 7.1.7.2.1-1 and 7.2.3-2 in TS 36.213 [6].  
 Note 2: 3 symbols allocated to PDCCH.  
 Note 3: Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

**Table A.4-16: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS index Table 3)**

| CQI Index          |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11       | 12       | 13       | 14       | 15       | Notes |  |  |       |
|--------------------|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|-------|--|--|-------|
| Target Coding Rate |     |                | OOO  | 0.0391 | 0.0762 | 0.1172 | 0.1885 | 0.3008 | 0.4385 | 0.5879 | 0.3691 | 0.4785 | 0.6015 | Reserved | Reserved | Reserved | Reserved | Reserved |       |  |  |       |
| Modulation         |     |                | OOO  | QPSK   |        |        |        |        |        |        | 16QAM  |        |        |          |          |          |          |          |       |  |  | Notes |
| MCS Scheme         | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |          |          |          |          |          | Notes |  |  |       |
| MCS.28             | 3   | 378            | DTX  | 0      | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | N/A      | N/A      | N/A      | N/A      | N/A      |       |  |  |       |

Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6].  
 Note 2: startSymbolBR = 3



**Table A.4-17: Mapping of CQI Index to Modulation coding scheme (Slot-PDSCH)**

| CQI Index                  |     |                |             | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes  |
|----------------------------|-----|----------------|-------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Target Spectral Efficiency |     |                |             | OOR  | 0.1523 | 0.2344 | 0.3770 | 0.6016 | 0.8770 | 1.1758 | 1.4766 | 1.9141 | 2.4063 | 2.7305 | 3.3223 | 3.9023 | 4.5234 | 5.1152 | 5.5547 |        |
| MCS Scheme                 | PRB | Available RE-s | Slot number | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| MCS.32-1                   | 50  | 2800           | 0           | DTX  | 0      | 0      | 2      | 4      | 6      | 7      | 10     | 12     | 14     | 17     | 19     | 21     | 23     | 25     | 26     | Slot 0 |
| MCS.32-2                   | 50  | 3672           | 1           | DTX  | 0      | 1      | 3      | 5      | 7      | 9      | 13     | 15     | 16     | 20     | 23     | 25     | 27     | 28     | 28     | Slot 1 |
| MCS.33-1                   | 50  | 2600           | 0           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 18     | 20     | 22     | 24     | 25     | Slot 0 |
| MCS.33-2                   | 50  | 3348           | 1           | DTX  | 0      | 0      | 2      | 4      | 7      | 9      | 12     | 14     | 16     | 19     | 21     | 23     | 26     | 27     | 28     | Slot 1 |
| MCS.34-1                   | 50  | 2500           | 0           | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 13     | 17     | 18     | 20     | 22     | 23     | 24     | Slot 0 |
| MCS.34-2                   | 50  | 3348           | 1           | DTX  | 0      | 0      | 2      | 4      | 7      | 9      | 12     | 14     | 16     | 19     | 21     | 23     | 26     | 27     | 28     | Slot 1 |

Note 1: Mapping between Imcs and CQI Index according to Tables 7.1.7.1-1 in TS 36.213 [6].  
 Note 2: Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

**Table A.4-18: Mapping of CQI Index to Modulation coding scheme (Subslot-PDSCH)**

| CQI Index                  |     |                |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes     |
|----------------------------|-----|----------------|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|
| Target Spectral Efficiency |     |                |                | OOR  | 0.1523 | 0.2344 | 0.3770 | 0.6016 | 0.8770 | 1.1758 | 1.4766 | 1.9141 | 2.4063 | 2.7305 | 3.3223 | 3.9023 | 4.5234 | 5.1152 | 5.5547 |           |
| MCS Scheme                 | PRB | Available RE-s | Subslot number | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |
| MCS.35-1                   | 50  | 1408           | 1              | DTX  | 0      | 1      | 3      | 6      | 8      | 9      | 14     | 16     | 16     | 22     | 24     | 27     | 28     | 28     | 28     | Subslot 1 |
| MCS.35-2                   | 50  | 1008           | 2              | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     | Subslot 2 |
| MCS.35-3                   | 50  | 872            | 3              | DTX  | 0      | 0      | 1      | 3      | 5      | 7      | 10     | 12     | 14     | 17     | 18     | 20     | 22     | 24     | 25     | Subslot 3 |
| MCS.35-4                   | 50  | 1008           | 4              | DTX  | 0      | 0      | 2      | 4      | 6      | 8      | 11     | 13     | 15     | 18     | 20     | 22     | 24     | 26     | 27     | Subslot 4 |
| MCS.35-5                   | 50  | 1472           | 5              | DTX  | 0      | 1      | 3      | 6      | 9      | 9      | 14     | 16     | 16     | 22     | 25     | 27     | 28     | 28     | 28     | Subslot 5 |
| MCS.36-1                   | 50  | 1180           | 1              | DTX  | 0      | 0      | 2      | 5      | 7      | 9      | 12     | 14     | 16     | 19     | 22     | 24     | 27     | 28     | 28     | Subslot 1 |
| MCS.36-2                   | 50  | 680            | 2              | DTX  | 0      | 0      | 0      | 2      | 4      | 5      | 10     | 10     | 12     | 17     | 17     | 17     | 19     | 20     | 22     | Subslot 2 |
| MCS.36-3                   | 50  | 612            | 3              | DTX  | 0      | 0      | 0      | 2      | 3      | 5      | 10     | 10     | 11     | 17     | 17     | 17     | 18     | 19     | 20     | Subslot 3 |
| MCS.36-4                   | 50  | 680            | 4              | DTX  | 0      | 0      | 0      | 2      | 4      | 5      | 10     | 10     | 12     | 17     | 17     | 17     | 19     | 20     | 20     | Subslot 4 |
| MCS.36-5                   | 50  | 1212           | 5              | DTX  | 0      | 1      | 3      | 5      | 7      | 9      | 12     | 15     | 16     | 20     | 22     | 25     | 27     | 28     | 28     | Subslot 5 |
| MCS.37-1                   | 50  | 1180           | 1              | DTX  | 0      | 0      | 2      | 5      | 7      | 9      | 12     | 14     | 16     | 19     | 22     | 24     | 27     | 28     | 28     | Subslot 1 |

|  |    |      |   |     |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |           |
|--|----|------|---|-----|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|-----------|
| MCS.37-2   | 50 | 612  | 2 | DTX | 0 | 0 | 0 | 2 | 3 | 5 | 10 | 10 | 11 | 17 | 17 | 17 | 18 | 19 | 20 | Subslot 2 |
| MCS.37-3   | 50 | 612  | 3 | DTX | 0 | 0 | 0 | 2 | 3 | 5 | 10 | 10 | 11 | 17 | 17 | 17 | 18 | 19 | 20 | Subslot 3 |
| MCS.37-4   | 50 | 680  | 4 | DTX | 0 | 0 | 0 | 2 | 4 | 5 | 10 | 10 | 12 | 17 | 17 | 17 | 19 | 20 | 22 | Subslot 4 |
| MCS.37-5   | 50 | 1212 | 5 | DTX | 0 | 1 | 3 | 5 | 7 | 9 | 12 | 15 | 16 | 20 | 22 | 25 | 27 | 28 | 28 | Subslot 5 |
| Note 1: Mapping between Imcs and CQI Index according to Tables 7.1.7.1-1 in TS 36.213 [6].   |    |      |   |     |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |           |
| Note 2: Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions. |    |      |   |     |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |           |

**Table A.4-19: Mapping of CQI Index to Modulation coding scheme (4-bit CQI Table 5)**

| CQI Index  |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes |  |
|--|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--|
| Target Coding Rate   |     |                | OOOR | 0.0391 | 0.0762 | 0.1172 | 0.1885 | 0.3008 | 0.4385 | 0.5879 | 0.3691 | 0.4785 | 0.6016 | 0.4551 | 0.5337 | 0.6504 | 0.7439 | 0.8525 |       |  |
| Modulation   |     |                | OOOR |        |        | QPSK   |        |        | 16QAM  |        |        |        | 64QAM  |        |        |        |        |        |       |  |
| MCS Scheme   | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |
| MCS.40   | 1   | 126            | DTX  | 0      | 0      | 0      | 1      | 4      | 5      | 8      | 12     | 14     | 16     | 18     | 21     | 23     | 25     | 27     |       |  |
| Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6]. |     |                |      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |
| Note 2: startSymbolBR = 3  |     |                |      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |

**Table A.4-20: Mapping of CQI Index to Modulation coding scheme (4-bit CQI Table 6)**

| CQI Index  |     |                | 0    | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | Notes |  |
|--|-----|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--|
| Target Coding Rate   |     |                | OOOR | 0.0547 | 0.2021 | 0.2598 | 0.1904 | 0.1387 | 0.2598 | 0.4424 | 0.6221 | 0.4131 | 0.5439 | 0.6797 | 0.8252 | 0.6357 | 0.7617 | 0.8672 |       |  |
| Modulation   |     |                | OOOR |        |        | QPSK   |        |        | 16QAM  |        |        |        | 64QAM  |        |        |        |        |        |       |  |
| MCS Scheme   | PRB | Available RE-s | Imcs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |
| MCS.41   | 3   | 378            | DTX  | 0      | 2      | 3      | 2      | 1      | 3      | 7      | 9      | 12     | 15     | 16     | 16     | 22     | 25     | 27     |       |  |
| Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6]. |     |                |      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |
| Note 2: startSymbolBR = 3  |     |                |      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |  |

**Table A.4-21: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS index Table 3 and 4-bit CQI Table 4)**

| CQI Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Notes |
|-----------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|-------|
|-----------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|-------|

| Target Spectral Efficiency |     |                | 00R  | 0.1523 | 0.3770 | 0.8770 | 1.4766 | 2.4063 | 3.3223 | 3.9023 | 4.5234 | 5.1152 | 5.5547 | 6.2266 | 6.9141 | 7.4063 | 8.3321 | 9.2578 |  |
|----------------------------|-----|----------------|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| MCS Scheme                 | PRB | Available RE-s | Imcs   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| MCS.38                     | 50  | 6300           | DTX  | 0      | 1      | 3      | 5      | 7      | 9      | 11     | 13     | 15     | 17     | 19     | 21     | 22     | 23     | 25     |  |
| MCS.39                     | 100 | 12600          | DTX  | 0      | 1      | 3      | 5      | 7      | 9      | 11     | 13     | 15     | 17     | 19     | 21     | 22     | 23     | 25     |  |
| Note 1:                    |     |                | Mapping between Imcs and CQI Index according to Tables 7.1.7.1-1B, 7.1.7.2.1-1 and 7.2.3-4 in TS 36.213 [6].   |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| Note 2:                    |     |                | 3 symbols allocated to PDCCH.  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| Note 3:                    |     |                | Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions. |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |

## A.5 OFDMA Channel Noise Generator (OCNG)

### A.5.1 OCNG Patterns for FDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test) and/or allocations used for MBSFN. The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG\_RA and OCNG\_RB which together with a relative power level ( $\gamma$ ) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA / OCNG\_RA = PDSCH_i\_RB / OCNG\_RB,$$

where  $\gamma_i$  denotes the relative power level of the  $i$ :th virtual UE. The parameter settings of OCNG\_RA, OCNG\_RB, and the set of relative power levels  $\gamma$  are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a constant transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover the OCNG pattern is accompanied by a PCFICH/PDCCH/PHICH reference channel which specifies the control region. For any aggregation and PHICH allocation, the PDCCH and any unused PHICH groups are padded with resource element groups with a power level given respectively by PDCCH\_RA/RB and PHICH\_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

For the performance requirements of UE with the CA capability, the OCNG patterns apply for each CC.

#### A.5.1.1 OCNG FDD pattern 1: One sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.1.1-1: OP.1 FDD: One sided dynamic OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]  |  |  | PDSCH<br>Data |
|---|--|--|---------------|
| Subframe  |  |  |               |
| 0   | 5  | 1 – 4, 6 – 9                                       |               |
| Allocation  |  |  |               |
| First unallocated PRB<br>–<br>Last unallocated PRB  | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB |               |
| 0   | 0  | 0  | Note 1        |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.   |  |  |               |
| Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. |  |  |               |

### A.5.1.2 OCNG FDD pattern 2: Two sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB  $N_{RB} - 1$ .

**Table A.5.1.2-1: OP.2 FDD: Two sided dynamic OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]  |   |   | PDSCH Data |
|---|---|---|------------|
| Subframe  |   |   |            |
| 0   | 5   | 1 – 4, 6 – 9  |            |
| Allocation  |   |   |            |
| 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ )   | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ ) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ ) |            |
| 0   | 0   | 0   | Note 1     |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |            |

### A.5.1.3 OCNG FDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz

**Table A.5.1.3-1: OP.3 FDD: OCNG FDD Pattern 3**

| Allocation<br>$n_{PRB}$   | Relative power level $\gamma_{PRB}$ [dB] |                                    |      |              | PDSCH Data | PMCH Data |
|---|--|------------------------------------|------|--------------|------------|-----------|
|   | Subframe                                 |                                    |      |              |            |           |
|   | 0  | 5                                  | 4, 9 | 1 – 3, 6 – 8 |            |           |
| 1 – 49  | 0  | 0<br>(Allocation: all empty PRB-s) | 0    | N/A          | Note 1     | N/A       |
| 0 – 49  | N/A                                      | N/A                                | N/A  | 0            | N/A        | Note 2    |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH subframes shall contain cell-specific Reference Signals only in the first symbol of the first time slot. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PMCH.</p> <p>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> <p>N/A: Not Applicable</p> |  |                                    |      |              |            |           |

### A.5.1.3A OCNG FDD pattern 3A: 49 RB OCNG allocation with MBSFN enhancement in 10 MHz

**Table A.5.1.3A-1: OP.3A FDD: OCNG FDD Pattern 3A**

| Allocation<br>$n_{PRB}$  | Relative power level $\gamma_{PRB}$ [dB] |  |              | PDSCH<br>Data | PMCH<br>Data |
|--|--|--|--------------|---------------|--------------|
|  | Subframe                                 |  |              |               |              |
|  | 0  | 5  | 1 – 4, 6 – 9 |               |              |
| 1 – 49   | 0  | 0<br>(Allocation:<br>all empty<br>PRB-s) | N/A          | Note 1        | N/A          |
| 0 – 49   | N/A                                      | N/A                                      | 0            | N/A           | Note 2       |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated and transmitted using 1.25kHz numerology. PMCH subframes shall not contain any cell-specific Reference Signals. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PMCH.</p> <p>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> <p>N/A: Not Applicable</p> |  |  |              |               |              |

### A.5.1.4 OCNG FDD pattern 4: One sided dynamic OCNG FDD pattern for MBMS transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided) and MBMS performance is tested.

**Table A.5.1.4-1: OP.4 FDD: One sided dynamic OCNG FDD Pattern for MBMS transmission**

| Allocation<br>$n_{PRB}$  | Relative power level $\gamma_{PRB}$ [dB] |  |              | PDSCH<br>Data | PMCH<br>Data |
|--|--|--|--------------|---------------|--------------|
|  | Subframe                                 |  |              |               |              |
|  | 0, 4, 9                                  | 5  | 1 – 3, 6 – 8 |               |              |
| First unallocated<br>PRB<br>–<br>Last unallocated<br>PRB   | 0  | 0<br>(Allocation:<br>all empty<br>PRB-s) | N/A          | Note 1        | N/A          |
| First unallocated<br>PRB<br>–<br>Last unallocated<br>PRB   | N/A                                      | N/A                                      | N/A          | N/A           | Note 2       |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH subframes shall</p> |  |  |              |               |              |

|         |   |
|---------|---|
|         | contain cell-specific Reference Signals only in the first symbol of the first time slot. The parameter $\gamma_{PRB}$ is used to scale the power of PMCH.   |
| Note 3: | If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. |
| N/A:    | Not Applicable  |

### A.5.1.4A OCNG FDD pattern 4A: One sided dynamic OCNG FDD pattern for enhanced MBMS transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided) and MBMS performance is tested.

**Table A.5.1.4A-1: OP.4A FDD: One sided dynamic OCNG FDD Pattern for MBMS transmission**

| Allocation<br>$n_{PRB}$  | Relative power level $\gamma_{PRB}$ [dB] |                                    |              | PDSCH Data | PMCH Data |
|--|--|------------------------------------|--------------|------------|-----------|
|  | Subframe                                 |                                    |              |            |           |
|  | 0  | 5                                  | 1 – 4, 6 – 9 |            |           |
| First unallocated PRB<br>–<br>Last unallocated PRB   | 0  | 0<br>(Allocation: all empty PRB-s) | N/A          | Note 1     | N/A       |
| First unallocated PRB<br>–<br>Last unallocated PRB   | N/A                                      | N/A                                | N/A          | N/A        | Note 2    |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH subframes shall not contain any cell-specific Reference Signals. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PMCH.</p> <p>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |  |                                    |              |            |           |
| N/A: Not Applicable  |  |                                    |              |            |           |

### A.5.1.5 OCNG FDD pattern 5: One sided dynamic 16QAM modulated OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of DL sub-frames, when the unallocated area is continuous in the frequency domain (one sided).

**Table A.5.1.5-1: OP.5 FDD: One sided dynamic 16QAM modulated OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] |  | PDSCH Data |
|--|--|------------|
| Subframe                                 |  |            |
|  |  |            |

|  |  |  |        |
|--|--|--|--------|
| 0  | 5  | 1 – 4, 6 – 9                                       |        |
| <b>Allocation</b>  |  |  |        |
| First unallocated PRB<br>–<br>Last unallocated PRB   | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB |        |
| 0  | 0  | 0  | Note 1 |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 3 (Large Delay CDD). The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |  |  |        |

### A.5.1.6 OCNG FDD pattern 6: dynamic OCNG FDD pattern when user data is in 2 non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in two parts by the first allocated block). The second allocated block ends with PRB  $N_{RB} - 1$ .

**Table A.5.1.6-1: OP.6 FDD: OCNG FDD Pattern when user data is in 2 non-contiguous blocks**

|   |   |   |                   |
|---|---|---|-------------------|
| <b>Relative power level <math>\gamma_{PRB}</math> [dB]</b>  |   |   | <b>PDSCH Data</b> |
| <b>Subframe</b>   |   |   |                   |
| 0   | 5   | 1 – 4, 6 – 9  |                   |
| <b>Allocation</b>   |   |   |                   |
| 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1)   | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) |                   |
| 0   | 0   | 0   | Note 1            |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |                   |

### A.5.1.7 OCNG FDD pattern 7: dynamic OCNG FDD pattern when user data is in multiple non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data, EPDCCH or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in multiple parts by the  $M$  allocated blocks for data transmission). The  $m$ -th allocated block starts with RPB  $N_{Start,m}$  and ends with PRB  $N_{End,m} - 1$ , where  $m = 1, \dots, M$ . The system bandwidth starts with RPB 0 and ends with  $N_{RB} - 1$ .



**Table A.5.1.7-1: OP.7 FDD: OCNF FDD Pattern when user data is in multiple non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB]  |   |   | PDSCH Data |
|---|---|---|------------|
| Subframe  |   |   |            |
| 0   | 5   | 1 – 4, 6 – 9  |            |
| Allocation  |   |   |            |
| 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} - (PRB N_{Start,m} - 1)$ )<br>...<br>(PRB $N_{End,M} - (PRB N_{RB} - 1)$ )   | 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} - (PRB N_{Start,m} - 1)$ )<br>...<br>(PRB $N_{End,M} - (PRB N_{RB} - 1)$ ) | 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} - (PRB N_{Start,m} - 1)$ )<br>...<br>(PRB $N_{End,M} - (PRB N_{RB} - 1)$ ) |            |
| 0   | 0   | 0   | Note 1     |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNF PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNF shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |            |

### A.5.1.8 OCNF FDD pattern 8: Dynamic OCNF FDD pattern for TM10 transmission

This OCNF Pattern fills with OCNF all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain where there are  $M$  unallocated PRB blocks labled from 1-st block to  $M$ -th block ( $M > 1$ ) and the  $m$ -th block starts with PRB  $N_{Start,m}$  and end with PRB  $N_{End,m}$  or when the unallocated area is continuous in frequency domain where  $M = 1$  (one sided). The system bandwidth starts with PRB 0 and ends with  $N_{RB} - 1$ .  $N_{End,M}$  should be equal to or less than  $N_{RB} - 1$ .

**Table A.5.1.8-1: OP.8 FDD: Dynamic OCNF FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]   |  |  | PDSCH Data |
|--|--|--|------------|
| Subframe   |  |  |            |
| 0  | 5  | 1 – 4, 6 – 9   |            |
| Allocation   |  |  |            |
| 1-st unallocated PRB (PRB $N_{Start,1} \sim PRB N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim PRB N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim PRB N_{End,M}$ )   | 1-st unallocated PRB (PRB $N_{Start,1} \sim PRB N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim PRB N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim PRB N_{End,M}$ ) | 1-st unallocated PRB (PRB $N_{Start,1} \sim PRB N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim PRB N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim PRB N_{End,M}$ ) |            |
| 0  | 0  | 0  | Note 1,2,3 |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNF PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: The OCNF shall be transmitted to the virtual users by all the transmit antennas according to transmission mode10. The the transmit power is equal between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> <p>Note 3: The detailed test set-up for TM10 transmission i.e PMI configuration is specified to each test case.</p> |  |  |            |

## A.5.2 OCNG Patterns for TDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG\_RA and OCNG\_RB which together with a relative power level ( $\gamma$ ) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA/OCNG\_RA = PDSCH_i\_RB/OCNG\_RB,$$

where  $\gamma_i$  denotes the relative power level of the  $i$ :th virtual UE. The parameter settings of OCNG\_RA, OCNG\_RB, and the set of relative power levels  $\gamma$  are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover the OCNG pattern is accompanied by a PCFICH/PDCCH/PHICH reference channel which specifies the control region. For any aggregation and PHICH allocation, the PDCCH and any unused PHICH groups are padded with resource element groups with a power level given respectively by PDCCH\_RA/RB and PHICH\_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

### A.5.2.1 OCNG TDD pattern 1: One sided dynamic OCNG TDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the subframes available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.2.1-1: OP.1 TDD: One sided dynamic OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]  |  |  |   | PDSCH<br>Data |
|---|--|--|---|---------------|
| Subframe (only if available for DL)   |  |  |   |               |
| 0   | 5  | 3, 4, 7, 8, 9<br>and 6 (as normal<br>subframe) <sup>Note 2</sup> | 1<br>and 6 (as special<br>subframe) <sup>Note 2</sup> |               |
| Allocation  |  |  |   |               |
| First unallocated PRB<br>–<br>Last unallocated PRB  | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB               | First unallocated PRB<br>–<br>Last unallocated PRB    |               |
| 0   | 0  | 0  | 0   | Note 1        |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.   |  |  |   |               |
| Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211   |  |  |   |               |
| Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. |  |  |   |               |

### A.5.2.2 OCNG TDD pattern 2: Two sided dynamic OCNG TDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the subframes available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB  $N_{RB} - 1$ .

**Table A.5.2.2-1: OP.2 TDD: Two sided dynamic OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]   |   |   |   | PDSCH Data |
|--|---|---|---|------------|
| Subframe (only if available for DL)  |   |   |   |            |
| 0  | 5   | 3, 4, 6, 7, 8, 9<br>(6 as normal subframe)<br><small>Note 2</small>                   | 1, 6<br>(6 as special subframe)<br><small>Note 2</small>                              |            |
| Allocation   |   |   |   |            |
| 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) –<br>( $N_{RB} - 1$ )  | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) –<br>( $N_{RB} - 1$ ) | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) –<br>( $N_{RB} - 1$ ) | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) –<br>( $N_{RB} - 1$ ) |            |
| 0  | 0   | 0   | 0   | Note 1     |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211</p> <p>Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |   |            |

### A.5.2.3 OCNG TDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz

**Table A.5.2.3-1: OP.3 TDD: OCNG TDD Pattern 3 for 5ms downlink-to-uplink switch-point periodicity**

| Allocation<br>$n_{PRB}$  | Relative power level $\gamma_{PRB}$ [dB] |                                    |                        |      | PDSCH Data | PMCH Data |
|--|--|------------------------------------|------------------------|------|------------|-----------|
|  | Subframe                                 |                                    |                        |      |            |           |
|  | 0  | 5                                  | 4, 9 <sup>Note 2</sup> | 1, 6 |            |           |
| 1 – 49   | 0  | 0<br>(Allocation: all empty PRB-s) | N/A                    | 0    | Note 1     | N/A       |
| 0 – 49   | N/A                                      | N/A                                | 0                      | N/A  | N/A        | Note 3    |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211.</p> <p>Note 3: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.</p> <p>Note 4: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |  |                                    |                        |      |            |           |
| N/A  | Not Applicable                           |                                    |                        |      |            |           |

### A.5.2.4 OCNG TDD pattern 4: One sided dynamic OCNG TDD pattern for MBMS transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided) and MBMS performance is tested.

**Table A.5.2.4-1: OP.4 TDD: One sided dynamic OCNG TDD Pattern for MBMS transmission**

| Allocation<br>$n_{PRB}$  | Relative power level $\gamma_{PRB}$ [dB] |   |                                    |             | PDSCH Data | PMCH Data |
|--|--|---|------------------------------------|-------------|------------|-----------|
|  | Subframe (only for DL)                   |   |                                    |             |            |           |
|  | 0 and 6 (as normal subframe)             | 1 (as special subframe)                     | 5                                  | 3, 4, 7 – 9 |            |           |
| First unallocated PRB – Last unallocated PRB   | 0  | 0<br>(Allocation: all empty PRB-s of DwPTS) | 0<br>(Allocation: all empty PRB-s) | N/A         | Note 1     | N/A       |
| First unallocated PRB – Last unallocated PRB   | N/A                                      | N/A   | N/A                                | N/A         | N/A        | Note2     |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.<br>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.<br>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.<br>N/A Not Applicable |  |   |                                    |             |            |           |

### A.5.2.5 OCNG TDD pattern 5: One sided dynamic 16QAM modulated OCNG TDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the sub-frames available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.2.5-1: OP.5 TDD: One sided dynamic 16QAM modulated OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] |   |  |   | PDSCH Data |
|--|---|--|---|------------|
| Subframe (only if available for DL)      |   |  |   |            |
| 0  | 5 | 3, 4, 7, 8, 9 and 6 (as normal subframe) <sup>Note 2</sup> | 1 and 6 (as special subframe) <sup>Note 2</sup> |            |
| <b>Allocation</b>                        |   |  |   |            |

|   |  |  |  |        |
|---|--|--|--|--------|
| First unallocated PRB<br>–<br>Last unallocated PRB  | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB |        |
| 0   | 0  | 0  | 0  | Note 1 |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211</p> <p>Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 3 (Large Delay CDD). The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |  |  |  |        |

### A.5.2.6 OCNG TDD pattern 6: dynamic OCNG TDD pattern when user data is in 2 non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the subframes available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is discontinuous in frequency domain (divided in two parts by the first allocated block). The second allocated block ends with PRB  $N_{RB} - 1$ .

**Table A.5.2.6-1: OP.6 TDD: OCNG TDD Pattern when user data is in 2 non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB]   |   |   |   | PDSCH Data |
|--|---|---|---|------------|
| Subframe (only if available for DL)  |   |   |   |            |
| 0  | 5   | 3, 4, 6, 7, 8, 9<br>(6 as normal subframe)<br><small>Note 2</small>   | 1,6<br>(6 as special subframe)<br><small>Note 2</small>   |            |
| Allocation   |   |   |   |            |
| 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1)  | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) |            |
| 0  | 0   | 0   | 0   | Note 1     |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211</p> <p>Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |   |            |

### A.5.2.7 OCNG TDD pattern 7: dynamic OCNG TDD pattern when user data is in multiple non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data, EPDCCH or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in multiple parts by the  $M$  allocated blocks for data transmission). The  $m$ -th allocated block starts with RPB  $N_{Start,m}$  and ends with PRB  $N_{End,m} - 1$ , where  $m = 1, \dots, M$ . The system bandwidth starts with RPB 0 and ends with  $N_{RB} - 1$ .

**Table A.5.2.7-1: OP.7 TDD: OCNG TDD Pattern when user data is in multiple non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB]   |   |   |   | PDSCH Data |
|--|---|---|---|------------|
| Subframe (only if available for DL)  |   |   |   |            |
| 0  | 5   | 3, 4, 6, 7, 8, 9<br>(6 as normal subframe)<br><small>Note 2</small>   | 1,6<br>(6 as special subframe)<br><small>Note 2</small>   |            |
| Allocation   |   |   |   |            |
| 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} -$<br>(PRB $N_{Start,m} - 1$ )<br>...<br>(PRB $N_{End,M} -$ (PRB<br>$N_{RB} - 1$ )  | 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} -$<br>(PRB $N_{Start,m} - 1$ )<br>...<br>(PRB $N_{End,M} -$ (PRB<br>$N_{RB} - 1$ ) | 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} -$<br>(PRB $N_{Start,m} - 1$ )<br>...<br>(PRB $N_{End,M} -$ (PRB<br>$N_{RB} - 1$ ) | 0 – (PRB $N_{Start,1} - 1$ )<br>...<br>(PRB $N_{End,(m-1)} -$<br>(PRB $N_{Start,m} - 1$ )<br>...<br>(PRB $N_{End,M} -$ (PRB<br>$N_{RB} - 1$ ) |            |
| 0  | 0   | 0   | 0   | Note 1     |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211</p> <p>Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> |   |   |   |            |

### A.5.2.8 OCNG TDD pattern 8: Dynamic OCNG TDD pattern for TM10 transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain where there are  $M$  unallocated PRB blocks labled from 1-st block to  $M$ -th block ( $M > 1$ ) and the  $m$ -th block starts with PRB  $N_{Start,m}$  and end with PRB  $N_{End,m}$ , or when the unallocated area is continuous in frequency domain where  $M=1$  (one sided). The system bandwidth starts with RPB 0 and ends with  $N_{RB} - 1$ .  $N_{End,M}$  should be equal to or less than  $N_{RB} - 1$ .

**Table A.5.2.8-1: OP.8 TDD: Dynamic OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB]   |  |  | PDSCH Data |
|--|--|--|------------|
| Subframe   |  |  |            |
| 0  | 5  | 1 – 4, 6 – 9   |            |
| Allocation   |  |  |            |
| 1-st unallocated PRB (PRB $N_{Start,1} \sim$ PRB $N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim$ PRB $N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim$ PRB $N_{End,M}$ ) | 1-st unallocated PRB (PRB $N_{Start,1} \sim$ PRB $N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim$ PRB $N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim$ PRB $N_{End,M}$ ) | 1-st unallocated PRB (PRB $N_{Start,1} \sim$ PRB $N_{End,1}$ )<br>...<br>$m$ -th unallocated PRB (PRB $N_{Start,m} \sim$ PRB $N_{End,m}$ )<br>...<br>$M$ -th unallocated PRB (PRB $N_{Start,M} \sim$ PRB $N_{End,M}$ ) |            |
| 0  | 0  | 0  | Note 1,2,3 |

|         |  |
|---------|--|
| Note 1: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH. |
| Note 2: | The OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode10. The the transmit power is equal between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.             |
| Note 3: | The detailed test set-up for TM10 transmission i.e PMI configuration is specified to each test case.   |

### A.5.3 OCNG Patterns for Narrowband IoT

The following OCNG patterns are used for modelling allocations to virtual narrowband IoT UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG\_RA and OCNG\_RB which together with a relative power level ( $\gamma$ ) specifies the NPDSCH EPRE-to-NRS EPRE ratios in OFDM symbols with and without Narrowband reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = NPDSCH_i\_RA / OCNG\_RA = NPDSCH_i\_RB / OCNG\_RB,$$

where  $\gamma_i$  denotes the relative power level of the  $i$ :th virtual UE. The parameter settings of OCNG\_RA, OCNG\_RB, and the set of relative power levels  $\gamma$  are chosen such that when also taking allocations to the UE under test into account, as given by a NPDSCH or NPDCCH reference channel, a transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

#### A.5.3.1 Narrowband IoT OCNG pattern 1

**Table A.5.3.1-1: NB.OP.1 FDD: OCNG FDD Pattern 1**

| Bandwidth | Relative power level $\gamma$ [dB]   |  | NPDCCH and corresponding NPDSCH Data |
|-----------|--|--|--------------------------------------|
|           | Subframe   |  |                                      |
|           | Unused subframes   |  |                                      |
| 200KHz    | 0  |  | Note 2                               |
| Note 1:   | These subframes are assigned to an arbitrary number of virtual UEs with one NPDSCH per virtual UE with corresponding NPDCCH; the data transmitted over the OCNG NPDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma$ is used to scale the power of NPDSCH and NPDCCH.   |  |                                      |
| Note 2:   | Subframes and/or REs available for narrowband IOT DL transmission depend on the in-band, guard band or standalone mode indicated in MIB, and scheduling delay between NPDCCH, NPDSCH, NPUSCH format 2 and NPDCCH specified in test cases.  |  |                                      |
| Note 3:   | If two or more transmit antennas with NRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with NRS according to transmit diversity scheme. The parameter $\gamma$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with NRS used in the test. |  |                                      |

### A.5.4 OCNG Patterns for frame structure type 3

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG\_RA and OCNG\_RB which together with a relative power level ( $\gamma$ ) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference

symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA / OCNG\_RA = PDSCH_i\_RB / OCNG\_RB,$$

where  $\gamma_i$  denotes the relative power level of the  $i$ :th virtual UE. The parameter settings of OCNG\_RA, OCNG\_RB, and the set of relative power levels  $\gamma$  are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a constant transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover the OCNG pattern is accompanied by a PDCCH reference channel which specifies the control region. For any aggregation the PDCCH are padded with resource element groups with a power level given respectively by PDCCH\_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

For the performance requirements of UE with the CA capability, the OCNG patterns apply for each LAA Scell.

### A.5.4.1 OCNG FS3 pattern 1: One sided dynamic OCNG frame structure type 3 pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.4.1-1: OP.1 FS3: One sided dynamic OCNG frame structure type 3 Pattern**

| Relative power level $\gamma_{PRB}$ [dB]  |  |  | PDSCH Data |
|---|--|--|------------|
| Subframe  |  |  |            |
| 0   | 5  | 1 – 4, 6 – 9                                       |            |
| Allocation  |  |  |            |
| First unallocated PRB<br>–<br>Last unallocated PRB  | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB |            |
| 0   | 0  | 0  | Note 1     |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.   |  |  |            |
| Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. |  |  |            |
| Note 3: Subframes available for DL transmission and Occupied OFDM symbols in each subframe depend on the downlink burst transmission pattern and its corresponding configuration  |  |  |            |

### A.5.4.2 OCNG FS3 pattern 2: Two sided dynamic OCNG frame structure type 3 pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB  $N_{RB} - 1$ .

**Table A.5.4.2-1: OP.2 FS3: Two sided dynamic OCNG frame structure type 3 Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | PDSCH Data |
|--|------------|
|--|------------|



| Subframe   |   |   |        |
|--|---|---|--------|
| 0  | 5   | 1 – 4, 6 – 9  |        |
| Allocation   |   |   |        |
| 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ )  | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ ) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ( $N_{RB} - 1$ ) |        |
| 0  | 0   | 0   | Note 1 |
| <p>Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter <math>\gamma_{PRB}</math> is used to scale the power of PDSCH.</p> <p>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter <math>\gamma_{PRB}</math> applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.</p> <p>Note 3: Subframes available for DL transmission and Occupied OFDM symbols in each subframe depend on the downlink burst transmission pattern and its corresponding configuration.</p> |   |   |        |

## A.6 Sidelink reference measurement channels

### A.6.1 General

The algorithm for determining the payload size  $A$  is as follows; given a desired coding rate  $R$  and radio block allocation  $N_{RB}$

1. Calculate the number of channel bits  $N_{ch}$  that can be transmitted during the first transmission of a given subframe.
2. Find  $A$  such that the resulting coding rate is as close to  $R$  as possible, that is,

$$\min \left| R - (A + 24 * (N_{CB} + 1)) / N_{ch} \right|, \text{ where } N_{CB} = \begin{cases} 0, & \text{if } C = 1 \\ C, & \text{if } C > 1 \end{cases}$$

subject to

- a)  $A$  is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of  $N_{RB}$  resource blocks.
  - b)  $C$  is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].
3. If there is more than one  $A$  that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

#### A.6.1.1 Overview of ProSe reference measurement channels

In Table A.6.1.1-1 are listed the ProSe reference measurement channels specified in annexes A.6.2 to A.6.6 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.6.2 to A.6.6 as appropriate.

**Table A.6.1.1-1: Overview of ProSe reference measurement channels**

| Table         | Name | BW | Mod  | RB | UE Categ | Notes |
|---------------|------|----|------|----|----------|-------|
| Table A.6.2-1 | -    | 5  | QPSK | 2  | $\geq 1$ |       |
| Table A.6.2-1 | -    | 10 | QPSK | 2  | $\geq 1$ |       |
| Table A.6.2-1 | -    | 15 | QPSK | 2  | $\geq 1$ |       |
| Table A.6.2-1 | -    | 20 | QPSK | 2  | $\geq 1$ |       |

|               |                   |      |       |    |          |  |
|---------------|-------------------|------|-------|----|----------|--|
| Table A.6.2-2 | -                 | 5    | QPSK  | 25 | $\geq 1$ |  |
| Table A.6.2-2 | -                 | 10   | QPSK  | 50 | $\geq 1$ |  |
| Table A.6.2-3 | -                 | 5    | 16QAM | 25 | 2-8      |  |
| Table A.6.2-3 | -                 | 10   | 16QAM | 50 | 2-8      |  |
| Table A.6.2-4 | -                 | 5    | 16QAM | 25 | 1        |  |
| Table A.6.2-4 | -                 | 10   | 16QAM | 50 | 1        |  |
| Table A.6.3-1 | D.1 FDD / D.1 TDD | 5    | QPSK  | 2  | $\geq 1$ |  |
| Table A.6.3-1 | D.1 FDD / D.1 TDD | 10   | QPSK  | 2  | $\geq 1$ |  |
| Table A.6.3-1 | D.1 FDD / D.1 TDD | 15   | QPSK  | 2  | $\geq 1$ |  |
| Table A.6.3-1 | D.1 FDD / D.1 TDD | 20   | QPSK  | 2  | $\geq 1$ |  |
| Table A.6.4-1 | CC.1 FDD          | 5    | QPSK  | 1  | -        |  |
| Table A.6.4-1 | CC.2 FDD          | 10   | QPSK  | 1  | -        |  |
| Table A.6.4-1 | CC.3 FDD          | 5    | QPSK  | 1  | -        |  |
| Table A.6.4-1 | CC.4 FDD          | 10   | QPSK  | 1  | -        |  |
| Table A.6.4-1 | CC.5 FDD          | 5    | QPSK  | 1  | -        |  |
| Table A.6.4-1 | CC.6 FDD          | 10   | QPSK  | 1  | -        |  |
| Table A.6.5-1 | CD.1 FDD          | 5/10 | QPSK  | 10 | -        |  |
| Table A.6.5-1 | CD.2 FDD          | 5/10 | 16QAM | 10 | -        |  |
| Table A.6.5-1 | CD.3 FDD          | 5    | 16QAM | 25 | -        |  |
| Table A.6.5-1 | CD.4 FDD          | 10   | 16QAM | 50 | -        |  |
| Table A.6.5-1 | CD.5 FDD          | 5/10 | QPSK  | 2  | -        |  |
| Table A.6.5-2 | CD.6 FDD          | 5    | 16QAM | 25 | -        |  |
| Table A.6.5-2 | CD.7 FDD          | 10   | 16QAM | 50 | -        |  |
| Table A.6.6-1 | CP.1 FDD          | 5/10 | QPSK  | 6  | -        |  |

## A.6.2 Reference measurement channel for receiver characteristics

For ProSe Direct Discovery, Table A.6.2-1 is applicable for measurements on the Receiver Characteristics (clause 7) including the requirements of subclause 7.4D (Maximum input level).

For ProSe Direct Communication, Table A.6.2-2 is applicable for measurements on the Receiver Characteristics (clause 7) with the exception of subclause 7.4D (Maximum input level). Tables A.6.2-3, A.6.2-4, are applicable for subclause 7.4D (Maximum input level).

**Table A.6.2-1: Fixed Reference measurement channel for ProSe Direct Discovery receiver requirements and maximum input level**

| Parameter   | Unit | Value |   |          |          |          |          |
|---|------|-------|---|----------|----------|----------|----------|
|   |      | 1.4   | 3 | 5        | 10       | 15       | 20       |
| Channel bandwidth   | MHz  |       |   |          |          |          |          |
| Allocated resource blocks                                 |      |       |   | 2        | 2        | 2        | 2        |
| Subcarriers per resource block                            |      |       |   | 12       | 12       | 12       | 12       |
| Allocated subframes per Discovery period                  |      |       |   | 1        | 1        | 1        | 1        |
| DFT-OFDM Symbols per subframe (see note)                  |      |       |   | 11       | 11       | 11       | 11       |
| Modulation  |      |       |   | QPSK     | QPSK     | QPSK     | QPSK     |
| Transport Block Size                                      |      |       |   | 232      | 232      | 232      | 232      |
| Transport block CRC                                       | Bits |       |   | 24       | 24       | 24       | 24       |
| Maximum number of HARQ transmissions                      |      |       |   | 1        | 1        | 1        | 1        |
| Binary Channel Bits (see note)                            | Bits |       |   | 528      | 528      | 528      | 528      |
| Max. Throughput averaged over 1 Discovery period of 320ms | kbps |       |   | 0.725    | 0.725    | 0.725    | 0.725    |
| UE Category   |      |       |   | $\geq 1$ | $\geq 1$ | $\geq 1$ | $\geq 1$ |

NOTE1: PSDCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.  
 NOTE2: Throughput is 232 bits per Discovery period. The discovery period is configured as 320ms in the test.

**Table A.6.2-2: Fixed Reference measurement channel for ProSe Direct Communication receiver requirements**

| Parameter   | Unit | Value |   |      |       |    |    |
|---|------|-------|---|------|-------|----|----|
|   |      | 1.4   | 3 | 5    | 10    | 15 | 20 |
| Channel bandwidth                                 | MHz  |       |   |      |       |    |    |
| Allocated resource blocks                         |      |       |   | 25   | 50    |    |    |
| Subcarriers per resource block                    |      |       |   | 12   | 12    |    |    |
| Packets per SA period                             |      |       |   | 1    | 1     |    |    |
| Modulation  |      |       |   | QPSK | QPSK  |    |    |
| Transport Block Size                              |      |       |   | 2216 | 4392  |    |    |
| Transport block CRC                               | Bits |       |   | 24   | 24    |    |    |
| Maximum number of HARQ transmissions              |      |       |   | 4    | 4     |    |    |
| Binary Channel Bits                               | Bits |       |   | 7200 | 14400 |    |    |
| Max. Throughput averaged over 1 SA period of 40ms | kbps |       |   | 55.4 | 109.8 |    |    |
| UE Category                                       |      |       |   | ≥ 1  | ≥ 1   |    |    |

NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.  
 NOTE 2: Throughput (in kbps) will depend on SA period configuration

**Table A.6.2-3: Fixed Reference measurement channel for ProSe Direct Communication for maximum input power for UE categories 2-8**

| Parameter   | Unit | Value |   |       |       |    |    |
|---|------|-------|---|-------|-------|----|----|
|   |      | 1.4   | 3 | 5     | 10    | 15 | 20 |
| Channel bandwidth                                 | MHz  |       |   |       |       |    |    |
| Allocated resource blocks                         |      |       |   | 25    | 50    |    |    |
| Subcarriers per resource block                    |      |       |   | 12    | 12    |    |    |
| Packets per SA period                             |      |       |   | 1     | 1     |    |    |
| Modulation  |      |       |   | 16QAM | 16QAM |    |    |
| Transport Block Size                              |      |       |   | 9912  | 18336 |    |    |
| Transport block CRC                               | Bits |       |   | 24    | 24    |    |    |
| Maximum number of HARQ transmissions              |      |       |   | 4     | 4     |    |    |
| Binary Channel Bits                               | Bits |       |   | 14400 | 28800 |    |    |
| Max. Throughput averaged over 1 SA period of 40ms | kbps |       |   | 247.8 | 458.4 |    |    |

NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.  
 NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  
 NOTE 3: Throughput (in kbps) will depend on SA period configuration

**Table A.6.2-4: Fixed Reference measurement channel for ProSe Direct Communication for maximum input power for UE category 1**

| Parameter   | Unit | Value |   |       |       |    |    |
|---|------|-------|---|-------|-------|----|----|
|   |      | 1.4   | 3 | 5     | 10    | 15 | 20 |
| Channel bandwidth                                 | MHz  |       |   |       |       |    |    |
| Allocated resource blocks                         |      |       |   | 25    | 24    |    |    |
| Subcarriers per resource block                    |      |       |   | 12    | 12    |    |    |
| Packets per SA period                             |      |       |   | 1     | 1     |    |    |
| Modulation  |      |       |   | 16QAM | 16QAM |    |    |
| Transport Block Size                              |      |       |   | 9912  | 10296 |    |    |
| Transport block CRC                               | Bits |       |   | 24    | 24    |    |    |
| Maximum number of HARQ transmissions              |      |       |   | 4     | 4     |    |    |
| Binary Channel Bits                               | Bits |       |   | 14400 | 13824 |    |    |
| Max. Throughput averaged over 1 SA period of 40ms | kbps |       |   | 247.8 | 257.4 |    |    |

NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.

NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  
 NOTE 3: Throughput (in kbps) will depend on SA period configuration

### A.6.3 Reference measurement channels for PSDCH performance requirements

**Table A.6.3-1: Fixed Reference measurement channel for PSDCH performance requirement**

| Parameter   | Unit | Value             |   |       |       |       |       |
|---|------|-------------------|---|-------|-------|-------|-------|
|   |      | D.1 FDD / D.1 TDD |   |       |       |       |       |
| Reference channel   |      |                   |   |       |       |       |       |
| Channel bandwidth   | MHz  | 1.4               | 3 | 5     | 10    | 15    | 20    |
| Allocated resource blocks   |      |                   |   | 2     | 2     | 2     | 2     |
| Subcarriers per resource block  |      |                   |   | 12    | 12    | 12    | 12    |
| DFT-OFDM Symbols per subframe (NOTE 1)  |      |                   |   | 11    | 11    | 11    | 11    |
| Modulation  |      |                   |   | QPSK  | QPSK  | QPSK  | QPSK  |
| Transport Block Size  |      |                   |   | 232   | 232   | 232   | 232   |
| Transport block CRC   | Bits |                   |   | 24    | 24    | 24    | 24    |
| Binary Channel Bits (NOTE 1)  | Bits |                   |   | 528   | 528   | 528   | 528   |
| Max. Throughput averaged over 1 Discovery period of 320ms   | kbps |                   |   | 0.725 | 0.725 | 0.725 | 0.725 |
| UE Category   |      |                   |   | ≥ 1   | ≥ 1   | ≥ 1   | ≥ 1   |
| NOTE 1: PSDCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. |      |                   |   |       |       |       |       |

### A.6.4 Reference measurement channels for PSCCH performance requirements

**Table A.6.4-1: Fixed reference measurement channel for PSCCH performance requirement**

| Parameter   | Unit                                | Value  |          |                        |                            |                        |                            |
|---|-------------------------------------|--|----------|------------------------|----------------------------|------------------------|----------------------------|
|   |                                     | CC.1 FDD   | CC.2 FDD | CC.3 FDD               | CC.4 FDD                   | CC.5 FDD               | CC.6 FDD                   |
| Reference channel   |                                     |  |          |                        |                            |                        |                            |
| Channel bandwidth   | MHz                                 | 5  | 10       | 5                      | 10                         | 5                      | 10                         |
| Allocated resource blocks   |                                     | 1  | 1        | 1                      | 1                          | 1                      | 1                          |
| Subcarriers per resource block  |                                     | 12   | 12       | 12                     | 12                         | 12                     | 12                         |
| DFT-OFDM Symbols per subframe (see Note 1)  |                                     | 11   | 11       | 11                     | 11                         | 11                     | 11                         |
| Modulation  |                                     | QPSK   | QPSK     | QPSK                   | QPSK                       | QPSK                   | QPSK                       |
| Transport Block Size  | Bits                                | 41   | 43       | 41                     | 43                         | 41                     | 43                         |
| Information bits  | Frequency hopping flag              | 0  | 0        | 1                      | 1                          | 1                      | 1                          |
|   | RB assignment                       | Set as per PSSCH RB allocation specific in the test    |          |                        |                            |                        |                            |
|   | Hopping bits                        | N/A  | N/A      | 1<br>Type 2<br>Hopping | (1,1)<br>Type 2<br>Hopping | 0<br>Type 1<br>Hopping | (1,0)<br>Type 1<br>Hopping |
|   | Time resource pattern ( $I_{TRP}$ ) | 8 (unless specified otherwise in the test)<br>(Note 3) |          |                        |                            |                        |                            |
|   | Modulation and coding scheme        | Set as the PSSCH MCS specified in the test             |          |                        |                            |                        |                            |
|   | Timing advance indication           | 0 (unless specified otherwise in the test)             |          |                        |                            |                        |                            |
| Group destination ID  | As set by higher layers             |  |          |                        |                            |                        |                            |
| Transport block CRC   | Bits                                | 16   | 16       | 16                     | 16                         | 16                     | 16                         |
| Maximum number of HARQ transmissions  |                                     | 2  | 2        | 2                      | 2                          | 2                      | 2                          |
| Binary Channel Bits (see Note 1,2)  | Bits                                | 264  | 264      | 264                    | 264                        | 264                    | 264                        |
| Max. Throughput averaged over one sc-period (bits/sc-period)  |                                     | 41   | 43       | 41                     | 43                         | 41                     | 43                         |
| NOTE 1: PSCCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.             |                                     |  |          |                        |                            |                        |                            |
| NOTE 2: Binary channel bits per HARQ transmission.  |                                     |  |          |                        |                            |                        |                            |
| NOTE 3: For $N_{TRP} = 8$ (FDD) and $trpt-Subset = 010$ , $I_{TRP} = 8$ corresponds to a time repetition pattern of (1,1,0,0,0,0,0,0) as per TS 36.213. |                                     |  |          |                        |                            |                        |                            |

## A.6.5 Reference measurement channels for PSSCH performance requirements

**Table A.6.5-1: Fixed reference measurement channel for PSSCH performance requirement**

| Parameter   | Unit | Value    |          |          |          |          |
|---|------|----------|----------|----------|----------|----------|
|   |      | CD.1 FDD | CD.2 FDD | CD.3 FDD | CD.4 FDD | CD.5 FDD |
| Reference channel   |      | CD.1 FDD | CD.2 FDD | CD.3 FDD | CD.4 FDD | CD.5 FDD |
| Channel bandwidth   | MHz  | 5 / 10   | 5 / 10   | 5        | 10       | 5 / 10   |
| Allocated resource blocks   |      | 10       | 10       | 25       | 50       | 2        |
| Subcarriers per resource block  |      | 12       | 12       | 12       | 12       | 12       |
| DFT-OFDM Symbols per subframe (see Note 1)  |      | 11       | 11       | 11       | 11       | 11       |
| Modulation  |      | QPSK     | 16QAM    | 16QAM    | 16QAM    | QPSK     |
| Transport Block Size  |      | 872      | 2536     | 6456     | 12960    | 328      |
| Transport block CRC   | Bits | 24       | 24       | 24       | 24       | 24       |
| Maximum number of HARQ transmissions  |      | 4        | 4        | 4        | 4        | 4        |
| Binary Channel Bits (see Note 1,2)  | Bits | 2640     | 5280     | 13200    | 26400    | 528      |
| Max. Throughput averaged over one sc-period (bits/sc-period)  |      | 872      | 2536     | 6456     | 12960    | 328      |
| NOTE 1: PSSCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.     |      |          |          |          |          |          |
| NOTE 2: Binary channel bits per HARQ transmission.  |      |          |          |          |          |          |
| NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |          |          |          |          |          |

**Table A.6.5-2: Fixed reference measurement channel for PSSCH for maximum Sidelink processes test**

| Parameter   | Unit | Value    |          |
|---|------|----------|----------|
|   |      | CD.6 FDD | CD.7 FDD |
| Reference channel   |      | CD.6 FDD | CD.7 FDD |
| Channel bandwidth   | MHz  | 5        | 10       |
| Allocated resource blocks   |      | 25       | 50       |
| Subcarriers per resource block  |      | 12       | 12       |
| DFT-OFDM Symbols per subframe (see Note 1)  |      | 11       | 11       |
| Modulation  |      | 16QAM    | 16QAM    |
| Transport Block Size  |      | 15840    | 25456    |
| Transport block CRC   | Bits | 24       | 24       |
| Maximum number of HARQ transmissions  |      | 4        | 4        |
| Binary Channel Bits (see Note 1,2)  | Bits | 13200    | 26400    |
| Max. Throughput averaged over one sc-period (bits/sc-period)  |      | 15840    | 25456    |
| NOTE 1: PSSCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.     |      |          |          |
| NOTE 2: Binary channel bits per HARQ transmission.  |      |          |          |
| NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |          |          |

## A.6.6 Reference measurement channels for PSBCH performance requirements

**Table A.6.6-1: Fixed reference measurement channel for PSBCH performance requirement**

| Parameter  | Unit | Value    |
|--|------|----------|
| Reference channel  |      | CP.1 FDD |
| Channel bandwidth  | MHz  | 5 / 10   |
| Allocated resource blocks  |      | 6        |
| Subcarriers per resource block   |      | 12       |
| DFT-OFDM Symbols per subframe<br>(see Note 1)  |      | 7        |
| Modulation   |      | QPSK     |
| Transport Block Size   |      | 40       |
| Transport block CRC  | Bits | 16       |
| Maximum number of HARQ transmissions   |      | 1        |
| Binary Channel Bits (see Note 1,2)   | Bits | 1008     |
| Max. Throughput averaged over 40ms   | kbps | 1        |
| NOTE 1: PSBCH transmissions are rate-matched for 8 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. |      |          |
| NOTE 2: Binary channel bits per HARQ transmission.   |      |          |

## A.7 Sidelink reference resource pool configurations

### A.7.1 Reference resource pool configurations for ProSe Direct Discovery demodulation tests

#### A.7.1.1 FDD

**Table A.7.1.1-1: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #1-FDD)**

| Information Element |                   |                 | Value  |
|---------------------|-------------------|-----------------|--|
| discRxPool          | cp-Len            |                 | Normal   |
|                     | discPeriod        |                 | rf32   |
|                     | numRetx           |                 | 0  |
|                     | numRepetition     |                 | 1  |
|                     | tf-ResourceConfig | prb-Num         | 12   |
|                     |                   | prb-Start       | 0  |
|                     |                   | prb-End         | 23   |
|                     |                   | offsetIndicator | 160  |
|                     |                   | subframeBitmap  | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
|                     | txParameters      |                 | not present  |
|                     | rxParameters      |                 | not present  |
| discTxPoolCommon    |                   |                 | not present  |
| discTxPowerInfo     |                   |                 | not present  |
| SL-SyncConfig       |                   |                 | not present  |
| discInterFreqList   |                   |                 | not present  |

**Table A.7.1.1-2: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #2-FDD)**

| Information Element |                   |           | Value  |
|---------------------|-------------------|-----------|--------|
| discRxPool(0)       | cp-Len            |           | Normal |
|                     | discPeriod        |           | rf32   |
|                     | numRetx           |           | 0      |
|                     | numRepetition     |           | 1      |
|                     | tf-ResourceConfig | prb-Num   | 12     |
|                     |                   | prb-Start | 0      |

|                   |                     |                 |  |
|-------------------|---------------------|-----------------|--|
|                   |                     | prb-End         | 23   |
|                   |                     | offsetIndicator | 150  |
|                   |                     | subframeBitmap  | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
|                   | txParameters        |                 | not present  |
|                   | rxParameters        |                 | not present  |
| discRxPool(1)     | cp-Len              |                 | Normal   |
|                   | discPeriod          |                 | rf32   |
|                   | numRetx             |                 | 0  |
|                   | numRepetition       |                 | 1  |
|                   | tf-ResourceConfig   | prb-Num         | 12   |
|                   |                     | prb-Start       | 0  |
|                   |                     | prb-End         | 23   |
|                   |                     | offsetIndicator | 170  |
|                   |                     | subframeBitmap  | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
|                   | txParameters        |                 | not present  |
|                   | rxParameters        | tdd-Config      | not present  |
|                   |                     | syncConfigIndex | 0  |
| discTxPoolCommon  |                     |                 | not present  |
| discTxPowerInfo   |                     |                 | not present  |
| SL-SyncConfig(0)  | syncCP-Len          |                 | Normal   |
|                   | syncOffsetIndicator |                 | 0 (160 mod 40)   |
|                   | slssid              |                 | 30   |
|                   | txParameters        |                 | not present  |
|                   | rxParamsNCell       | physCellId      | 1  |
|                   |                     | discSyncWindow  | w1   |
| discInterFreqList |                     |                 | not present  |

**Table A.7.1.1-3: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #3-FDD)**

| Information Element                       |                   | Value   |
|---|-------------------|---|
| discRxPool(iPool),<br>iPool = 0...NPool-1 | cp-Len            | Normal  |
|   | discPeriod        | rf32  |
|   | numRetx           | 3   |
|   | numRepetition     | =2 if NPool > 10,<br>=1 otherwise   |
|   | tf-ResourceConfig | prb-Num<br>5MHz: min{24, 2N-24*iPool} / 2<br>10MHz: 25<br>15MHz: min{74, 2N-74*iPool} / 2<br>20MHz: 50  |
|   |                   | prb-Start<br>0  |
|   |                   | prb-End<br>5 MHz: min{24, 2N-24*iPool} - 1<br>10 MHz: 49<br>15 MHz: min{74, 2N-74*iPool} - 1<br>20 MHz: 99  |
|   |                   | offsetIndicator<br>160  |
|   |                   | subframeBitmap<br>a(0), a(1), ..., a(39), s.t.<br><br>a(i * NPool + iPool) = 1, i = 0,...,K;<br>a(k) = 0 otherwise<br><br>where<br>K = 1 is NPool > 10, K = 3 otherwise |
|   | txParameters      | not present   |
|   | rxParameters      | not present   |
| discTxPoolCommon                          |                   | not present   |

|  |  |  |             |
|--|--|--|-------------|
| discTxPowerInfo  |  |  | not present |
| SL-SyncConfig  |  |  | not present |
| discInterFreqList  |  |  | not present |
| NOTE 1: The resource pool configuration description is parameterized using channel BW, number of configured resource pools (NPool), and maximum number of configured Sidelink UEs to be supported (N). |  |  |             |

**Table A.7.1.1-4: ProSe Direct Discovery configuration for E-UTRA FDD for out-of-network coverage operation (Configuration #4-FDD)**

| Information Element |                      |                   |                 | Value  |       |
|---------------------|----------------------|-------------------|-----------------|--|-------|
|                     |                      |                   |                 | 5MHz   | 10MHz |
| preconfigSync       | syncCP-Len-r12       |                   |                 | Normal   |       |
|                     | syncOffsetIndicator1 |                   |                 | 1  |       |
|                     | syncOffsetIndicator2 |                   |                 | 2  |       |
|                     | syncTxParameters     |                   |                 | 23   |       |
|                     | syncTxThreshOoC      |                   |                 | 0<br>(-110dBm / 15kHz)                                   |       |
|                     | filterCoefficient    |                   |                 | fc0  |       |
|                     | syncRefMinHyst       |                   |                 | dB0  |       |
|                     | syncRefDiffHyst      |                   |                 | dB0  |       |
|                     | syncTxPeriodic       |                   |                 | TRUE   |       |
| preconfigDisc       | discRxPoolList(0)    | cp-Len            |                 | Normal   |       |
|                     |                      | discPeriod        |                 | rf4  |       |
|                     |                      | numRetx           |                 | 0  |       |
|                     |                      | numRepetition     |                 | 1  |       |
|                     |                      | tf-ResourceConfig | prb-Num         | 12   | 25    |
|                     |                      |                   | prb-Start       | 0  | 0     |
|                     |                      |                   | prb-End         | 23   | 49    |
|                     |                      |                   | offsetIndicator | 0  |       |
|                     |                      |                   | subframeBitmap  | 00000000<br>10000000<br>00000000<br>00000000<br>00000000 |       |
|                     |                      | txParameters      |                 | not present  |       |

**A.7.1.2 TDD**

**Table A.7.1.2-1: ProSe Direct Discovery configuration for E-UTRA TDD Config 0 (Configuration #1-TDD)**

| Information Element |                   |                 | Value  |
|---------------------|-------------------|-----------------|--|
| discRxPool          | cp-Len            |                 | Normal   |
|                     | discPeriod        |                 | rf32   |
|                     | numRetx           |                 | 0  |
|                     | numRepetition     |                 | 1  |
|                     | tf-ResourceConfig | prb-Num         | 12   |
|                     |                   | prb-Start       | 0  |
|                     |                   | prb-End         | 23   |
|                     |                   | offsetIndicator | 163  |
|                     |                   | subframeBitmap  | 10000000<br>00000000<br>00000000<br>00000000<br>00000000<br>00 |
|                     |                   | txParameters    | not present  |
|                     | rxParameters      | not present     |  |
| discTxPoolCommon    |                   | not present     |  |
| discTxPowerInfo     |                   | not present     |  |



|                   |  |  |             |
|-------------------|--|--|-------------|
| SL-SyncConfig     |  |  | not present |
| discInterFreqList |  |  | not present |

**Table A.7.1.2-2: ProSe Direct Discovery configuration for E-UTRA TDD (Configuration #2-TDD)**

| Information Element  |                   |                 | Value   |
|--|-------------------|-----------------|---|
| discRxPool(iPool),<br>iPool = 0...NPool-1  | cp-Len            |                 | Normal  |
|  | discPeriod        |                 | rf32  |
|  | numRetx           |                 | 3   |
|  | numRepetition     |                 | =2 if NPool > 10,<br>=1 otherwise   |
|  | tf-ResourceConfig | prb-Num         | 5MHz: $\min\{24, 2N-24 \cdot iPool\} / 2$<br>10MHz: 25<br>15MHz: $\min\{74, 2N-74 \cdot iPool\} / 2$<br>20MHz: 50                                     |
|  |                   | prb-Start       | 0   |
|  |                   | prb-End         | 5 MHz: $\min\{24, 2N-24 \cdot iPool\} - 1$<br>10 MHz: 49<br>15 MHz: $\min\{74, 2N-74 \cdot iPool\} - 1$<br>20 MHz: 99                                 |
|  |                   | offsetIndicator | 163   |
|  |                   | subframeBitmap  | a(0), a(1), ..., a(39), s.t.<br><br>a(i * NPool + iPool) = 1, i = 0,...,K;<br>a(k) = 0 otherwise<br><br>where<br>K = 1 is NPool > 10, K = 3 otherwise |
|  | txParameters      |                 | not present   |
|  | rxParameters      |                 | not present   |
| discTxPoolCommon   |                   |                 | not present   |
| discTxPowerInfo  |                   |                 | not present   |
| SL-SyncConfig  |                   |                 | not present   |
| discInterFreqList  |                   |                 | not present   |
| NOTE 1: The resource pool configuration description is parameterized using channel BWs, number of configured resource pools (NPool), and maximum number of configured Sidelink UE to be supported (N). |                   |                 |   |

## A.7.2 Reference resource pool configurations for ProSe Direct Communication demodulation tests

### A.7.2.1 FDD

**Table A.7.2.1-1: ProSe Direct Communication pre-configuration for E-UTRAN FDD for out-of-network coverage operation (Configuration #1-FDD)**

| Information Element / (BW configuration) |                      |         | Value (5MHz)           | Value (10MHz) |
|--|----------------------|---------|------------------------|---------------|
| preconfigSync                            | syncCP-Len-r12       |         | Normal                 |               |
|  | syncOffsetIndicator1 |         | 1                      |               |
|  | syncOffsetIndicator2 |         | 2                      |               |
|  | syncTxParameters     |         | 23                     |               |
|  | syncTxThreshOoC      |         | 0<br>(-110dBm / 15kHz) |               |
|  | filterCoefficient    |         | fc0                    |               |
|  | syncRefMinHyst       |         | dB0                    |               |
|  | syncRefDiffHyst      |         | dB0                    |               |
| preconfigComm                            | sc-CP-Len            |         | Normal                 |               |
|  | sc-Period            |         | sf40                   |               |
|  | sc-TF-ResourceConfig | prb-Num | 13                     | 25            |

|  |                           |                        |                 |  |    |
|--|---------------------------|------------------------|-----------------|--|----|
|  |                           | prb-Start              |                 | 0  | 0  |
|  |                           | prb-End                |                 | 24   | 49 |
|  |                           | offsetIndicator        |                 | 0  |    |
|  |                           | subframeBitmap         |                 | 00011000<br>00000000<br>00000000<br>00000000<br>00000000 |    |
|  | data-CP-Len               |                        |                 | Normal   |    |
|  | dataHoppingConfig         | hoppingParameter       |                 | 504  |    |
|  |                           | numSubbands            |                 | ns2  |    |
|  |                           | rb-Offset              |                 | 0  |    |
|  | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num         | 13   | 25 |
|  |                           |                        | prb-Start       | 0  | 0  |
|  |                           |                        | prb-End         | 24   | 49 |
|  |                           |                        | offsetIndicator | 0  |    |
|  |                           |                        | subframeBitmap  | 00000000<br>11111111<br>11111111<br>00000000<br>00000000 |    |
|  |                           | trpt-Subset-r12        |                 | 010  |    |

**Table A.7.2.1-2: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #2-FDD)**

| Information Element / (BW configuration) |                           |                        |                 | Value (5MHz)   | Value (10MHz) |
|--|---------------------------|------------------------|-----------------|--|---------------|
| commRxPool                               | sc-CP-Len                 |                        |                 | Normal   |               |
|  | sc-Period                 |                        |                 | sf40   |               |
|  | sc-TF-ResourceConfig      | prb-Num                |                 | 13   | 25            |
|  |                           | prb-Start              |                 | 0  | 0             |
|  |                           | prb-End                |                 | 24   | 49            |
|  |                           | offsetIndicator        |                 | 0  |               |
|  |                           | subframeBitmap         |                 | 00111100<br>00000000<br>00000000<br>00000000<br>00000000 |               |
|  | data-CP-Len               |                        |                 | Normal   |               |
|  | dataHoppingConfig         | hoppingParameter       |                 | 504  |               |
|  |                           | numSubbands            |                 | ns2  |               |
|  |                           | rb-Offset              |                 | 0  |               |
|  | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num         | 13   | 25            |
|  |                           |                        | prb-Start       | 0  | 0             |
|  |                           |                        | prb-End         | 24   | 49            |
|  |                           |                        | offsetIndicator | 0  |               |
|  |                           |                        | subframeBitmap  | 00000000<br>11111111<br>11111111<br>00000000<br>00000000 |               |
|  |                           | trpt-Subset-r12        |                 | 010  |               |
|  | rxParametersNCell         |                        |                 | not present  |               |
|  | txParameters              |                        |                 | not present  |               |
| commTxPoolNormalCommon                   |                           |                        |                 | not present  |               |
| SL-SyncConfig                            |                           |                        |                 | not present  |               |

**Table A.7.2.1-3: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #3-FDD)**

| Information Element / (BW configuration) |           |  |  | Value (5MHz) | Value (10MHz) |
|--|-----------|--|--|--------------|---------------|
| commRxPool(0)                            | sc-CP-Len |  |  | Normal       |               |

|                        |                           |                        |                 |  |    |
|------------------------|---------------------------|------------------------|-----------------|--|----|
|                        | sc-Period                 |                        |                 | sf40   |    |
|                        | sc-TF-ResourceConfig      | prb-Num                |                 | 13   | 25 |
|                        |                           | prb-Start              |                 | 0  | 0  |
|                        |                           | prb-End                |                 | 24   | 49 |
|                        |                           | offsetIndicator        |                 | 0  |    |
|                        |                           | subframeBitmap         |                 | 00110000<br>00000000<br>00000000<br>00000000<br>00000000 |    |
|                        | data-CP-Len               |                        |                 | Normal   |    |
|                        | dataHoppingConfig         | hoppingParameter       |                 | 504  |    |
|                        |                           | numSubbands            |                 | ns2  |    |
|                        |                           | rb-Offset              |                 | 0  |    |
|                        | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num         | 13   | 25 |
|                        |                           |                        | prb-Start       | 0  | 0  |
|                        |                           |                        | prb-End         | 24   | 49 |
|                        |                           |                        | offsetIndicator | 0  |    |
|                        |                           |                        | subframeBitmap  | 00001111<br>11110000<br>00000000<br>11111111<br>00000000 |    |
|                        |                           | trpt-Subset-r12        |                 | 010  |    |
|                        | rxParametersNCell         |                        |                 | not present  |    |
|                        | txParameters              |                        |                 | not present  |    |
| commRxPool(1)          | sc-CP-Len                 |                        |                 | Normal   |    |
|                        | sc-Period                 |                        |                 | sf40   |    |
|                        | sc-TF-ResourceConfig      | prb-Num                |                 | 13   | 25 |
|                        |                           | prb-Start              |                 | 0  | 0  |
|                        |                           | prb-End                |                 | 24   | 49 |
|                        |                           | offsetIndicator        |                 | 0  |    |
|                        |                           | subframeBitmap         |                 | 00110000<br>00000000<br>00000000<br>00000000<br>00000000 |    |
|                        | data-CP-Len               |                        |                 | Normal   |    |
|                        | dataHoppingConfig         | hoppingParameter       |                 | 504  |    |
|                        |                           | numSubbands            |                 | ns2  |    |
|                        |                           | rb-Offset              |                 | 0  |    |
|                        | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num         | 13   | 25 |
|                        |                           |                        | prb-Start       | 0  | 0  |
|                        |                           |                        | prb-End         | 24   | 49 |
|                        |                           |                        | offsetIndicator | 0  |    |
|                        |                           |                        | subframeBitmap  | 00001111<br>11110000<br>00001111<br>11110000<br>00000000 |    |
|                        |                           | trpt-Subset-r12        |                 | 010  |    |
|                        | rxParametersNCell         | tdd-Config             |                 | not present  |    |
|                        |                           | syncConfigIndex        |                 | 0  |    |
|                        | txParameters              |                        |                 | not present  |    |
| commTxPoolNormalCommon |                           |                        |                 | not present  |    |
| SL-SyncConfig(0)       | syncCP-Len                |                        |                 | Normal   |    |
|                        | syncOffsetIndicator       |                        |                 | 1  |    |
|                        | slssid                    |                        |                 | 30   |    |
|                        | txParameters              |                        |                 | not present  |    |
|                        | rxParamsNCell             | physCellId             |                 | 1  |    |
|                        |                           | discSyncWindow         |                 | w1   |    |

Table A.7.2.1-4: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #4-FDD)

| Information Element / (BW configuration) |                           |                        |           | Value (5MHz)   | Value (10MHz) |
|--|---------------------------|------------------------|-----------|--|---------------|
| commRxPool(0)                            | sc-CP-Len                 |                        |           | Normal   |               |
|  | sc-Period                 |                        |           | sf80   |               |
|  | sc-TF-ResourceConfig      | prb-Num                |           | 13   | 25            |
|  |                           | prb-Start              |           | 0  | 0             |
|  |                           | prb-End                |           | 24   | 49            |
|  |                           | offsetIndicator        |           | 0  |               |
|  |                           | subframeBitmap         |           | 11110000<br>00000000<br>00000000<br>00000000<br>00000000 |               |
|  | data-CP-Len               |                        |           | Normal   |               |
|  | dataHoppingConfig         | hoppingParameter       |           | 504  |               |
|  |                           | numSubbands            |           | ns2  |               |
|  |                           | rb-Offset              |           | 0  |               |
|  | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num   | 13   | 25            |
|  |                           |                        | prb-Start |  | 0             |
|  |                           | prb-End                |           | 24   | 49            |
|  |                           | offsetIndicator        |           | 0  |               |
|  |                           | subframeBitmap         |           | 00000000<br>11111111<br>00000000<br>11111111<br>00000000 |               |
|  |                           | trpt-Subset-r12        |           | 001  |               |
|  | rxParametersNCell         |                        |           | not present  |               |
|  | txParameters              |                        |           | not present  |               |
| commRxPool(1)                            | sc-CP-Len                 |                        |           | Normal   |               |
|  | sc-Period                 |                        |           | sf80   |               |
|  | sc-TF-ResourceConfig      | prb-Num                |           | 13   | 25            |
|  |                           | prb-Start              |           | 0  | 0             |
|  |                           | prb-End                |           | 24   | 49            |
|  |                           | offsetIndicator        |           | 0  |               |
|  |                           | subframeBitmap         |           | 00001111<br>00000000<br>00000000<br>00000000<br>00000000 |               |
|  | data-CP-Len               |                        |           | Normal   |               |
|  | dataHoppingConfig         | hoppingParameter       |           | 504  |               |
|  |                           | numSubbands            |           | ns2  |               |
|  |                           | rb-Offset              |           | 0  |               |
|  | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num   | 13   | 25            |
|  |                           |                        | prb-Start |  | 0             |
|  |                           | prb-End                |           | 24   | 49            |
|  |                           | offsetIndicator        |           | 0  |               |
|  |                           | subframeBitmap         |           | 00000000<br>00000000<br>11111111<br>00000000<br>11111111 |               |
|  |                           | trpt-Subset-r12        |           | 001  |               |
|  | rxParametersNCell         |                        |           | not present  |               |
|  | txParameters              |                        |           | not present  |               |
| commTxPoolNormalCommon                   |                           |                        |           | not present  |               |
| SL-SyncConfig                            |                           |                        |           | not present  |               |

Table A.7.2.1-5: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #5-FDD)

| Information Element / (BW configuration) |                           |                        |                 | Value (5MHz) | Value (10MHz) |
|--|---------------------------|------------------------|-----------------|--------------|---------------|
| commRxPool                               | sc-CP-Len                 |                        |                 | Normal       |               |
|  | sc-Period                 |                        |                 | sf40         |               |
|  | sc-TF-ResourceConfig      | prb-Num                |                 | 13           | 25            |
|  |                           | prb-Start              |                 | 0            | 0             |
|  |                           | prb-End                |                 | 24           | 49            |
|  |                           | offsetIndicator        |                 | 0            |               |
|  |                           | subframeBitmap         |                 | 00011000     |               |
|  |                           |                        |                 | 00000000     |               |
|  |                           |                        |                 | 00000000     |               |
|  |                           |                        |                 | 00000000     |               |
|  |                           |                        |                 | 00000000     |               |
|  | data-CP-Len               |                        |                 | Normal       |               |
|  | dataHoppingConfig         | hoppingParameter       |                 | 504          |               |
|  |                           | numSubbands            |                 | ns2          |               |
|  |                           | rb-Offset              |                 | 0            |               |
|  | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num         | 13           | 25            |
|  |                           |                        | prb-Start       | 0            | 0             |
|  |                           |                        | prb-End         | 24           | 49            |
|  |                           |                        | offsetIndicator | 0            |               |
|  |                           | subframeBitmap         |                 | 00000000     |               |
|  |                           |                        |                 | 11111111     |               |
|  |                           |                        |                 | 11111111     |               |
|  |                           |                        |                 | 11111111     |               |
|  |                           |                        |                 | 11111111     |               |
|  |                           | trpt-Subset-r12        |                 | 001          |               |
|  | rxParametersNCell         |                        |                 | not present  |               |
|  | txParameters              |                        |                 | not present  |               |
| commTxPoolNormalCommon                   |                           |                        |                 | not present  |               |
| SL-SyncConfig                            |                           |                        |                 | not present  |               |

## A.8 V2X reference measurement channels

### A.8.1 General

The algorithm for determining the payload size  $A$  is as follows; given a desired coding rate  $R$  and radio block allocation  $N_{RB}$

1. Calculate the number of channel bits  $N_{ch}$  that can be transmitted during the first transmission of a given sub-frame.
2. Find  $A$  such that the resulting coding rate is as close to  $R$  as possible, that is,

$$\min |R - (A + 24 * (N_{CB} + 1)) / N_{ch}|, \text{ where } N_{CB} = \begin{cases} 0, & \text{if } C = 1 \\ C, & \text{if } C > 1 \end{cases}$$

subject to

- a)  $A$  is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of  $N_{RB}$  resource blocks.
  - b)  $C$  is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].
3. If there is more than one  $A$  that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

### A.8.1.1 Overview of V2X reference measurement channels

In Table A.8.1.1-1 are listed the Sidelink reference measurement channels specified in annexes A.8.2 to A.8.6 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.8.2 to A.8.6 as appropriate.

**Table A.8.1.1-1: Overview of Sidelink reference measurement channels**

| Table         | Name  | BW    | Mod   | TCR | RB | UE Categ                                     | Notes |
|---------------|-------|-------|-------|-----|----|--|-------|
| Table A.8.2-1 | -     | 10    | QPSK  | 1/3 | 48 | SL-C Category 2<br>SL-C-RX Category $\geq 2$ |       |
| Table A.8.2-1 | -     | 20    | QPSK  | 1/3 | 96 | SL-C Category 2<br>SL-C-RX Category $\geq 2$ |       |
| Table A.8.2-2 | -     | 10    | 16QAM | 2/3 | 48 | SL-C Category 2<br>SL-C-RX Category $\geq 2$ |       |
| Table A.8.2-2 | -     | 20    | 16QAM | 2/3 | 96 | SL-C Category 2<br>SL-C-RX Category $\geq 2$ |       |
| Table A.8.2-4 | -     | 10    | 64QAM | 3/4 | 48 | SL-C-RX Category $\geq 3$                    |       |
| Table A.8.2-4 | -     | 20    | 64QAM | 3/4 | 96 | SL-C-RX Category $\geq 3$                    |       |
| Table A.8.3-1 |       | 10/20 | QPSK  | 1/3 | -  | SL-C Category 2<br>SL-C-TX Category $\geq 2$ |       |
| Table A.8.3-2 |       | 10/20 | 16QAM | 2/3 | -  | SL-C Category 2<br>SL-C-TX Category $\geq 2$ |       |
| Table A.8.3-3 |       | 10/20 | 64QAM | 3/4 | -  | SL-C-TX Category $\geq 3$                    |       |
| Table A.8.4-1 | CC.8  | 10/20 | QPSK  | -   | 2  | -  |       |
| Table A.8.5-1 | CD.8  | 20    | 16QAM | -   | 8  | -  |       |
| Table A.8.5-1 | CD.9  | 10    | QPSK  | -   | 3  | -  |       |
| Table A.8.5-1 | CD.10 | 20    | QPSK  | -   | 3  | -  |       |
| Table A.8.5-1 | CD.11 | 20    | 16QAM | -   | 96 | -  |       |
| Table A.8.5-1 | CD.12 | 20    | QPSK  | -   | 8  | -  |       |
| Table A.8.5-2 | CD.13 | 20    | 64QAM | -   | 8  | -  |       |
| Table A.8.5-2 | CD.14 | 10    | QPSK  | -   | 3  | -  |       |
| Table A.8.5-2 | CD.15 | 20    | 64QAM | -   | 96 | -  |       |
| Table A.8.5-2 | CD.16 | 10    | 64QAM | -   | 48 | -  |       |
| Table A.8.5-2 | CD.17 | 20    | QPSK  | -   | 8  | -  |       |
| Table A.8.5-2 | CD.18 | 10    | QPSK  | -   | 8  | -  |       |
| Table A.8.5-2 | CD.19 | 20    | QPSK  | -   | 3  | -  |       |
| Table A.8.5-2 | CD.20 | 10    | QPSK  | -   | 3  | -  |       |
| Table A.8.6-1 | CP.2  | 20    | QPSK  | -   | 6  | -  |       |

### A.8.2 Reference measurement channel for receiver characteristics

For V2X side link transmission over PC5, Table A.8.2-1 is applicable for measurements on the Receiver Characteristics (clause 7) with the exception of Maximum input level (subclause 7.4G). Table A.8.2-2 and Table A.8.2-3, are applicable for Maximum input level (subclause 7.4G).

**Table A.8.2-1 Fixed Reference measurement channel for V2X receiver requirements**

| Parameter   | Unit | Value |   |   |       |    |       |
|---|------|-------|---|---|-------|----|-------|
|   |      | 1.4   | 3 | 5 | 10    | 15 | 20    |
| Channel bandwidth   | MHz  |       |   |   |       |    |       |
| Allocated resource blocks   |      |       |   |   | 48    |    | 96    |
| Subcarriers per resource block  |      |       |   |   | 12    |    | 12    |
| Packets per period  |      |       |   |   | 1     |    | 1     |
| Modulation  |      |       |   |   | QPSK  |    | QPSK  |
| Target Coding Rate  |      |       |   |   | 1/3   |    | 1/3   |
| Transport Block Size  |      |       |   |   | 3496  |    | 6968  |
| Transport block CRC   | Bits |       |   |   | 24    |    | 24    |
| Number of Code Blocks per Sub-Frame   |      |       |   |   | 1     |    | 2     |
| Maximum number of HARQ transmissions  |      |       |   |   | 1     |    | 1     |
| Binary Channel Bits per subframe  | Bits |       |   |   | 11520 |    | 23040 |
| Max. Throughput averaged over 1 period of 100ms   | kbps |       |   |   | 34.96 |    | 69.68 |
| UE Category   |      |       |   |   | ≥ 1   |    | ≥ 1   |
| Note 1: 2RBs allocated to SA transmission and 4 symbols allocated to RS.  |      |       |   |   |       |    |       |
| Note 2: Throughput (in kbps) will depend on SA period configuration.  |      |       |   |   |       |    |       |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |   |   |       |    |       |

**Table A.8.2-2 Fixed Reference measurement channel for V2X maximum input level requirements for 16QAM**

| Parameter   | Unit | Value |   |   |       |    |        |
|---|------|-------|---|---|-------|----|--------|
|   |      | 1.4   | 3 | 5 | 10    | 15 | 20     |
| Channel bandwidth   | MHz  |       |   |   |       |    |        |
| Allocated resource blocks   |      |       |   |   | 48    |    | 96     |
| Subcarriers per resource block  |      |       |   |   | 12    |    | 12     |
| Packets per period  |      |       |   |   | 1     |    | 1      |
| Modulation  |      |       |   |   | 16QAM |    | 16QAM  |
| Target Coding Rate  |      |       |   |   | 2/3   |    | 2/3    |
| Transport Block Size  |      |       |   |   | 15840 |    | 29296  |
| Transport block CRC   | Bits |       |   |   | 24    |    | 24     |
| Number of Code Blocks per Sub-Frame   |      |       |   |   | 3     |    | 5      |
| Maximum number of HARQ transmissions  |      |       |   |   | 1     |    | 1      |
| Binary Channel Bits per subframe  | Bits |       |   |   | 23040 |    | 46080  |
| Max. Throughput averaged over 1 period of 100ms   | kbps |       |   |   | 158.4 |    | 292.96 |
| Note 1: 2RBs allocated to SA transmission and 4 symbols allocated to RS.  |      |       |   |   |       |    |        |
| Note 2: Throughput (in kbps) will depend on SA period configuration.  |      |       |   |   |       |    |        |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |   |   |       |    |        |

**Table A.8.2-3 (Void)****Table A.8.2-4 Fixed Reference measurement channel for V2X maximum input level for 64QAM**

| Parameter                                       | Unit | Value |   |   |       |    |        |
|---|------|-------|---|---|-------|----|--------|
|   |      | 1.4   | 3 | 5 | 10    | 15 | 20     |
| Channel bandwidth                               | MHz  |       |   |   |       |    |        |
| Allocated resource blocks                       |      |       |   |   | 48    |    | 96     |
| Subcarriers per resource block                  |      |       |   |   | 12    |    | 12     |
| Packets per period                              |      |       |   |   | 1     |    | 1      |
| Modulation                                      |      |       |   |   | 64QAM |    | 64QAM  |
| Target Coding Rate                              |      |       |   |   | 3/4   |    | 3/4    |
| Transport Block Size                            |      |       |   |   | 22920 |    | 46888  |
| Transport block CRC                             | Bits |       |   |   | 24    |    | 24     |
| Number of Code Blocks per Sub-Frame             |      |       |   |   | 4     |    | 8      |
| Maximum number of HARQ transmissions            |      |       |   |   | 1     |    | 1      |
| Binary Channel Bits per subframe                | Bits |       |   |   | 31104 |    | 62208  |
| Max. Throughput averaged over 1 period of 100ms | kbps |       |   |   | 229.2 |    | 468.88 |

|         |   |
|---------|---|
| Note 1: | 2RBs allocated to SA transmission, 4 symbols allocated to RS and the last symbol within a subframe is not considered in the mapping process |
| Note 2: | Throughput (in kbps) will depend on SA period configuration.  |
| Note 3: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).     |

### A.8.3 Reference measurement channel for transmitter characteristics

For V2X side link transmission over PC5, Table A.8.3-1 and Table A.8.3-2 are applicable for measurements on the Transmitter Characteristics (clause 6).

**Table A.8.3-1 Fixed Reference measurement channel for V2X Transmitter requirements for QPSK**

| Parameter | Ch BW  | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame |
|-----------|--------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|
| Unit      | MHz    |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |
|           | 10, 20 | 3             | 10                             | QPSK  | 1/3                | 208          | 24                  | 1  | 720                                | 360                         |
|           | 10, 20 | 4             | 10                             | QPSK  | 1/3                | 256          | 24                  | 1  | 960                                | 480                         |
|           | 10, 20 | 5             | 10                             | QPSK  | 1/3                | 328          | 24                  | 1  | 1200                               | 600                         |
|           | 10, 20 | 6             | 10                             | QPSK  | 1/3                | 408          | 24                  | 1  | 1440                               | 720                         |
|           | 10, 20 | 8             | 10                             | QPSK  | 1/3                | 552          | 24                  | 1  | 1920                               | 960                         |
|           | 10, 20 | 9             | 10                             | QPSK  | 1/3                | 632          | 24                  | 1  | 2160                               | 1080                        |
|           | 10, 20 | 10            | 10                             | QPSK  | 1/3                | 696          | 24                  | 1  | 2400                               | 1200                        |
|           | 10, 20 | 12            | 10                             | QPSK  | 1/3                | 840          | 24                  | 1  | 2880                               | 1440                        |
|           | 10, 20 | 15            | 10                             | QPSK  | 1/3                | 1064         | 24                  | 1  | 3600                               | 1800                        |
|           | 10, 20 | 16            | 10                             | QPSK  | 1/3                | 1128         | 24                  | 1  | 3840                               | 1920                        |
|           | 10, 20 | 18            | 10                             | QPSK  | 1/3                | 1288         | 24                  | 1  | 4320                               | 2160                        |
|           | 10, 20 | 20            | 10                             | QPSK  | 1/3                | 1416         | 24                  | 1  | 4800                               | 2400                        |
|           | 10, 20 | 24            | 10                             | QPSK  | 1/3                | 1736         | 24                  | 1  | 5760                               | 2880                        |
|           | 10, 20 | 25            | 10                             | QPSK  | 1/3                | 1800         | 24                  | 1  | 6000                               | 3000                        |
|           | 10, 20 | 27            | 10                             | QPSK  | 1/3                | 1928         | 24                  | 1  | 6480                               | 3240                        |
|           | 10, 20 | 30            | 10                             | QPSK  | 1/3                | 2152         | 24                  | 1  | 7200                               | 3600                        |
|           | 10, 20 | 32            | 10                             | QPSK  | 1/3                | 2280         | 24                  | 1  | 7680                               | 3840                        |
|           | 10, 20 | 36            | 10                             | QPSK  | 1/3                | 2600         | 24                  | 1  | 8640                               | 4320                        |
|           | 10, 20 | 40            | 10                             | QPSK  | 1/3                | 2856         | 24                  | 1  | 9600                               | 4800                        |
|           | 10, 20 | 45            | 10                             | QPSK  | 1/3                | 3240         | 24                  | 1  | 10800                              | 5400                        |
|           | 10, 20 | 48            | 10                             | QPSK  | 1/3                | 3496         | 24                  | 1  | 11520                              | 5760                        |
|           | 20     | 50            | 10                             | QPSK  | 1/3                | 3624         | 24                  | 1  | 24000                              | 12000                       |
|           | 20     | 54            | 10                             | QPSK  | 1/3                | 4776         | 24                  | 1  | 25920                              | 12960                       |
|           | 20     | 60            | 10                             | QPSK  | 1/3                | 5352         | 24                  | 1  | 28800                              | 14400                       |
|           | 20     | 64            | 10                             | QPSK  | 1/3                | 4584         | 24                  | 1  | 30720                              | 15360                       |
|           | 20     | 72            | 10                             | QPSK  | 1/3                | 5160         | 24                  | 1  | 34560                              | 17280                       |
|           | 20     | 75            | 10                             | QPSK  | 1/3                | 5352         | 24                  | 1  | 36000                              | 18000                       |
|           | 20     | 80            | 10                             | QPSK  | 1/3                | 5736         | 24                  | 1  | 38400                              | 19200                       |
|           | 20     | 81            | 10                             | QPSK  | 1/3                | 5736         | 24                  | 1  | 38880                              | 19440                       |
|           | 20     | 90            | 10                             | QPSK  | 1/3                | 6456         | 24                  | 2  | 43200                              | 21600                       |
|           | 20     | 96            | 10                             | QPSK  | 1/3                | 6968         | 24                  | 2  | 46080                              | 23040                       |

**Table A.8.3-2 Fixed Reference measurement channel for V2X Transmitter requirements for 16QAM**

| Parameter | Ch BW  | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame |
|-----------|--------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|
| Unit      | MHz    |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |
|           | 10, 20 | 3             | 10                             | 16QAM | 2/3                | 904          | 24                  | 1  | 1440                               | 360                         |
|           | 10, 20 | 4             | 10                             | 16QAM | 2/3                | 1224         | 24                  | 1  | 1920                               | 480                         |
|           | 10, 20 | 5             | 10                             | 16QAM | 2/3                | 1544         | 24                  | 1  | 2400                               | 600                         |
|           | 10, 20 | 6             | 10                             | 16QAM | 2/3                | 1800         | 24                  | 1  | 2880                               | 720                         |
|           | 10, 20 | 8             | 10                             | 16QAM | 2/3                | 2472         | 24                  | 1  | 3840                               | 960                         |



|  |        |    |    |       |     |       |    |   |       |       |
|--|--------|----|----|-------|-----|-------|----|---|-------|-------|
|  | 10, 20 | 9  | 10 | 16QAM | 2/3 | 2728  | 24 | 1 | 4320  | 1080  |
|  | 10, 20 | 10 | 10 | 16QAM | 2/3 | 3112  | 24 | 1 | 4800  | 1200  |
|  | 10, 20 | 12 | 10 | 16QAM | 2/3 | 3624  | 24 | 1 | 5760  | 1440  |
|  | 10, 20 | 15 | 10 | 16QAM | 2/3 | 4584  | 24 | 1 | 7200  | 1800  |
|  | 10, 20 | 16 | 10 | 16QAM | 2/3 | 4968  | 24 | 1 | 7680  | 1920  |
|  | 10, 20 | 18 | 10 | 16QAM | 2/3 | 5544  | 24 | 1 | 8640  | 2160  |
|  | 10, 20 | 20 | 10 | 16QAM | 2/3 | 6200  | 24 | 2 | 9600  | 2400  |
|  | 10, 20 | 24 | 10 | 16QAM | 2/3 | 7736  | 24 | 2 | 11520 | 2880  |
|  | 10, 20 | 25 | 10 | 16QAM | 2/3 | 7992  | 24 | 2 | 12000 | 3000  |
|  | 10, 20 | 27 | 10 | 16QAM | 2/3 | 8760  | 24 | 2 | 12960 | 3240  |
|  | 10, 20 | 30 | 10 | 16QAM | 2/3 | 9912  | 24 | 2 | 14400 | 3600  |
|  | 10, 20 | 32 | 10 | 16QAM | 2/3 | 10296 | 24 | 2 | 15360 | 3840  |
|  | 10, 20 | 36 | 10 | 16QAM | 2/3 | 11832 | 24 | 2 | 17280 | 4320  |
|  | 10, 20 | 40 | 10 | 16QAM | 2/3 | 12960 | 24 | 3 | 19200 | 4800  |
|  | 10, 20 | 45 | 10 | 16QAM | 2/3 | 14688 | 24 | 3 | 21600 | 5400  |
|  | 10, 20 | 48 | 10 | 16QAM | 2/3 | 15840 | 24 | 3 | 23040 | 5760  |
|  | 20     | 50 | 10 | 16QAM | 2/3 | 16416 | 24 | 3 | 24000 | 6000  |
|  | 20     | 54 | 10 | 16QAM | 2/3 | 17568 | 24 | 3 | 25920 | 6480  |
|  | 20     | 60 | 10 | 16QAM | 2/3 | 18336 | 24 | 3 | 28800 | 7200  |
|  | 20     | 64 | 10 | 16QAM | 2/3 | 20616 | 24 | 4 | 30720 | 7680  |
|  | 20     | 72 | 10 | 16QAM | 2/3 | 23688 | 24 | 4 | 34560 | 8640  |
|  | 20     | 75 | 10 | 16QAM | 2/3 | 24496 | 24 | 4 | 36000 | 9000  |
|  | 20     | 80 | 10 | 16QAM | 2/3 | 26416 | 24 | 5 | 38400 | 9600  |
|  | 20     | 81 | 10 | 16QAM | 2/3 | 26416 | 24 | 5 | 38880 | 9720  |
|  | 20     | 90 | 10 | 16QAM | 2/3 | 29296 | 24 | 5 | 43200 | 10800 |
|  | 20     | 96 | 10 | 16QAM | 2/3 | 29296 | 24 | 5 | 46080 | 11520 |

Table A.8.3-3 Fixed Reference measurement channel for V2X Transmitter requirements for 64QAM

| Parameter | Ch BW  | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame |
|-----------|--------|---------------|--------------------------------|-------|--------------------|--------------|---------------------|--|------------------------------------|-----------------------------|
| Unit      | MHz    |               |                                |       |                    | Bits         | Bits                |  | Bits                               |                             |
|           | 10, 20 | 3             | 9                              | 64QAM | 3/4                | 1480         | 24                  | 1  | 1944                               | 324                         |
|           | 10, 20 | 4             | 9                              | 64QAM | 3/4                | 1864         | 24                  | 1  | 2592                               | 432                         |
|           | 10, 20 | 5             | 9                              | 64QAM | 3/4                | 2408         | 24                  | 1  | 3240                               | 540                         |
|           | 10, 20 | 6             | 9                              | 64QAM | 3/4                | 2984         | 24                  | 1  | 3888                               | 648                         |
|           | 10, 20 | 8             | 9                              | 64QAM | 3/4                | 3752         | 24                  | 1  | 5184                               | 864                         |
|           | 10, 20 | 9             | 9                              | 64QAM | 3/4                | 4392         | 24                  | 1  | 5832                               | 972                         |
|           | 10, 20 | 10            | 9                              | 64QAM | 3/4                | 4968         | 24                  | 1  | 6480                               | 1080                        |
|           | 10, 20 | 12            | 9                              | 64QAM | 3/4                | 5736         | 24                  | 1  | 7776                               | 1296                        |
|           | 10, 20 | 15            | 9                              | 64QAM | 3/4                | 7224         | 24                  | 2  | 9720                               | 1620                        |
|           | 10, 20 | 16            | 9                              | 64QAM | 3/4                | 7480         | 24                  | 2  | 10368                              | 1728                        |
|           | 10, 20 | 18            | 9                              | 64QAM | 3/4                | 8760         | 24                  | 2  | 11664                              | 1944                        |
|           | 10, 20 | 20            | 9                              | 64QAM | 3/4                | 9912         | 24                  | 2  | 12960                              | 2160                        |
|           | 10, 20 | 24            | 9                              | 64QAM | 3/4                | 11448        | 24                  | 2  | 15552                              | 2592                        |
|           | 10, 20 | 25            | 9                              | 64QAM | 3/4                | 12216        | 24                  | 2  | 16200                              | 2700                        |
|           | 10, 20 | 27            | 9                              | 64QAM | 3/4                | 12960        | 24                  | 3  | 17496                              | 2916                        |
|           | 10, 20 | 30            | 9                              | 64QAM | 3/4                | 14688        | 24                  | 3  | 19440                              | 3240                        |
|           | 10, 20 | 32            | 9                              | 64QAM | 3/4                | 15264        | 24                  | 3  | 20736                              | 3456                        |
|           | 10, 20 | 36            | 9                              | 64QAM | 3/4                | 17568        | 24                  | 3  | 23328                              | 3888                        |
|           | 10, 20 | 40            | 9                              | 64QAM | 3/4                | 19848        | 24                  | 4  | 25920                              | 4320                        |
|           | 10, 20 | 45            | 9                              | 64QAM | 3/4                | 22152        | 24                  | 4  | 29160                              | 4860                        |
|           | 10, 20 | 48            | 9                              | 64QAM | 3/4                | 22920        | 24                  | 4  | 31104                              | 5184                        |
|           | 20     | 50            | 9                              | 64QAM | 3/4                | 24496        | 24                  | 4  | 32400                              | 5400                        |
|           | 20     | 54            | 9                              | 64QAM | 3/4                | 26416        | 24                  | 5  | 34992                              | 5832                        |
|           | 20     | 60            | 9                              | 64QAM | 3/4                | 29296        | 24                  | 5  | 38880                              | 6480                        |
|           | 20     | 64            | 9                              | 64QAM | 3/4                | 31704        | 24                  | 6  | 41472                              | 6912                        |
|           | 20     | 72            | 9                              | 64QAM | 3/4                | 35160        | 24                  | 6  | 46656                              | 7776                        |
|           | 20     | 75            | 9                              | 64QAM | 3/4                | 36696        | 24                  | 6  | 48600                              | 8100                        |
|           | 20     | 80            | 9                              | 64QAM | 3/4                | 39232        | 24                  | 7  | 51840                              | 8640                        |
|           | 20     | 81            | 9                              | 64QAM | 3/4                | 39232        | 24                  | 7  | 52488                              | 8748                        |
|           | 20     | 90            | 9                              | 64QAM | 3/4                | 43816        | 24                  | 8  | 58320                              | 9720                        |
|           | 20     | 96            | 9                              | 64QAM | 3/4                | 46888        | 24                  | 8  | 62208                              | 10368                       |

## A.8.4 Reference measurement for PSCCH performance requirements

**Table A.8.4-1: Fixed reference measurement channel for PSCCH performance requirement**

| Parameter   | Unit | Value |
|---|------|-------|
| Reference channel   |      | CC.8  |
| Allocated resource blocks   |      | 2     |
| DFT-OFDM Symbols per subframe (see Note 1)  |      | 9     |
| Modulation  |      | QPSK  |
| Payload (without CRC)   | Bits | 32    |
| CRC   | Bits | 16    |
| SCI Format  |      | 1     |
| Number of PSCCH transmissions   |      | 1     |
| Binary Channel Bits (see Note 2)  | Bits | 432   |
| Note 1: PSCCH transmissions are rate-matched for 10 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. |      |       |
| Note 2: Binary Channel Bits are calculated under assumption of 9 symbols.   |      |       |
| Note 3: Un-used or redundant bits/code-points in SCI format 1 are randomized.   |      |       |

## A.8.5 Reference measurement for PSSCH performance requirements

**Table A.8.5-1: Fixed reference measurement channel for PSSCH performance requirement**

| Parameter   | Unit | Value |      |       |       |       |
|---|------|-------|------|-------|-------|-------|
|   |      | CD.8  | CD.9 | CD.10 | CD.11 | CD.12 |
| Reference channel   |      | CD.8  | CD.9 | CD.10 | CD.11 | CD.12 |
| Channel bandwidth   | MHz  | 20    | 10   | 20    | 20    | 20    |
| Allocated resource blocks   |      | 8     | 3    | 3     | 96    | 8     |
| DFT-OFDM Symbols per subframe (see Note 1)  |      | 9     | 9    | 9     | 9     | 9     |
| Modulation  |      | 16QAM | QPSK | QPSK  | 16QAM | QPSK  |
| Transport Block Size  | Bits | 1800  | 208  | 504   | 31704 | 552   |
| Transport block CRC   | Bits | 24    | 24   | 24    | 24    | 24    |
| Number of PSSCH transmissions   |      | 1     | 2    | 1     | 2     | 1     |
| Binary Channel Bits (see Note 2)  | Bits | 3456  | 648  | 648   | 41472 | 1728  |
| Note 1: PSSCH transmissions are rate-matched for 10 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.     |      |       |      |       |       |       |
| Note 2: Binary Channel Bits are calculated under assumption of 9 symbols.   |      |       |      |       |       |       |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |      |       |       |       |

**Table A.8.5-2: Fixed reference measurement channel for PSSCH performance requirement**

| Parameter   | Unit | Value |       |       |       |       |       |       |       |
|---|------|-------|-------|-------|-------|-------|-------|-------|-------|
|   |      | CD.13 | CD.14 | CD.15 | CD.16 | CD.17 | CD.18 | CD.19 | CD.20 |
| Reference channel   |      | CD.13 | CD.14 | CD.15 | CD.16 | CD.17 | CD.18 | CD.19 | CD.20 |
| Channel bandwidth   | MHz  | 20    | 10    | 20    | 10    | 20    | 10    | 20    | 10    |
| Allocated resource blocks   |      | 8     | 3     | 96    | 48    | 8     | 8     | 3     | 3     |
| DFT-OFDM Symbols per subframe (see Note 1)  |      | 9     | 9     | 9     | 9     | 9     | 9     | 9     | 9     |
| Modulation  |      | 64QAM | QPSK  | 64QAM | 64QAM | QPSK  | QPSK  | QPSK  | QPSK  |
| Transport Block Size  | Bits | 2600  | 120   | 48936 | 24496 | 408   | 408   | 120   | 120   |
| Transport block CRC   | Bits | 24    | 24    | 24    | 24    | 24    | 24    | 24    | 24    |
| Number of PSSCH transmissions   |      | 2     | 2     | 2     | 2     | 1     | 1     | 1     | 1     |
| Binary Channel Bits (see Note 2)  | Bits | 5184  | 648   | 62208 | 31104 | 1728  | 1728  | 648   | 648   |
| Note 1: PSSCH transmissions are rate-matched for 9 DFT-OFDM symbols per subframe.   |      |       |       |       |       |       |       |       |       |
| Note 2: Binary Channel Bits are calculated under assumption of 9 symbols.   |      |       |       |       |       |       |       |       |       |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). |      |       |       |       |       |       |       |       |       |

## A.8.6 Reference measurement for PSBCH performance requirements

Table A.8.6-1: Fixed reference measurement channel for PSBCH performance requirement

| Parameter                                  | Unit   | Value |
|--|--|-------|
| Reference channel                          |  | CP.2  |
| Channel bandwidth                          | MHz  | 20    |
| Allocated resource blocks                  |  | 6     |
| DFT-OFDM Symbols per subframe (see Note 1) |  | 6     |
| Modulation                                 |  | QPSK  |
| Transport Block Size                       | Bits   | 48    |
| Transport block CRC                        | Bits   | 16    |
| Binary Channel Bits (see Note 2)           | Bits   | 864   |
| Note 1:                                    | PSBCH transmissions are rate-matched for 7 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. |       |
| Note 2:                                    | Binary Channel Bits are calculated under assumption of 6 symbols.  |       |

## A.9 V2X reference resource pool configurations

Table A.9-1: V2X sidelink communication pre-configuration for PSSCH/PSCCH tests (Configuration #1-V2X)

| Information Element          |                                       | Value (10MHz) | Value (20MHz) |
|------------------------------|---------------------------------------|---------------|---------------|
| SL-V2X-PreconfigCommPool-r14 | sl-OffsetIndicator-r14                |               | 0             |
|                              | sl-Subframe-r14                       | bs20-r14      | 0xFFFFF       |
|                              | adjacencyPSCCH-PSSCH-r14              |               | TRUE          |
|                              | sizeSubchannel-r14                    |               | n5   n10      |
|                              | numSubchannel-r14                     |               | n1            |
|                              | startRB-Subchannel-r14                |               | 0             |
|                              | startRB-PSCCH-Pool-r14                |               | not present   |
|                              | dataTxParameters-r14                  | P0-SL-r12     | -126          |
|                              | zoneID-r14                            |               | not present   |
|                              | threshS-RSSI-CBR-r14                  |               | not present   |
|                              | cbr-pssch-TxConfigList-r14            |               | not present   |
|                              | resourceSelectionConfigP2X-r14        |               | not present   |
|                              | syncAllowed-r14                       |               | not present   |
|                              | restrictResourceReservationPeriod-r14 |               | not present   |

Table A.9-2: V2X sidelink communication pre-configuration for power imbalance test (Configuration #2-V2X)

| Information Element          |                          | Value (20MHz) |
|------------------------------|--------------------------|---------------|
| SL-V2X-PreconfigCommPool-r14 | sl-OffsetIndicator-r14   | 0             |
|                              | sl-Subframe-r14          | bs20-r14      |
|                              | adjacencyPSCCH-PSSCH-r14 | TRUE          |
|                              | sizeSubchannel-r14       | n5            |
|                              | numSubchannel-r14        | n10           |
|                              | startRB-Subchannel-r14   | 0             |
|                              | startRB-PSCCH-Pool-r14   | not present   |
|                              | dataTxParameters-r14     | P0-SL-r12     |
|                              |                          | -126          |

|  |                                       |  |             |
|--|---------------------------------------|--|-------------|
|  | zoneID-r14                            |  | not present |
|  | threshS-RSSI-CBR-r14                  |  | not present |
|  | cbr-pssch-TxConfigList-r14            |  | not present |
|  | resourceSelectionConfigP2X-r14        |  | not present |
|  | syncAllowed-r14                       |  | not present |
|  | restrictResourceReservationPeriod-r14 |  | not present |

**Table A.9-3: V2X sidelink communication configuration for PSSCH with eNB based synchronization test (Configuration #3-V2X)**

| Information Element        |                                       |           | Value (20MHz) |
|----------------------------|---------------------------------------|-----------|---------------|
| SL-CommResourcePoolV2X-r14 | sl-OffsetIndicator-r14                |           | 0             |
|                            | sl-Subframe-r14                       | bs20-r14  | 0xFFFFF       |
|                            | adjacencyPSCCH-PSSCH-r14              |           | TRUE          |
|                            | sizeSubchannel-r14                    |           | n10           |
|                            | numSubchannel-r14                     |           | n1            |
|                            | startRB-Subchannel-r14                |           | 0             |
|                            | startRB-PSCCH-Pool-r14                |           | not present   |
|                            | rxParametersNCell-r14                 |           | not present   |
|                            | dataTxParameters-r14                  | P0-SL-r12 | -126          |
|                            | zoneID-r14                            |           | not present   |
|                            | threshS-RSSI-CBR-r14                  |           | not present   |
|                            | poolReportId-r14                      |           | not present   |
|                            | cbr-pssch-TxConfigList-r14            |           | not present   |
|                            | resourceSelectionConfigP2X-r14        |           | not present   |
|                            | syncAllowed-r14                       |           | not present   |
|                            | restrictResourceReservationPeriod-r14 |           | not present   |
| SL-TypeTxSync-r14          |                                       |           | enb           |

**Table A.9-4: V2X sidelink communication pre-configuration for soft buffer test (Configuration #4-V2X)**

| Information Element          |                                       |           | Value (10MHz) | Value (20MHz) |
|------------------------------|---------------------------------------|-----------|---------------|---------------|
| SL-V2X-PreconfigCommPool-r14 | sl-OffsetIndicator-r14                |           | 0             |               |
|                              | sl-Subframe-r14                       | bs20-r14  | 0xFFFFF       |               |
|                              | adjacencyPSCCH-PSSCH-r14              |           | TRUE          |               |
|                              | sizeSubchannel-r14                    |           | n50           | n100          |
|                              | numSubchannel-r14                     |           | n1            |               |
|                              | startRB-Subchannel-r14                |           | 0             |               |
|                              | startRB-PSCCH-Pool-r14                |           | not present   |               |
|                              | dataTxParameters-r14                  | P0-SL-r12 | -126          |               |
|                              | zoneID-r14                            |           | not present   |               |
|                              | threshS-RSSI-CBR-r14                  |           | not present   |               |
|                              | cbr-pssch-TxConfigList-r14            |           | not present   |               |
|                              | resourceSelectionConfigP2X-r14        |           | not present   |               |
|                              | syncAllowed-r14                       |           | not present   |               |
|                              | restrictResourceReservationPeriod-r14 |           | not present   |               |

**Table A.9-5: V2X sidelink communication pre-configuration for PSCCH/PSSCH decoding capability test (Configuration #5-V2X)**

| Information Element          |                          |          | Value (20MHz) |
|------------------------------|--------------------------|----------|---------------|
| SL-V2X-PreconfigCommPool-r14 | sl-OffsetIndicator-r14   |          | 0             |
|                              | sl-Subframe-r14          | bs20-r14 | 0xFFFFF       |
|                              | adjacencyPSCCH-PSSCH-r14 |          | TRUE          |

|  |                                       |           |             |     |
|--|---------------------------------------|-----------|-------------|-----|
|  | sizeSubchannel-r14                    |           | n10         | n5  |
|  | numSubchannel-r14                     |           | n10         | n20 |
|  | startRB-Subchannel-r14                |           | 0           |     |
|  | startRB-PSCCH-Pool-r14                |           | not present |     |
|  | dataTxParameters-r14                  | P0-SL-r12 | -126        |     |
|  | zoneID-r14                            |           | not present |     |
|  | threshS-RSSI-CBR-r14                  |           | not present |     |
|  | cbr-pssch-TxConfigList-r14            |           | not present |     |
|  | resourceSelectionConfigP2X-r14        |           | not present |     |
|  | syncAllowed-r14                       |           | not present |     |
|  | restrictResourceReservationPeriod-r14 |           | not present |     |

**Table A.9-6: V2X sidelink communication pre-configuration for PSCCH/PSSCH decoding capability test (Configuration #6-V2X)**

| Information Element          |                                       | Value (10MHz) |             |
|------------------------------|---------------------------------------|---------------|-------------|
| SL-V2X-PreconfigCommPool-r14 | sl-OffsetIndicator-r14                |               | 0           |
|                              | sl-Subframe-r14                       | bs20-r14      | 0xFFFF      |
|                              | adjacencyPSCCH-PSSCH-r14              |               | TRUE        |
|                              | sizeSubchannel-r14                    |               | n10 n5      |
|                              | numSubchannel-r14                     |               | n5 n10      |
|                              | startRB-Subchannel-r14                |               | 0           |
|                              | startRB-PSCCH-Pool-r14                |               | not present |
|                              | dataTxParameters-r14                  | P0-SL-r12     | -126        |
|                              | zoneID-r14                            |               | not present |
|                              | threshS-RSSI-CBR-r14                  |               | not present |
|                              | cbr-pssch-TxConfigList-r14            |               | not present |
|                              | resourceSelectionConfigP2X-r14        |               | not present |
|                              | syncAllowed-r14                       |               | not present |
|                              | restrictResourceReservationPeriod-r14 |               | not present |

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## Annex B (normative): Propagation conditions

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### B.1 Static propagation condition

#### B.1.1 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}.$$

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}.$$

For 4 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 & -j & -j \end{bmatrix}$$

For 8 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j & j \\ 1 & 1 & 1 & 1 & -j & -j & -j & -j \end{bmatrix}$$

#### B.1.2 UE Receiver with 4Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}.$$

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & j \\ 1 & -j \\ 1 & j \\ 1 & -j \end{bmatrix}.$$

For 4 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 & -j & -j \\ 1 & -1 & j & -j \\ 1 & -1 & -j & j \end{bmatrix}.$$

For 8 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j & j \\ 1 & 1 & 1 & 1 & -j & -j & -j & -j \\ 1 & 1 & -1 & -1 & j & j & -j & -j \\ 1 & 1 & -1 & -1 & -j & -j & j & j \end{bmatrix}$$

### B.1.3 UE Receiver with 8Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}.$$

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & j \\ 1 & -j \\ 1 & j \\ 1 & -j \\ -1 & j \\ -1 & -j \\ -1 & j \\ -1 & -j \end{bmatrix}.$$

For 4 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 & -j & -j \\ 1 & 1 & j & -j \\ 1 & 1 & -j & j \\ 1 & -1 & j & j \\ 1 & -1 & -j & -j \\ 1 & -1 & j & -j \\ 1 & -1 & -j & j \end{bmatrix}.$$

For 8 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j & j \\ 1 & 1 & 1 & 1 & -j & -j & -j & -j \\ 1 & 1 & -1 & -1 & j & j & -j & -j \\ 1 & 1 & -1 & -1 & -j & -j & j & j \\ 1 & -1 & 1 & -1 & j & -j & j & -j \\ 1 & -1 & 1 & -1 & -j & j & -j & j \\ 1 & -1 & -1 & 1 & j & -j & -j & j \\ 1 & -1 & -1 & 1 & -j & j & j & -j \end{bmatrix}$$

## B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum, that is characterized by a classical spectrum shape and a maximum Doppler frequency
- A set of correlation matrices defining the correlation between the UE and eNodeB antennas in case of multi-antenna systems.
- Additional multi-path models used for CQI (Channel Quality Indication) tests

### B.2.1 Delay profiles

The delay profiles are selected to be representative of low, medium and high delay spread environments. The resulting model parameters are defined in Table B.2.1-1 and the tapped delay line models are defined in Tables B.2.1-2, B.2.1-3 and B.2.1-4.

**Table B.2.1-1 Delay profiles for E-UTRA channel models**

| Model                              | Number of channel taps | Delay spread (r.m.s.) | Maximum excess tap delay (span) |
|------------------------------------|------------------------|-----------------------|---------------------------------|
| Extended Pedestrian A (EPA)        | 7                      | 43 ns                 | 410 ns                          |
| Extended Vehicular A model (EVA)   | 9                      | 357 ns                | 2510 ns                         |
| Extended Typical Urban model (ETU) | 9                      | 991 ns                | 5000 ns                         |



**Table B.2.1-2 Extended Pedestrian A model (EPA)**

| Excess tap delay<br>[ns] | Relative power<br>[dB] |
|--------------------------|------------------------|
| 0                        | 0.0                    |
| 30                       | -1.0                   |
| 70                       | -2.0                   |
| 90                       | -3.0                   |
| 110                      | -8.0                   |
| 190                      | -17.2                  |
| 410                      | -20.8                  |

**Table B.2.1-3 Extended Vehicular A model (EVA)**

| Excess tap delay<br>[ns] | Relative power<br>[dB] |
|--------------------------|------------------------|
| 0                        | 0.0                    |
| 30                       | -1.5                   |
| 150                      | -1.4                   |
| 310                      | -3.6                   |
| 370                      | -0.6                   |
| 710                      | -9.1                   |
| 1090                     | -7.0                   |
| 1730                     | -12.0                  |
| 2510                     | -16.9                  |

**Table B.2.1-4 Extended Typical Urban model (ETU)**

| Excess tap delay<br>[ns] | Relative power<br>[dB] |
|--------------------------|------------------------|
| 0                        | -1.0                   |
| 50                       | -1.0                   |
| 120                      | -1.0                   |
| 200                      | 0.0                    |
| 230                      | 0.0                    |
| 500                      | 0.0                    |
| 1600                     | -3.0                   |
| 2300                     | -5.0                   |
| 5000                     | -7.0                   |

## B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as EVA[number], EPA[number] or ETU[number] where 'number' indicates the maximum Doppler frequency (Hz).

**Table B.2.2-1 Void**

## B.2.3 MIMO Channel Correlation Matrices

The MIMO channel correlation matrices defined in B.2.3 apply for the antenna configuration using uniform linear arrays at both eNodeB and UE.

### B.2.3.1 Definition of MIMO Correlation Matrices

Table B.2.3.1-1 defines the correlation matrix for the eNodeB

**Table B.2.3.1-1 eNodeB correlation matrix**

|                     | One antenna   | Two antennas   | Four antennas   | Eight antennas  |
|---------------------|---------------|--|---|---|
| eNode B Correlation | $R_{eNB} = 1$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} & \alpha^{36/49} & \alpha \\ \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} & \alpha^{36/49} \\ \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} \\ \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} \\ \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} \\ \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} \\ \alpha^{36/49*} & \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} \\ \alpha^* & \alpha^{36/49*} & \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 \end{pmatrix}$ |

Table B.2.3.1-2 defines the correlation matrix for the UE:

**Table B.2.3.1-2 UE correlation matrix**

|  | One antenna | Two antennas | Four antennas | Eight antennas |
|--|-------------|--------------|---------------|----------------|
|  |             |              |               |                |

|                   |              |   |  |  |
|-------------------|--------------|---|--|--|
| UE<br>Correlation | $R_{UE} = 1$ | $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} & \beta \\ \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} \\ \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} \\ \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} \\ \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} \\ \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} \\ \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} \\ \beta^* & \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 \end{pmatrix}$ |
|-------------------|--------------|---|--|--|

Table B.2.3.1-3 defines the channel spatial correlation matrix  $R_{spat}$ . The parameters,  $\alpha$  and  $\beta$  in Table B.2.3.1-3 defines the spatial correlation between the antennas at the eNodeB and UE.

**Table B.2.3.1-3:  $R_{spat}$  correlation matrices**

|                          |   |
|--------------------------|---|
| <b>1x2<br/>cas<br/>e</b> | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$  |
| <b>1x4<br/>cas<br/>e</b> | $R_{spat} = R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{pmatrix}$ |
| <b>2x1<br/>cas<br/>e</b> | $R_{spat} = R_{eNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$   |
| <b>2x2<br/>cas<br/>e</b> |   |

|          |   |
|----------|---|
|          | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$  |
| 2x4 case | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{bmatrix}$  |
| 4x1 case | $R_{spat} = R_{eNB} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix}$  |
| 4x2 case | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$  |
| 4x4 case | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{bmatrix}$ |

|                        |   |  |
|------------------------|---|--|
| <p><b>2x8 case</b></p> | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes$  | $\begin{pmatrix} 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} & \beta \\ \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} \\ \beta^{4/9*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} \\ \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} \\ \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} \\ \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} \\ \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} \\ \beta^* & \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 \end{pmatrix}$ |
| <p><b>4x8 case</b></p> | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix} \otimes$ | $\begin{pmatrix} 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} & \beta \\ \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} \\ \beta^{4/9*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} \\ \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} \\ \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} \\ \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} \\ \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} \\ \beta^* & \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 \end{pmatrix}$ |

|                     |                                       |   |  |
|---------------------|---------------------------------------|---|--|
| <b>8x8<br/>case</b> | $R_{spat} = R_{eNB} \otimes R_{UE} =$ | $\begin{pmatrix} 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} & \alpha^{36/49} & \alpha \\ \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} & \alpha^{36/49} \\ \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} & \alpha^{25/49} \\ \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} & \alpha^{16/49} \\ \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} & \alpha^{9/49} \\ \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} & \alpha^{4/49} \\ \alpha^{36/49*} & \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 & \alpha^{1/49} \\ \alpha^* & \alpha^{36/49*} & \alpha^{25/49*} & \alpha^{16/49*} & \alpha^{9/49*} & \alpha^{4/49*} & \alpha^{1/49*} & 1 \end{pmatrix} \otimes$ | $\begin{pmatrix} 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} & \beta^{36/49} \\ \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} & \beta^{25/49} \\ \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} & \beta^{16/49} \\ \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} & \beta^{9/49} \\ \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} & \beta^{4/49} \\ \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 & \beta^{1/49} \\ \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} & 1 \\ \beta^* & \beta^{36/49*} & \beta^{25/49*} & \beta^{16/49*} & \beta^{9/49*} & \beta^{4/49*} & \beta^{1/49*} \end{pmatrix}$ |
|---------------------|---------------------------------------|---|--|

For cases with more antennas at either eNodeB or UE or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of  $R_{eNB}$  and  $R_{UE}$  according to  $R_{spat} = R_{eNB} \otimes R_{UE}$ .

### B.2.3.2 MIMO Correlation Matrices at High, Medium and Low Level

The  $\alpha$  and  $\beta$  for different correlation types are given in Table B.2.3.2-1.

**Table B.2.3.2-1: The  $\alpha$  and  $\beta$  parameters for ULA MIMO correlation matrices**

| Correlation Model    | $\alpha$ | $\beta$  |
|----------------------|----------|----------|
| Low correlation      | 0        | 0        |
| Medium Correlation   | 0.3      | 0.9      |
| Medium Correlation A | 0.3      | 0.3874   |
| Medium Correlation B | 0.3      | 0.005154 |
| High Correlation     | 0.9      | 0.9      |

The correlation matrices for high, medium, low and medium A correlation are defined in Table B.2.3.1-2, B.2.3.2-3, B.2.3.2-4 and B.2.3.2-5 as below.

The values in Table B.2.3.2-2 have been adjusted for the 4x2 and 4x4 high correlation cases to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$\mathbf{R}_{high} = [\mathbf{R}_{spatial} + a\mathbf{I}_n] / (1 + a)$$

Where the value “a” is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 4x2 high correlation case, a=0.00010. For the 4x4 high correlation case, a=0.00012.

The same method is used to adjust the 2x4 and 4x4 medium correlation matrix in Table B.2.3.2-3 to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a = 0.00010 and a = 0.00012.

**Table B.2.3.2-2: MIMO correlation matrices for high correlation**

|                 |   |
|-----------------|---|
| <b>1x2 case</b> | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$   |
| <b>2x1 case</b> | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$   |
| <b>2x2 case</b> | $R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$   |
| <b>4x2 case</b> | $R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8999 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$ |

|                 |              |  |
|-----------------|--------------|--|
| <b>4x4 case</b> | $R_{high} =$ | 1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894 0.9541 0.9430 0.9105 0.8587 0.8999 0.8894 0.8587 0.8099<br>0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430 0.9430 0.9541 0.9430 0.9105 0.8894 0.8999 0.8894 0.8587<br>0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767 0.9105 0.9430 0.9541 0.9430 0.8587 0.8894 0.8999 0.8894<br>0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882 0.8587 0.9105 0.9430 0.9541 0.8099 0.8587 0.8894 0.8999<br>0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894 0.9541 0.9430 0.9105 0.8587<br>0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430 0.9430 0.9541 0.9430 0.9105<br>0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767 0.9105 0.9430 0.9541 0.9430<br>0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882 0.8587 0.9105 0.9430 0.9541<br>0.9541 0.9430 0.9105 0.8587 0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894<br>0.9430 0.9541 0.9430 0.9105 0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430<br>0.9105 0.9430 0.9541 0.9430 0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767<br>0.8587 0.9105 0.9430 0.9541 0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882<br>0.8999 0.8894 0.8587 0.8099 0.9541 0.9430 0.9105 0.8587 0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999<br>0.8894 0.8999 0.8894 0.8587 0.9430 0.9541 0.9430 0.9105 0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541<br>0.8587 0.8894 0.8999 0.8894 0.9105 0.9430 0.9541 0.9430 0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882<br>0.8099 0.8587 0.8894 0.8999 0.8587 0.9105 0.9430 0.9541 0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 |
|-----------------|--------------|--|

**Table B.2.3.2-3: MIMO correlation matrices for medium correlation**

|                 |   |
|-----------------|---|
| <b>1x2 case</b> | N/A   |
| <b>2x1 case</b> | N/A   |
| <b>2x2 case</b> | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$   |
| <b>2x4 case</b> | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$ |
| <b>4x2 case</b> | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{pmatrix}$ |



|                 |                       |   |
|-----------------|-----------------------|---|
| <b>4x4 case</b> | $R_{\text{medium}} =$ | 1.0000 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 0.5855 0.5787 0.5588 0.5270 0.3000 0.2965 0.2862 0.2700 |
|                 |                       | 0.9882 1.0000 0.9882 0.9541 0.8645 0.8747 0.8645 0.8347 0.5787 0.5855 0.5787 0.5588 0.2965 0.3000 0.2965 0.2862 |
|                 |                       | 0.9541 0.9882 1.0000 0.9882 0.8347 0.8645 0.8747 0.8645 0.5588 0.5787 0.5855 0.5787 0.2862 0.2965 0.3000 0.2965 |
|                 |                       | 0.8999 0.9541 0.9882 1.0000 0.7872 0.8347 0.8645 0.8747 0.5270 0.5588 0.5787 0.5855 0.2700 0.2862 0.2965 0.3000 |
|                 |                       | 0.8747 0.8645 0.8347 0.7872 1.0000 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 0.5855 0.5787 0.5588 0.5270 |
|                 |                       | 0.8645 0.8747 0.8645 0.8347 0.9882 1.0000 0.9882 0.9541 0.8645 0.8747 0.8645 0.8347 0.5787 0.5855 0.5787 0.5588 |
|                 |                       | 0.8347 0.8645 0.8747 0.8645 0.9541 0.9882 1.0000 0.9882 0.8347 0.8645 0.8747 0.8645 0.5588 0.5787 0.5855 0.5787 |
|                 |                       | 0.7872 0.8347 0.8645 0.8747 0.8999 0.9541 0.9882 1.0000 0.7872 0.8347 0.8645 0.8747 0.5270 0.5588 0.5787 0.5855 |
|                 |                       | 0.5855 0.5787 0.5588 0.5270 0.8747 0.8645 0.8347 0.7872 1.0000 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 |
|                 |                       | 0.5787 0.5855 0.5787 0.5588 0.8645 0.8747 0.8645 0.8347 0.9882 1.0000 0.9882 0.9541 0.8645 0.8747 0.8645 0.8347 |
|                 |                       | 0.5588 0.5787 0.5855 0.5787 0.8347 0.8645 0.8747 0.8645 0.9541 0.9882 1.0000 0.9882 0.8347 0.8645 0.8747 0.8645 |
|                 |                       | 0.5270 0.5588 0.5787 0.5855 0.7872 0.8347 0.8645 0.8747 0.8999 0.9541 0.9882 1.0000 0.7872 0.8347 0.8645 0.8747 |
|                 |                       | 0.3000 0.2965 0.2862 0.2700 0.5855 0.5787 0.5588 0.5270 0.8747 0.8645 0.8347 0.7872 1.0000 0.9882 0.9541 0.8999 |
|                 |                       | 0.2965 0.3000 0.2965 0.2862 0.5787 0.5855 0.5787 0.5588 0.8645 0.8747 0.8645 0.8347 0.9882 1.0000 0.9882 0.9541 |
|                 |                       | 0.2862 0.2965 0.3000 0.2965 0.5588 0.5787 0.5855 0.5787 0.8347 0.8645 0.8747 0.8645 0.9541 0.9882 1.0000 0.9882 |
|                 |                       | 0.2700 0.2862 0.2965 0.3000 0.5270 0.5588 0.5787 0.5855 0.7872 0.8347 0.8645 0.8747 0.8999 0.9541 0.9882 1.0000 |

**Table B.2.3.2-4: MIMO correlation matrices for low correlation**

|                 |                                    |
|-----------------|------------------------------------|
| <b>1x2 case</b> | $R_{\text{low}} = \mathbf{I}_2$    |
| <b>1x4 case</b> | $R_{\text{low}} = \mathbf{I}_4$    |
| <b>2x1 case</b> | $R_{\text{low}} = \mathbf{I}_2$    |
| <b>2x2 case</b> | $R_{\text{low}} = \mathbf{I}_4$    |
| <b>2x4 case</b> | $R_{\text{low}} = \mathbf{I}_8$    |
| <b>4x1 case</b> | $R_{\text{low}} = \mathbf{I}_4$    |
| <b>4x2 case</b> | $R_{\text{low}} = \mathbf{I}_8$    |
| <b>4x4 case</b> | $R_{\text{low}} = \mathbf{I}_{16}$ |

In Table B.2.3.2-4,  $\mathbf{I}_d$  is the  $d \times d$  identity matrix.

**Table B.2.3.2-5: MIMO correlation matrices for medium correlation A**

|                 |                         |   |
|-----------------|-------------------------|---|
| <b>2x4 case</b> | $R_{\text{Medium A}} =$ | 1.0000 0.9000 0.6561 0.3874 0.3000 0.2700 0.1968 0.1162 |
|                 |                         | 0.9000 1.0000 0.9000 0.6561 0.2700 0.3000 0.2700 0.1968 |
|                 |                         | 0.6561 0.9000 1.0000 0.9000 0.1968 0.2700 0.3000 0.2700 |
|                 |                         | 0.3874 0.6561 0.9000 1.0000 0.1162 0.1968 0.2700 0.3000 |
|                 |                         | 0.3000 0.2700 0.1968 0.1162 1.0000 0.9000 0.6561 0.3874 |
|                 |                         | 0.2700 0.3000 0.2700 0.1968 0.9000 1.0000 0.9000 0.6561 |
|                 |                         | 0.1968 0.2700 0.3000 0.2700 0.6561 0.9000 1.0000 0.9000 |
|                 |                         | 0.1162 0.1968 0.2700 0.3000 0.3874 0.6561 0.9000 1.0000 |

|                     |                  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
|---------------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| <b>4x4<br/>case</b> | $R_{medium A} =$ | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 0.5856 | 0.5270 | 0.3842 | 0.2269 | 0.3000 | 0.2700 |  |
|                     |                  | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.2700 | 0.3000 |  |
|                     |                  | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.1968 | 0.2700 |  |
|                     |                  | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.1162 | 0.1968 |  |
|                     |                  | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 0.5856 | 0.5270 |  |
|                     |                  | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.5270 | 0.5856 |  |
|                     |                  | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.3842 | 0.5270 |  |
|                     |                  | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.2269 | 0.3842 |  |
|                     |                  | 0.5856 | 0.5270 | 0.3842 | 0.2269 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 |  |
|                     |                  | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 |  |
|                     |                  | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 |  |
|                     |                  | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 |  |
|                     |                  | 0.3000 | 0.2700 | 0.1968 | 0.1162 | 0.5856 | 0.5270 | 0.3842 | 0.2269 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 |  |
|                     |                  | 0.2700 | 0.3000 | 0.2700 | 0.1968 | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 |  |
|                     |                  | 0.1968 | 0.2700 | 0.3000 | 0.2700 | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 |  |
|                     |                  | 0.1162 | 0.1968 | 0.2700 | 0.3000 | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 |  |

## B.2.3A MIMO Channel Correlation Matrices using cross polarized antennas

The MIMO channel correlation matrices defined in B.2.3A apply for the antenna configuration using cross polarized (XP/X-pol) antennas at both eNodeB and UE. The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at eNB and cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at UE.

For the cross-polarized antennas, the N antennas are labelled such that antennas for one polarization are listed from 1 to N/2 and antennas for the other polarization are listed from N/2+1 to N, where N is the number of transmit or receive antennas.

### B.2.3A.1 Definition of MIMO Correlation Matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P(R_{eNB} \otimes \Gamma \otimes R_{UE})P^T$$

where

- $R_{UE}$  is the spatial correlation matrix at the UE with same polarization,
- $R_{eNB}$  is the spatial correlation matrix at the eNB with same polarization,
- $\Gamma$  is a polarization correlation matrix, and
- $(\bullet)^T$  denotes transpose.

The matrix  $\Gamma$  is defined as

$$\Gamma = \begin{bmatrix} 1 & 0 & -\gamma & 0 \\ 0 & 1 & 0 & \gamma \\ -\gamma & 0 & 1 & 0 \\ 0 & \gamma & 0 & 1 \end{bmatrix}$$

A permutation matrix  $P$  elements are defined as

$$P(a,b) = \begin{cases} 1 & \text{for } a = (j-1)N_r + i \text{ and } b = 2(j-1)N_r + i, \quad i = 1, \dots, N_r, j = 1, \dots, N_t/2 \\ 1 & \text{for } a = (j-1)N_r + i \text{ and } b = 2(j - N_t/2)N_r - N_r + i, \quad i = 1, \dots, N_r, j = N_t/2 + 1, \dots, N_t \\ 0 & \text{otherwise} \end{cases}$$

where  $N_t$  and  $N_r$  is the number of transmitter and receiver respectively. This is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in B.2.3A.

## B.2.3A.2 Spatial Correlation Matrices using cross polarized antennas at eNB and UE sides

### B.2.3A.2.1 Spatial Correlation Matrices at eNB side

For 2-antenna transmitter using one pair of cross-polarized antenna elements,  $R_{eNB} = 1$ .

For 4-antenna transmitter using two pairs of cross-polarized antenna elements,  $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$ .

For 8-antenna transmitter using four pairs of cross-polarized antenna elements,  $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ .

### B.2.3A.2.2 Spatial Correlation Matrices at UE side

For 2-antenna receiver using one pair of cross-polarized antenna elements,  $R_{UE} = 1$ .

For 4-antenna receiver using two pairs of cross-polarized antenna elements,  $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$ .

## B.2.3A.3 MIMO Correlation Matrices using cross polarized antennas

The values for parameters  $\alpha$ ,  $\beta$  and  $\gamma$  for the cross polarized antenna models are given in Table B.2.3A.3-1.

**Table B.2.3A.3-1: : The  $\alpha$  and  $\beta$  parameters for cross-polarized MIMO correlation matrices**

| Correlation Model    | $\alpha$   | $\beta$ | $\gamma$ |
|----------------------|--|---------|----------|
| Medium Correlation A | 0.3  | 0.6     | 0.2      |
| High Correlation     | 0.9  | 0.9     | 0.3      |
| Note 1:              | Value of $\alpha$ applies when more than one pair of cross-polarized antenna elements at eNB side. |         |          |
| Note 2:              | Value of $\beta$ applies when more than one pair of cross-polarized antenna elements at UE side.   |         |          |

The correlation matrices for high spatial correlation and medium correlation A are defined in Table B.2.3A.3-2 and Table B.2.3A.3-3 as below.

The values in Table B.2.3A.3-2 have been adjusted to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$\mathbf{R}_{high} = [\mathbf{R}_{spat} + a\mathbf{I}_n]/(1+a)$$

Where the value “a” is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 8x2 high spatial correlation case, a=0.00010.

**Table B.2.3A.3-2: MIMO correlation matrices for high spatial correlation**

|                 |              |   |
|-----------------|--------------|---|
| <b>4x2 case</b> | $R_{high} =$ | 1.0000 0.0000 0.9000 0.0000 -0.3000 0.0000 -0.2700 0.0000   |
|                 |              | 0.0000 1.0000 0.0000 0.9000 0.0000 0.3000 0.0000 0.2700   |
|                 |              | 0.9000 0.0000 1.0000 0.0000 -0.2700 0.0000 -0.3000 0.0000   |
|                 |              | 0.0000 0.9000 0.0000 1.0000 0.0000 0.2700 0.0000 0.3000   |
|                 |              | -0.3000 0.0000 -0.2700 0.0000 1.0000 0.0000 0.9000 0.0000   |
|                 |              | 0.0000 0.3000 0.0000 0.2700 0.0000 1.0000 0.0000 0.9000   |
|                 |              | -0.2700 0.0000 -0.3000 0.0000 0.9000 0.0000 1.0000 0.0000   |
|                 |              | 0.0000 0.2700 0.0000 0.3000 0.0000 0.9000 0.0000 1.0000   |
| <b>8x2 case</b> | $R_{high} =$ | 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 0.8999 0.0000 -0.3000 0.0000 -0.2965 0.0000 -0.2862 0.0000 -0.2700 0.0000 |
|                 |              | 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 0.8999 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.2700     |
|                 |              | 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 -0.2965 0.0000 -0.3000 0.0000 -0.2965 0.0000 -0.2862 0.0000 |
|                 |              | 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862     |
|                 |              | 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 -0.2862 0.0000 -0.2965 0.0000 -0.3000 0.0000 -0.2965 0.0000 |
|                 |              | 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965     |
|                 |              | 0.8999 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 -0.2700 0.0000 -0.2862 0.0000 -0.2965 0.0000 -0.3000 0.0000 |
|                 |              | 0.0000 0.8999 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 0.2700 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000     |
|                 |              | -0.3000 0.0000 -0.2965 0.0000 -0.2862 0.0000 -0.2700 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 0.8999 0.0000 |
|                 |              | 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.2700 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 0.8999     |
|                 |              | -0.2965 0.0000 -0.3000 0.0000 -0.2965 0.0000 -0.2862 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542 0.0000 |
|                 |              | 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 0.9542     |
|                 |              | -0.2862 0.0000 -0.2965 0.0000 -0.3000 0.0000 -0.2965 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883 0.0000 |
|                 |              | 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 0.9883     |
|                 |              | -0.2700 0.0000 -0.2862 0.0000 -0.2965 0.0000 -0.3000 0.0000 0.8999 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000 0.0000 |
|                 |              | 0.0000 0.2700 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.8999 0.0000 0.9542 0.0000 0.9883 0.0000 1.0000     |

**Table B.2.3A.3-3: MIMO correlation matrices for medium correlation A**

|            |                  |  |
|------------|------------------|--|
| <b>4x4</b> | $R_{Medium A} =$ | $\begin{pmatrix} 1.0000 & 0.6000 & 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 & 0.0000 & -0.2000 & -0.1200 & 0.0000 & 0.0000 & -0.0600 & -0.0360 & 0.0000 & 0.0000 \\ 0.6000 & 1.0000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 & 0.0000 & -0.1200 & -0.2000 & 0.0000 & 0.0000 & -0.0360 & -0.0600 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 & 0.0000 & 0.2000 & 0.1200 & 0.0000 & 0.0000 & 0.0600 & 0.0360 \\ 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 & 0.0000 & 0.1200 & 0.2000 & 0.0000 & 0.0000 & 0.0360 & 0.0600 \\ 0.3000 & 0.1800 & 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 & -0.0600 & -0.0360 & 0.0000 & 0.0000 & -0.2000 & -0.1200 & 0.0000 & 0.0000 \\ 0.1800 & 0.3000 & 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 & -0.0360 & -0.0600 & 0.0000 & 0.0000 & -0.1200 & -0.2000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 & 0.0600 & 0.0360 & 0.0000 & 0.0000 & 0.2000 & 0.1200 \\ 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 & 0.0360 & 0.0600 & 0.0000 & 0.0000 & 0.1200 & 0.2000 \\ -0.2000 & -0.1200 & 0.0000 & 0.0000 & -0.0600 & -0.0360 & 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 \\ -0.1200 & -0.2000 & 0.0000 & 0.0000 & -0.0360 & -0.0600 & 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 \\ 0.0000 & 0.0000 & 0.2000 & 0.1200 & 0.0000 & 0.0000 & 0.0600 & 0.0360 & 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 & 0.3000 & 0.1800 \\ 0.0000 & 0.0000 & 0.1200 & 0.2000 & 0.0000 & 0.0000 & 0.0360 & 0.0600 & 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 \\ -0.0600 & -0.0360 & 0.0000 & 0.0000 & -0.2000 & -0.1200 & 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 & 0.0000 & 1.0000 & 0.6000 & 0.0000 & 0.0000 \\ -0.0360 & -0.0600 & 0.0000 & 0.0000 & -0.1200 & -0.2000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 & 0.0000 & 0.6000 & 1.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.0600 & 0.0360 & 0.0000 & 0.0000 & 0.2000 & 0.1200 & 0.0000 & 0.0000 & 0.3000 & 0.1800 & 0.0000 & 0.0000 & 1.0000 & 0.6000 \\ 0.0000 & 0.0000 & 0.0360 & 0.0600 & 0.0000 & 0.0000 & 0.1200 & 0.2000 & 0.0000 & 0.0000 & 0.1800 & 0.3000 & 0.0000 & 0.0000 & 0.6000 & 1.0000 \end{pmatrix}$ |
|------------|------------------|--|

### B.2.3A.4 Beam steering approach

Given the channel spatial correlation matrix in B.2.3A.1, the corresponding random channel matrix  $H$  can be calculated. The signal model for the  $k$ -th subframe is denoted as

$$y = HD_{\theta_k} Wx + n$$

Where

- $H$  is the  $N_r \times N_t$  channel matrix per subcarrier.
- $D_{\theta_k}$  is the steering matrix,

For 8 transmission antennas,  $D_{\theta_k} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_k} & 0 & 0 \\ 0 & 0 & e^{j2\theta_k} & 0 \\ 0 & 0 & 0 & e^{j3\theta_k} \end{bmatrix}$ ;

For 4 transmission antennas,  $D_{\theta_k} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_k} \end{bmatrix}$ .

- $\theta_k$  controls the phase variation, and the phase for  $k$ -th subframe is denoted by  $\theta_k = \theta_0 + \Delta\theta \cdot k$ , where  $\theta_0$  is the random start value with the uniform distribution, i.e.,  $\theta_0 \in [0, 2\pi]$ ,  $\Delta\theta$  is the step of phase variation, which is defined in Table B.2.3A.4-1, and  $k$  is the linear increment of 1 for every subframe throughout the simulation,
- $W$  is the precoding matrix for  $N_t$  transmission antennas,
- $y$  is the received signal,  $x$  is the transmitted signal, and  $n$  is AWGN.

**Table B.2.3A.4-1: The step of phase variation**

| Variation Step | Value (rad/subframe)    |
|----------------|-------------------------|
| $\Delta\theta$ | $1.2566 \times 10^{-3}$ |

### B.2.3B MIMO Channel Correlation Matrices using two-dimension cross polarized antennas at eNB and cross polarized antennas at UE

The MIMO channel correlation matrices defined in B.2.3B apply for the antenna configuration using two-dimension (2D) cross polarized antennas at eNodeB and the antenna configuration using cross polarized antennas at UE. The cross-polarized antenna elements with  $\pm 45$  degrees polarization slant angles are deployed at eNB and cross-polarized antenna elements with  $+90/0$  degrees polarization slant angles are deployed at UE.

For 2D cross-polarized antenna array at eNodeB, the  $N$  antennas are indexed by  $(N_1, N_2, P)$ , and total number of antennas is  $N = P \cdot N_1 \cdot N_2$ , where

- $N_1$  is the number of antenna elements in first dimension (i.e. vertical direction) with same polarization,
- $N_2$  is the number of antenna elements in second dimension (i.e. horizontal direction) with same polarization, and
- $P$  is the number of polarization groups.

For the 2D cross-polarized antennas at eNB, the  $N$  antennas are labelled such that antennas shall be in increasing order of the second dimension firstly, then the first dimension, and finally the polarization group. For a specific antenna element at  $p$ -th polarization,  $n_1$ -th row, and  $n_2$ -th column within the 2D antenna array, the following index number is used for antenna labelling:

$$\text{Index}(p, n_1, n_2) = p \cdot N_1 \cdot N_2 + n_1 \cdot N_2 + n_2 + 1, \quad p = 0, 1, \quad n_1 = 0, \dots, N_1 - 1, \quad n_2 = 0, \dots, N_2 - 1.$$

where  $N$  is the number of transmit antennas,  $p$  is the polarization group index,  $n_1$  is the row index, and  $n_2$  is the column index of the antenna element.

For the cross-polarized antennas at UE, the  $N$  antennas are labelled such that antennas for one polarization are listed from 1 to  $N/2$  and antennas for the other polarization are listed from  $N/2+1$  to  $N$ , where  $N$  is the number of receive antennas.

### B.2.3B.1 Definition of MIMO Correlation Matrices using two-dimension cross polarized antennas at eNB and cross polarized antennas at UE

For the channel spatial correlation matrix, the following is used:

$$R_{\text{spat}} = P(R_{\text{eNB}} \otimes \Gamma \otimes R_{\text{UE}})P^T$$

where

- $R_{\text{UE}}$  is the spatial correlation matrix at the UE with same polarization,
- $R_{\text{eNB}}$  is the spatial correlation matrix at the eNB with same polarization,
- $\Gamma$  is a polarization correlation matrix, and
- $(\bullet)^T$  denotes transpose.

The spatial correlation matrix at the eNB is further expressed as following:

$$R_{\text{eNB}} = R_{\text{eNB\_Dim,1}} \otimes R_{\text{eNB\_Dim,2}}$$

where

- $R_{\text{eNB\_Dim,1}}$  is the correlation matrix of antenna elements in first dimension with same polarization, and
- $R_{\text{eNB\_Dim,2}}$  is the correlation matrix of antenna elements in second dimension with same polarization.

The matrix  $\Gamma$  is defined as

$$\Gamma = \begin{bmatrix} 1 & 0 & -\gamma & 0 \\ 0 & 1 & 0 & \gamma \\ -\gamma & 0 & 1 & 0 \\ 0 & \gamma & 0 & 1 \end{bmatrix}$$

A permutation matrix  $P$  elements are defined as

$$P(a,b) = \begin{cases} 1 & \text{for } a = (j-1)Nr + i \text{ and } b = 2(j-1)Nr + i, \quad i = 1, \dots, Nr, j = 1, \dots, Nt/2 \\ 1 & \text{for } a = (j-1)Nr + i \text{ and } b = 2(j - Nt/2)Nr - Nr + i, \quad i = 1, \dots, Nr, j = Nt/2 + 1, \dots, Nt \\ 0 & \text{otherwise} \end{cases}$$

where  $N_t$  and  $N_r$  is the number of transmitter and receiver respectively. This is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in B.2.3B.

## B.2.3B.2 Spatial Correlation Matrices using two-dimension cross polarized antennas at eNB and cross polarized antennas at UE

### B.2.3B.2.1 Spatial Correlation Matrices at eNB side

For one direction of the 2D antenna array at the eNB side, the followings are used to construct the spatial correlation matrix:

For 1 antenna element of the same polarization in one direction,  $R_{eNB\_Dim,i} = 1$ .

For 2 antenna elements of the same polarization in one direction,  $R_{eNB\_Dim,i} = \begin{pmatrix} 1 & \alpha_i \\ \alpha_i^* & 1 \end{pmatrix}$ .

For 3 antenna elements of the same polarization in one direction,  $R_{eNB\_Dim,i} = \begin{pmatrix} 1 & \alpha_i^{1/4} & \alpha_i \\ \alpha_i^{1/4*} & 1 & \alpha_i^{1/4} \\ \alpha_i^* & \alpha_i^{1/4*} & 1 \end{pmatrix}$ .

For 4 antenna elements of the same polarization in one direction,  $R_{eNB\_Dim,i} = \begin{pmatrix} 1 & \alpha_i^{1/9} & \alpha_i^{4/9} & \alpha_i \\ \alpha_i^{1/9*} & 1 & \alpha_i^{1/9} & \alpha_i^{4/9} \\ \alpha_i^{4/9*} & \alpha_i^{1/9*} & 1 & \alpha_i^{1/9} \\ \alpha_i^* & \alpha_i^{4/9*} & \alpha_i^{1/9*} & 1 \end{pmatrix}$ .

where the index  $i=1,2$  stands for first dimension and second dimension respectively.

### B.2.3B.2.2 Spatial Correlation Matrices at UE side

For 2-antenna receiver using one pair of cross-polarized antenna elements,  $R_{UE} = 1$ .

For 4-antenna receiver using two pairs of cross-polarized antenna elements,  $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$ .

## B.2.3B.3 MIMO Correlation Matrices using two-dimension cross polarized antennas at eNB and cross polarized antennas at UE

The values for parameters  $\alpha_1$ ,  $\alpha_2$ ,  $\beta$  and  $\gamma$  for high and medium spatial correlation are given in Table B.2.3B.3-1.

**Table B.2.3B.3-1**

| Correlation type | $\alpha_1$   | $\alpha_2$ | $\beta$ | $\gamma$ |
|------------------|--|------------|---------|----------|
| High             | 0.9  | 0.9        | 0.9     | 0.3      |
| Medium           | 0.3  | 0.3        | 0.6     | 0.2      |
| Note 1:          | Value of $\alpha_1$ applies when more than one pair of cross-polarized antenna elements in first dimension at eNB side.  |            |         |          |
| Note 2:          | Value of $\alpha_2$ applies when more than one pair of cross-polarized antenna elements in second dimension at eNB side. |            |         |          |
| Note 3:          | Value of $\beta$ applies when more than one pair of cross-polarized antenna elements at UE side.                         |            |         |          |

The correlation matrices for high spatial correlation with 12(2,3,2)x2 case and 16(2,4,2)x2 case are defined in Table B.2.3B.3-2 as below.

The values in Table B.2.3B.3-2 have been adjusted to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:



$$R_{high} = [R_{spat} + aI_n]/(1 + a)$$

where the value “a” is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 16(2,4,2)x2 high spatial correlation case, a=0.00012.

The same method is used to adjust the the 24(3,4,2)x2 and 32(4,4,2)x2 high correlation matrix to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a =0.00012 and a=0.00022.

**Table B.2.3B.3-2: MIMO correlation matrices for high spatial correlation**

|                                |   |
|--------------------------------|---|
| <p><b>12(2,3,2)x2 case</b></p> | $R_{high} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}, \text{ where}$ $A=D = \begin{bmatrix} 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.9000 & 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.8100 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.9000 & 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.8100 \\ 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 \\ 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.8766 \\ 0.9000 & 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.8100 & 0.0000 & 0.8766 & 0.0000 & 0.9000 & 0.0000 \\ 0.0000 & 0.9000 & 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.8100 & 0.0000 & 0.8766 & 0.0000 & 0.9000 \\ 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.8100 & 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.9000 & 0.0000 \\ 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.8100 & 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 & 0.9000 \\ 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.9740 & 0.0000 \\ 0.0000 & 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.8766 & 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 & 0.9740 \\ 0.8100 & 0.0000 & 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.9000 & 0.0000 & 0.9740 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.8100 & 0.0000 & 0.8766 & 0.8766 & 0.0000 & 0.9000 & 0.0000 & 0.9000 & 0.0000 & 0.9740 & 0.0000 & 1.0000 \end{bmatrix}$ $B=C = \begin{bmatrix} -0.3000 & 0.0000 & -0.2922 & 0.0000 & -0.2700 & 0.0000 & -0.2700 & 0.0000 & -0.2630 & 0.0000 & -0.2430 & 0.0000 \\ 0.0000 & 0.3000 & 0.0000 & 0.2922 & 0.0000 & 0.2700 & 0.0000 & 0.2700 & 0.0000 & 0.2630 & 0.0000 & 0.2430 \\ -0.2922 & 0.0000 & -0.3000 & 0.0000 & -0.2922 & 0.0000 & -0.2630 & 0.0000 & -0.2700 & 0.0000 & -0.2630 & 0.0000 \\ 0.0000 & 0.2922 & 0.0000 & 0.3000 & 0.0000 & 0.2922 & 0.0000 & 0.2630 & 0.0000 & 0.2700 & 0.0000 & 0.2630 \\ -0.2700 & 0.0000 & -0.2922 & 0.0000 & -0.3000 & 0.0000 & -0.2430 & 0.0000 & -0.2630 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.2922 & 0.0000 & 0.3000 & 0.0000 & 0.2430 & 0.0000 & 0.2630 & 0.0000 & 0.2700 \\ -0.2700 & 0.0000 & -0.2630 & 0.0000 & -0.2430 & 0.0000 & -0.3000 & 0.0000 & -0.2922 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.2630 & 0.0000 & 0.2430 & 0.0000 & 0.3000 & 0.0000 & 0.2922 & 0.0000 & 0.2700 \\ -0.2630 & 0.0000 & -0.2700 & 0.0000 & -0.2630 & 0.0000 & -0.2922 & 0.0000 & -0.3000 & 0.0000 & -0.2922 & 0.0000 \\ 0.0000 & 0.2630 & 0.0000 & 0.2700 & 0.0000 & 0.2630 & 0.0000 & 0.2922 & 0.0000 & 0.3000 & 0.0000 & 0.2922 \\ -0.2430 & 0.0000 & -0.2630 & 0.0000 & -0.2700 & 0.0000 & -0.2700 & 0.0000 & -0.2922 & 0.0000 & -0.3000 & 0.0000 \\ 0.0000 & 0.2430 & 0.0000 & 0.2630 & 0.0000 & 0.2700 & 0.0000 & 0.2700 & 0.0000 & 0.2922 & 0.0000 & 0.3000 \end{bmatrix}$ |
| <p><b>16(2,4,2)x2 case</b></p> | $R_{high} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}, \text{ where}$ $A=D = \begin{bmatrix} 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8999 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.8099 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8999 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.8099 \\ 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 \\ 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 \\ 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 \\ 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 \\ 0.8999 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.8099 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 \\ 0.0000 & 0.8999 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.8099 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 \\ 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.8099 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8999 & 0.0000 \\ 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.8099 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 & 0.8999 \\ 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 & 0.0000 \\ 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.8587 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 & 0.9541 \\ 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 & 0.0000 \\ 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8894 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 & 0.9882 \\ 0.8099 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8999 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.8099 & 0.0000 & 0.8587 & 0.0000 & 0.8894 & 0.0000 & 0.8999 & 0.0000 & 0.8999 & 0.0000 & 0.9541 & 0.0000 & 0.9882 & 0.0000 & 1.0000 \end{bmatrix}$   |

|        |  |
|--------|--|
| $B=C=$ | -0.3000 0.0000-0.2965 0.0000-0.2862 0.0000-0.2700 0.0000-0.2700 0.0000-0.2668 0.0000-0.2576 0.0000-0.2430 0.0000 |
|        | 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.2700 0.0000 0.2700 0.0000 0.2668 0.0000 0.2576 0.0000 0.2430  |
|        | -0.2965 0.0000-0.3000 0.0000-0.2965 0.0000-0.2862 0.0000-0.2668 0.0000-0.2700 0.0000-0.2668 0.0000-0.2576 0.0000 |
|        | 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.2668 0.0000 0.2700 0.0000 0.2668 0.0000 0.2576  |
|        | -0.2862 0.0000-0.2965 0.0000-0.3000 0.0000-0.2965 0.0000-0.2576 0.0000-0.2668 0.0000-0.2700 0.0000-0.2668 0.0000 |
|        | 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.2576 0.0000 0.2668 0.0000 0.2700 0.0000 0.2668  |
|        | -0.2700 0.0000-0.2862 0.0000-0.2965 0.0000-0.3000 0.0000-0.2430 0.0000-0.2576 0.0000-0.2668 0.0000-0.2700 0.0000 |
|        | 0.0000 0.2700 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.2430 0.0000 0.2576 0.0000 0.2668 0.0000 0.2700  |
|        | -0.2700 0.0000-0.2668 0.0000-0.2576 0.0000-0.2430 0.0000-0.3000 0.0000-0.2965 0.0000-0.2862 0.0000-0.2700 0.0000 |
|        | 0.0000 0.2700 0.0000 0.2668 0.0000 0.2576 0.0000 0.2430 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862 0.0000 0.2700  |
|        | -0.2668 0.0000-0.2700 0.0000-0.2668 0.0000-0.2576 0.0000-0.2965 0.0000-0.3000 0.0000-0.2965 0.0000-0.2862 0.0000 |
|        | 0.0000 0.2668 0.0000 0.2700 0.0000 0.2668 0.0000 0.2576 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965 0.0000 0.2862  |
|        | -0.2576 0.0000-0.2668 0.0000-0.2700 0.0000-0.2668 0.0000-0.2862 0.0000-0.2965 0.0000-0.3000 0.0000-0.2965 0.0000 |
|        | 0.0000 0.2576 0.0000 0.2668 0.0000 0.2700 0.0000 0.2668 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000 0.0000 0.2965  |
|        | -0.2430 0.0000-0.2576 0.0000-0.2668 0.0000-0.2700 0.0000-0.2700 0.0000-0.2862 0.0000-0.2965 0.0000-0.3000 0.0000 |
|        | 0.0000 0.2430 0.0000 0.2576 0.0000 0.2668 0.0000 0.2700 0.0000 0.2700 0.0000 0.2862 0.0000 0.2965 0.0000 0.3000  |

### B.2.3B.4 Beam steering approach

Given the channel spatial correlation matrix in B.2.3B.1, the corresponding random channel matrix  $\mathbf{H}$  can be calculated. The signal model for the  $k$ -th subframe is denoted as

$$y = \mathbf{H} D_{\theta_{k,1}, \theta_{k,2}} Wx + n$$

And the steering matrix is further expressed as following:

$$D_{\theta_{k,1}, \theta_{k,2}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes (D_{\theta_{k,1}}(N_1) \otimes D_{\theta_{k,2}}(N_2))$$

where

- $\mathbf{H}$  is the  $N_r \times N_t$  channel matrix per subcarrier.
- $D_{\theta_{k,1}, \theta_{k,2}}$  is the steering matrix,
- $D_{\theta_{k,1}}(N_1)$  is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$  is the steering matrix in second dimension with same polarization,
- $N_1$  is the number of antenna elements in first dimension with same polarization,
- $N_2$  is the number of antenna elements in second dimension with same polarization,

For 1 antenna element of the same polarization in one direction,  $D_{\theta_{k,i}}(1) = 1$ .

For 2 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(2) = \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

For 3 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(3) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & e^{j1.5\theta_{k,i}} & 0 \\ 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

For 4 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_{k,i}} & 0 & 0 \\ 0 & 0 & e^{j2\theta_{k,i}} & 0 \\ 0 & 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

where the index  $i=1,2$  stands for first dimension and second dimension respectively.

- $\theta_{k,i}$  controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by  $\theta_{k,i} = \theta_{0,i} + \Delta\theta \cdot k$ , where  $\theta_{0,i}$  is the random start value with the uniform distribution, i.e.,  $\theta_{0,i} \in [0, 2\pi]$ ,  $\Delta\theta$  is the step of phase variation, which is defined in Table B.2.3B.4-1, and  $k$  is the linear increment of 1 for every subframe throughout the simulation, the index  $i=1,2$  stands for first dimension and second dimension respectively.
- $W$  is the precoding matrix for  $N_t$  transmission antennas,
- $y$  is the received signal,  $x$  is the transmitted signal, and  $n$  is AWGN.

**Table B.2.3B.4-1: The step of phase variation**

| Variation Step | Value (rad/subframe)    |
|----------------|-------------------------|
| $\Delta\theta$ | $1.2566 \times 10^{-3}$ |

### B.2.3B.4A Beam steering approach with dual cluster beams

Given the channel spatial correlation matrix in B.2.3B.1, the corresponding random channel matrix  $H$  can be calculated. The signal model for the k-th subframe is denoted as

$$y = \left[ \sqrt{\frac{1}{1+p^2}} H_m D_{\theta_{k,1}, \theta_{k,2}}^{(m)} + \sqrt{\frac{p^2}{1+p^2}} H_s D_{\theta_{k,1}, \theta_{k,2}}^{(s)} \right] Wx + n$$

And the steering matrix is further expressed as following:

$$D_{\theta_{k,1}, \theta_{k,2}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes (D_{\theta_{k,1}}(N_1) \otimes D_{\theta_{k,2}}(N_2))$$

where

- $H_m, H_s$  are independent channels for the first beam and second beam with the  $N_r \times N_t$  channel matrix per subcarrier.
- $D_{\theta_{k,1}, \theta_{k,2}}^{(m)}, D_{\theta_{k,1}, \theta_{k,2}}^{(s)}$  are the steering matrix for first beam and second beam
- $D_{\theta_{k,1}}(N_1)$  is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$  is the steering matrix in second dimension with same polarization,
- $N_1$  is the number of antenna elements in first dimension with same polarization,
- $N_2$  is the number of antenna elements in second dimension with same polarization,
- $p$  is the relative power ratio of the second beam to the first beam, the value of  $p$  is specific to a test case,

For 1 antenna element of the same polarization in one direction,  $D_{\theta_{k,i}}(1) = 1$ .

For 2 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(2) = \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

For 3 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(3) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & e^{j1.5\theta_{k,i}} & 0 \\ 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

For 4 antenna elements of the same polarization in one direction,  $D_{\theta_{k,i}}(4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_{k,i}} & 0 & 0 \\ 0 & 0 & e^{j2\theta_{k,i}} & 0 \\ 0 & 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}$ .

where the index  $i = 1,2$  stands for first dimension and second dimension respectively.

- $\theta_{k,i}$  controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by  $\theta_{k,i} = \theta_{0,i} + \Delta\theta \cdot k$ , where  $\theta_{0,i}$  is the random start value with the uniform distribution, i.e.,  $\theta_{0,i} \in [0,2\pi]$ ,  $\Delta\theta$  is the step of phase variation, which is defined in Table B.2.3B.4-1, and  $k$  is the linear increment of 1 for every subframe throughout the simulation, the index  $i = 1,2$  stands for first dimension and second dimension respectively.
- $W$  is the precoding matrix for Nt transmission antennas,
- $y$  is the received signal,  $x$  is the transmitted signal, and  $n$  is AWGN.

**Table B.2.3B.4A-1: The step of phase variation**

| Variation Step       | Value (rad/subframe)    |
|----------------------|-------------------------|
| $\Delta\theta^{(m)}$ | $1.2566 \times 10^{-3}$ |
| $\Delta\theta^{(s)}$ | $2.5132 \times 10^{-3}$ |

## B.2.4 Propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t, \tau) = \delta(\tau) + a \exp(-i2\pi f_D t) \delta(\tau - \tau_d),$$

in continuous time  $(t, \tau)$  representation, with  $\tau_d$  the delay,  $a$  a constant and  $f_D$  the Doppler frequency. The same  $h(t, \tau)$  is used to describe the fading channel between every pair of Tx and Rx.

### B.2.4.1 Propagation conditions for CQI tests with multiple CSI processes

For CQI tests with multiple CSI processes, the following additional multi-path profile is used for 2 port transmission:

$$H = \begin{bmatrix} 1 & j \\ 1 & -j \end{bmatrix} \circ H_{MP}$$

Where  $\circ$  represents Hadamard product,  $H_{MP}$  indicates the 2x2 propagation channel generated in the manner defined in Clause B.2.4.

## B.2.5 Void

## B.2.6 MBSFN Propagation Channel Profile

### B.2.6.1 Subcarrier spacing 15kHz or 7.5kHz

Table B.2.6.1-1 shows propagation conditions that are used for the MBSFN performance requirements in multi-path fading environment in an extended delay spread environment.

**Table B.2.6.1-1: Propagation Conditions for Multi-Path Fading Environments for MBSFN Performance Requirements in an extended delay spread environment with subcarrier spacing 15kHz or 7.5kHz**

| Extended Delay Spread           |                          |
|---------------------------------|--------------------------|
| Maximum Doppler frequency [5Hz] |                          |
| Relative Delay [ns]             | Relative Mean Power [dB] |
| 0                               | 0                        |
| 30                              | -1.5                     |
| 150                             | -1.4                     |
| 310                             | -3.6                     |
| 370                             | -0.6                     |
| 1090                            | -7.0                     |
| 12490                           | -10                      |
| 12520                           | -11.5                    |
| 12640                           | -11.4                    |
| 12800                           | -13.6                    |
| 12860                           | -10.6                    |
| 13580                           | -17.0                    |
| 27490                           | -20                      |
| 27520                           | -21.5                    |
| 27640                           | -21.4                    |
| 27800                           | -23.6                    |
| 27860                           | -20.6                    |
| 28580                           | -27.0                    |

### B.2.6.2 Subcarrier spacing 1.25kHz

Table B.2.6.2-1 shows propagation conditions that are used for the MBSFN performance requirements in multi-path fading environment in an extended delay spread environment for subcarrier spacing as 1.25kHz.

**Table B.2.6.2-1: Propagation Conditions for Multi-Path Fading Environments for MBSFN Performance Requirements in an extended delay spread environment with subcarrier spacing 1.25kHz**

| Extended Delay Spread           |                          |
|---------------------------------|--------------------------|
| Maximum Doppler frequency [5Hz] |                          |
| Relative Delay [ns]             | Relative Mean Power [dB] |
| 0                               | 0                        |
| 30                              | -1.5                     |

|        |       |
|--------|-------|
| 150    | -1.4  |
| 310    | -3.6  |
| 370    | -0.6  |
| 1090   | -7.0  |
| 49960  | -10   |
| 49990  | -11.5 |
| 50110  | -11.4 |
| 50270  | -13.6 |
| 50330  | -10.6 |
| 51050  | -17.0 |
| 109960 | -20   |
| 109990 | -21.5 |
| 110110 | -21.4 |
| 110270 | -23.6 |
| 110330 | -20.6 |
| 111050 | -27.0 |

### B.2.6.3 Subcarrier spacing 0.37kHz

Table B.2.6.3-1 shows propagation conditions that are used for the MBSFN performance requirements in multi-path fading environment in an extended delay spread environment for subcarrier spacing as 0.37kHz.

**Table B.2.6.3-1: Propagation Conditions for Multi-Path Fading Environments for MBSFN Performance Requirements in an extended delay spread environment with subcarrier spacing 0.37kHz**

| Extended Delay Spread     |                          |
|---------------------------|--------------------------|
| Zero Doppler frequency    |                          |
| Relative Delay [ $\mu$ s] | Relative Mean Power [dB] |
| 0                         | -11                      |
| 130                       | -10                      |
| 220                       | -4.5                     |
| 240                       | -3.5                     |
| 400                       | 0                        |
| 520                       | -13                      |
| 650                       | -20                      |
| 800                       | -25                      |

### B.2.6.4 Subcarrier spacing 2.5kHz

Table B.2.6.4-1 shows propagation conditions that are used for the MBSFN performance requirements in multi-path fading environment in an extended delay spread environment for subcarrier spacing as 2.5kHz.

**Table B.2.6.4-1: Propagation Conditions for Multi-Path Fading Environments for MBSFN Performance Requirements in an extended delay spread environment with subcarrier spacing 2.5kHz**

| Extended Delay Spread             |                          |
|-----------------------------------|--------------------------|
| Maximum Doppler frequency [162Hz] |                          |
| Relative Delay [ns]               | Relative Mean Power [dB] |
| -310                              | -3.6                     |

|        |       |
|--------|-------|
| -280   | -1.5  |
| -160   | -1.4  |
| 0      | 0     |
| 60     | -0.6  |
| 780    | -7.0  |
| 49650  | -10   |
| 49680  | -11.5 |
| 49800  | -11.4 |
| 49960  | -13.6 |
| 50020  | -10.6 |
| 50740  | -17.0 |
| 109650 | -20   |
| 109680 | -21.5 |
| 109800 | -21.4 |
| 109960 | -23.6 |
| 110020 | -20.6 |
| 110740 | -27.0 |

### B.3 High speed train scenario

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos \theta(t) \quad (\text{B.3.1})$$

where  $f_s(t)$  is the Doppler shift and  $f_d$  is the maximum Doppler frequency. The cosine of angle  $\theta(t)$  is given by

$$\cos \theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \quad 0 \leq t \leq D_s/v \quad (\text{B.3.2})$$

$$\cos \theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}^2 + (-1.5D_s + vt)^2}}, \quad D_s/v < t \leq 2D_s/v \quad (\text{B.3.3})$$

$$\cos \theta(t) = \cos \theta(t \bmod (2D_s/v)), \quad t > 2D_s/v \quad (\text{B.3.4})$$

where  $D_s/2$  is the initial distance of the train from eNodeB, and  $D_{\min}$  is eNodeB Railway track distance, both in meters;  $v$  is the velocity of the train in m/s,  $t$  is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1 and B.3.2-B.3.4 respectively, where the required input parameters listed in table B.3-1 and the resulting Doppler shift shown in Figure B.3-1 are applied for all frequency bands.

**Table B.3-1: High speed train scenario**

| Parameter | Value |
|-----------|-------|
| $D_s$     | 300 m |

|            |          |
|------------|----------|
| $D_{\min}$ | 2 m      |
| $v$        | 300 km/h |
| $f_d$      | 750 Hz   |

NOTE 1: Parameters for HST conditions in table B.3-1 including  $f_d$  and Doppler shift trajectories presented on figure B.3-1 were derived from Band 7 and are applied for performance verification in all frequency bands.

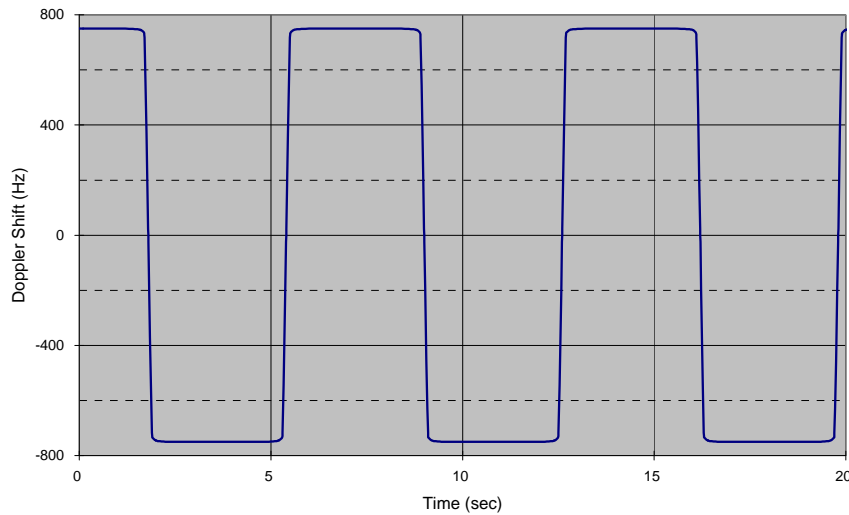


Figure B.3-1: Doppler shift trajectory

For 1x2 antenna configuration, the same  $h(t,\tau)$  is used to describe the channel between every pair of Tx and Rx.

For 2x2 antenna configuration, the same  $h(t,\tau)$  is used to describe the channel between every pair of Tx and Rx with

phase shift according to  $\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}$ .

### B.3A HST-SFN scenario

There is an infinite number of RRHs distributed equidistantly along the track with the same Cell ID as depicted in figure B.3A-1.

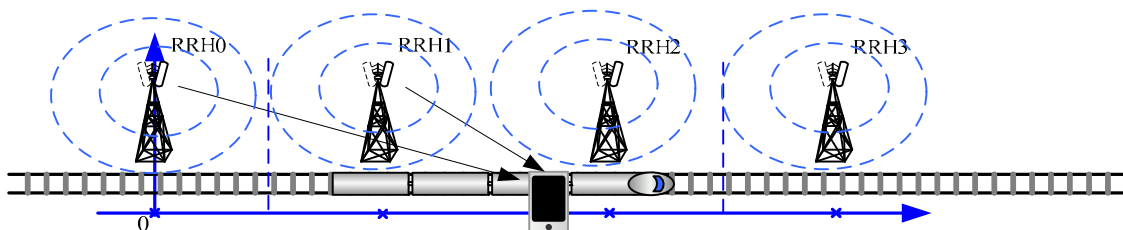


Figure B.3A-1: Deployment of HST-SFN

The location of RRH  $k$  is given as:



$$x_k = k * D_s + j * D_{\min} \quad (\text{B.3A.1})$$

where:  $k \in [-\infty, \infty]$ ,  $j = \text{sqrt}(-1)$  and  $D_{\min}$  is the distance between the RRHs and railway track, while  $D_s$  is the distance of two RRHs, both in meters.

The train location is denoted as:

$$y = a + j * 0 \quad (\text{B.3A.2})$$

where:  $a \in [0, \infty]$  and  $a$  means distance in meters, which means the train is right on the track.

The HST-SFN scenario for the test of the baseband performance is a non fading propagation channel with four taps, namely the four nearest RRHs. Thus RRH  $k$  is visible for the train only in the range:

$$k * D_s - 2 * D_s \leq a < k * D_s + 2 * D_s \quad (\text{B.3A.3})$$

Power level  $P_k$  (dB) for the signal from  $k$ th RRH, normalized to the total power received from all visible RRHs, is given by:

$$P_k = -20 \lg(|y - x_k|) - 10 \lg \left( \sum_{i \in \{i | i * D_s - 2 * D_s \leq a < i * D_s + 2 * D_s\}} \frac{1}{|y - x_i|^2} \right) \text{ for } k * D_s - 2 * D_s \leq a < k * D_s + 2 * D_s \quad (\text{B.3A.4})$$

Doppler shift  $F_{D,k}$  (Hz) from  $k$ th RRH is given by:

$$F_{D,k} = f_c \times \text{real} \left[ -v \times \frac{y - x_k}{|y - x_k| \times C} \right] \text{ for } k * D_s - 2 * D_s \leq a < k * D_s + 2 * D_s \quad (\text{B.3A.5})$$

The relative delay  $T_k$  (s) for the signal from  $k$ th RRH can be derived as:

$$T_k = \frac{|y - x_k|}{C} \text{ for } k * D_s - 2 * D_s \leq a < k * D_s + 2 * D_s \quad (\text{B.3A.6})$$

In the above  $v$  (m/s) is the moving speed of the train,  $f_c$  (Hz) is the center frequency, and  $C$  (m/s) is the velocity of light.

Power level, Doppler shift and relative delay are given by equations B.3A.4 ~ B.3A.6 respectively, where the required input parameters listed in table B.3A-1 and the resulting Doppler shift shown in Figure B.3A-3 are applied for all frequency bands.

**Table B.3A-1: HST-SFN scenario**

| Parameter  | Value    |
|------------|----------|
| $D_s$      | 1000 m   |
| $D_{\min}$ | 50m      |
| $v$        | 350 km/h |
| $f_d$      | 872 Hz   |

NOTE 1: Parameters for HST-SFN scenario in Table B.3A-1 including  $f_d$  and Doppler shift trajectories presented in Figure B.3A-2 were derived from Band 7 and are applied for performance verification in all frequency bands. And the trajectories of relative power, Doppler shifts and relative delay presented in Figures B.3A-2 ~ B.3A-4 are derived from the equations B.3A.4 ~ B.3A.6 respectively.

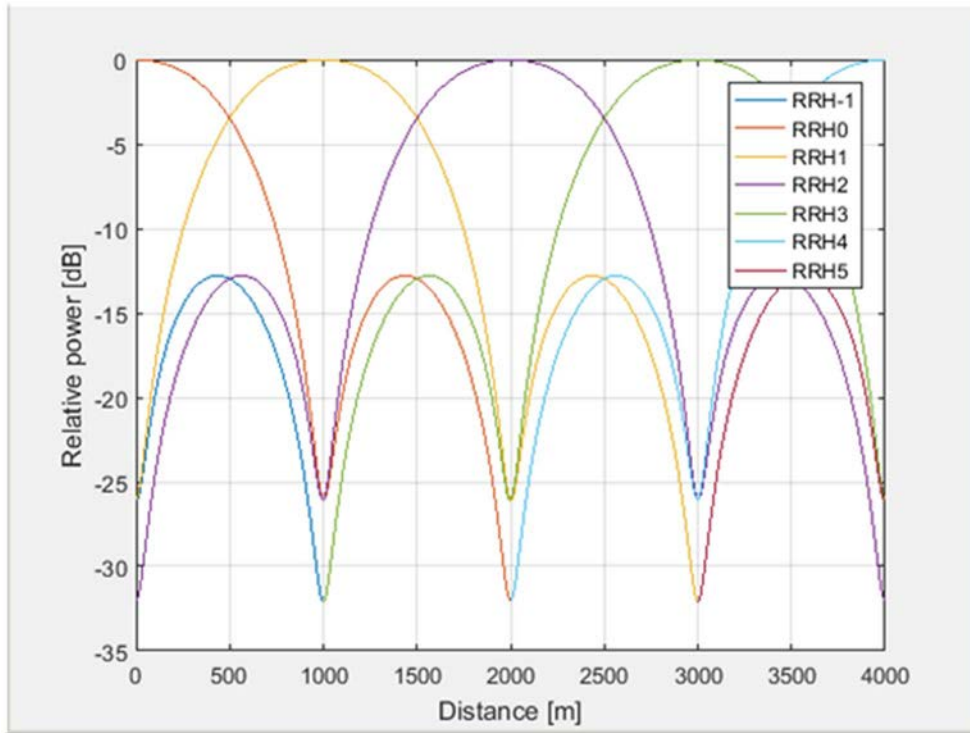


Figure B.3A-2 Relative power level trajectories

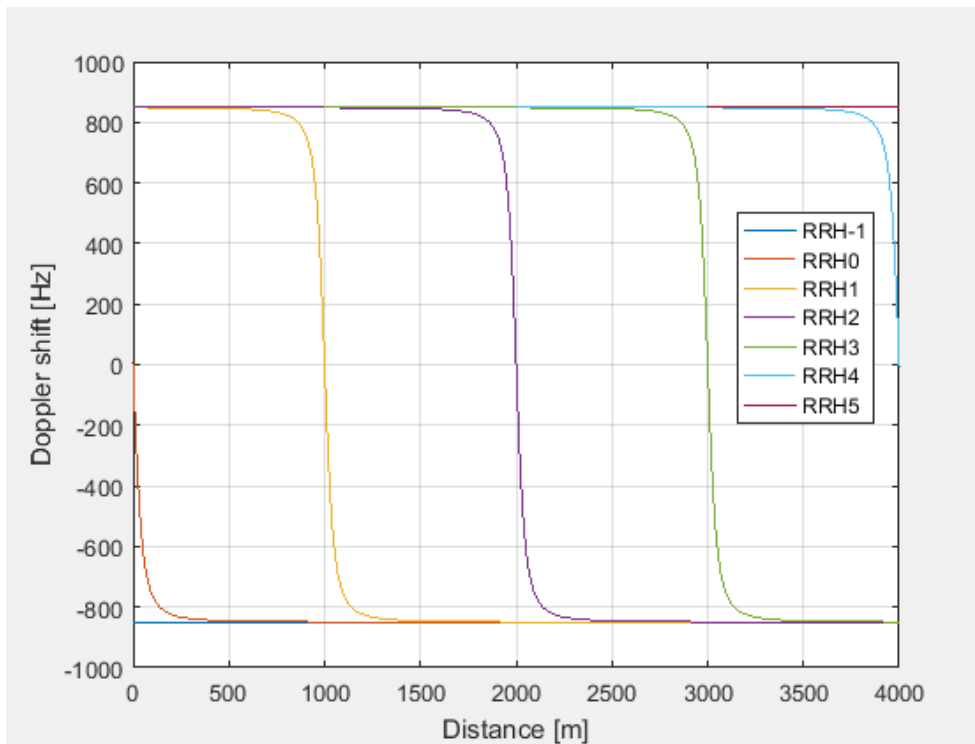


Figure B.3A-3 Doppler shifts trajectories

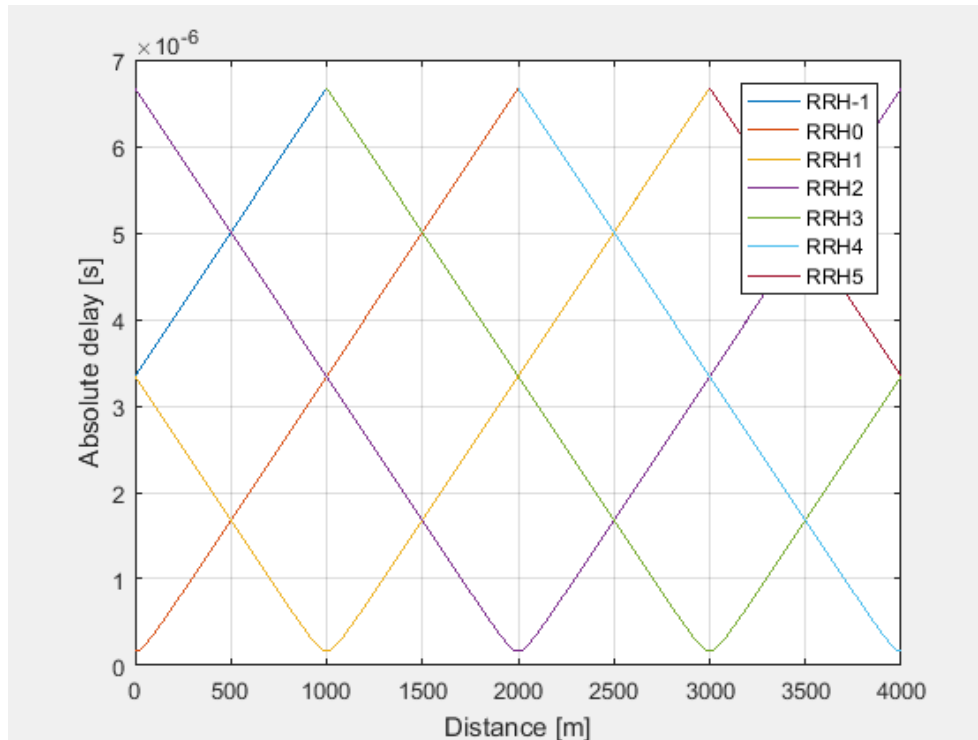


Figure B.3A-4 Relative delay trajectories

For 2x2 antenna configuration, the same  $h(t,\tau)$  is used to describe the channel between every pair of Tx and Rx with

phase shift according to  $\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}$ .

For 2x4 antenna configuration, the same  $h(t,\tau)$  is used to describe the channel between every pair of Tx and Rx with

$$\mathbf{H} = \begin{bmatrix} 1 & j \\ 1 & -j \\ 1 & j \\ 1 & -j \end{bmatrix}$$

phase shift according to

## B.3B HST-SFN scenario for 500 km/h speed

The channel model for this scenario is the same as B.3A, with the following parameters replacing Table B.3A-1:

Table B.3B-1-500: HST-SFN scenario for higher speed

| Parameter  | Value    |
|------------|----------|
| $D_s$      | 1000 m   |
| $D_{\min}$ | 50 m     |
| $v$        | 500 km/h |
| $f_d$      | 972 Hz   |

## B.3C HST scenario for 500 km/h speed

The channel model for this scenario is the same as B.3, with the following parameters replacing Table B.3-1:

Table B.3C-1: HST-500 scenario for higher speed

| Parameter  | Value    |
|------------|----------|
| $D_s$      | 300 m    |
| $D_{\min}$ | 2 m      |
| $v$        | 500 km/h |
| $f_d$      | 972 Hz   |

## B.4 Beamforming Model

### B.4.1 Single-layer random beamforming (Antenna port 5, 7, or 8)

Single-layer transmission on antenna port 5 or on antenna port 7 or 8 without a simultaneous transmission on the other antenna port, is defined by using a precoder vector  $W(i)$  of size  $2 \times 1$  or  $4 \times 1$  randomly selected with the number of layers  $\nu = 1$  from Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 in [4] as beamforming weights. This precoder takes as an input the signal  $y^{(p)}(i)$ ,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , for antenna port  $p \in \{5, 7, 8\}$ , with  $M_{\text{symb}}^{\text{ap}}$  the number of modulation symbols including the user-specific reference symbols (DRS), and generates a block of signals  $y_{\text{bf}}(i) = [y_{\text{bf}}(i) \ \tilde{y}_{\text{bf}}(i)]^T$  the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

$$\begin{bmatrix} y_{\text{bf}}(i) \\ \tilde{y}_{\text{bf}}(i) \end{bmatrix} = W(i)y^{(p)}(i)$$

Single-layer transmission on antenna port 7 or 8 with a simultaneous transmission on the other antenna port, is defined by using a pair of precoder vectors  $W_1(i)$  and  $W_2(i)$  each of size  $2 \times 1$  or  $4 \times 1$ , which are not identical and randomly selected with the number of layers  $\nu = 1$  from Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 in [4], as beamforming weights, and normalizing the transmit power as follows:

$$\begin{bmatrix} y_{\text{bf}}(i) \\ \tilde{y}_{\text{bf}}(i) \end{bmatrix} = \frac{1}{\sqrt{2}} (W_1(i)y^{(7)}(i) + W_2(i)y^{(8)}(i))$$

The precoder update granularity is specific to a test case.

The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 1$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $y_{\text{bf}}(i)$ . The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 0$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $\tilde{y}_{\text{bf}}(i)$ .

#### B.4.1A Single-layer random beamforming (Antenna port 7, 8, 11 or 13 with enhanced DMRS table configured)

Single-layer transmission on antenna port 11 with a simultaneous transmission on one antenna port from antenna port 7, 8 or 13, is defined by using a pair of precoder vectors  $W_1(i)$  and  $W_2(i)$  each of size  $2 \times 1$ , which are not identical and randomly selected with the number of layers  $\nu = 1$  from Table 6.3.4.2.3-1 in [4], as beamforming weights, and normalizing the transmit power as follows:

$$\begin{bmatrix} y_{\text{bf}}(i) \\ \tilde{y}_{\text{bf}}(i) \end{bmatrix} = \frac{1}{\sqrt{2}} (W_1(i)y^{(11)}(i) + W_2(i)y^{(p)}(i))$$

The precoder takes  $y^{(11)}(i)$  and  $y^{(p_1)}(i)$  as the input the signals,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , with  $M_{\text{symb}}^{\text{ap}}$  the number of modulation symbols including the user-specific reference symbols (DM-RS), and generates a block of signals  $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$  the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements.

The antenna port  $p_1 \in \{7, 8, 13\}$  update granularity is specific to a test case.

The precoder update granularity is specific to a test case.

The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 1$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $y_{bf}(i)$ . The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 0$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $\tilde{y}_{bf}(i)$ .

## B.4.2 Dual-layer random beamforming (antenna ports 7 and 8)

Dual-layer transmission on antenna ports 7 and 8 is defined by using a precoder matrix  $W(i)$  of size  $2 \times 2$  randomly selected with the number of layers  $\nu = 2$  from Table 6.3.4.2.3-1 in [4] as beamforming weights. This precoder takes as an input a block of signals for antenna ports 7 and 8,  $y(i) = [y^{(7)}(i) \quad y^{(8)}(i)]^T$ ,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , with  $M_{\text{symb}}^{\text{ap}}$  being the number of modulation symbols per antenna port including the user-specific reference symbols, and generates a block of signals  $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$  the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W(i) \begin{bmatrix} y^{(7)}(i) \\ y^{(8)}(i) \end{bmatrix},$$

The precoder update granularity is specific to a test case.

The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 1$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $y_{bf}(i)$ . The CSI reference symbols  $a_{k,l}^{(p)}$  satisfying  $p \bmod 2 = 0$ ,  $p \in \{15, 16, \dots, 22\}$ , are transmitted on the same physical antenna element as the modulation symbols  $\tilde{y}_{bf}(i)$ .

## B.4.3 Generic beamforming model (antenna ports 7-14)

The transmission on antenna port(s)  $p = 7, 8, \dots, \nu + 6$  is defined by using a precoder matrix  $W(i)$  of size  $N_{\text{CSI}} \times \nu$ , where  $N_{\text{CSI}}$  is the number of CSI reference signals configured per test and  $\nu$  is the number of spatial layers. This precoder takes as an input a block of signals for antenna port(s)  $p = 7, 8, \dots, \nu + 6$ ,

$y^{(p)}(i) = [y^{(7)}(i) \quad y^{(8)}(i) \quad \dots \quad y^{(6+\nu)}(i)]$ ,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , with  $M_{\text{symb}}^{\text{ap}}$  being the number of modulation symbols per antenna port including the user-specific reference symbols (DM-RS), and generates a block of signals

$y_{bf}^{(q)}(i) = [y_{bf}^{(0)}(i) \quad y_{bf}^{(1)}(i) \quad \dots \quad y_{bf}^{(N_{\text{CSI}}-1)}(i)]^T$  the elements of which are to be mapped onto the same time-frequency index pair  $(k, l)$  but transmitted on different physical antenna elements:

$$\begin{bmatrix} y_{bf}^{(0)}(i) \\ y_{bf}^{(1)}(i) \\ \vdots \\ y_{bf}^{(N_{\text{CSI}}-1)}(i) \end{bmatrix} = W(i) \begin{bmatrix} y^{(7)}(i) \\ y^{(8)}(i) \\ \vdots \\ y^{(6+\nu)}(i) \end{bmatrix}$$

The precoder matrix  $W(i)$  is specific to a test case.

The physical antenna elements are identified by indices  $j = 0, 1, \dots, N_{ANT} - 1$ , where  $N_{ANT} = N_{CSI}$  is the number of physical antenna elements configured per test.

Modulation symbols  $y_{bf}^{(q)}(i)$  with  $q \in \{0, 1, \dots, N_{CSI} - 1\}$  (i.e. beamformed PDSCH and DM-RS) are mapped to the physical antenna index  $j = q$ .

Modulation symbols  $y^{(p)}(i)$  with  $p \in \{0, 1, \dots, P - 1\}$  (i.e. PBCH, PDCCH, PHICH, PCFICH) are mapped to the physical antenna index  $j = p$ , where  $P$  is the number of cell-specific reference signals configured per test.

Modulation symbols  $a_{k,l}^{(p)}$  with  $p \in \{0, 1, \dots, P - 1\}$  (i.e. CRS) are mapped to the physical antenna index  $j = p$ , where  $P$  is the number of cell-specific reference signals configured per test.

Modulation symbols  $a_{k,l}^{(p)}$  with  $p \in \{15, 16, \dots, 14 + N_{CSI}\}$  (i.e. CSI-RS) are mapped to the physical antenna index  $j = p - 15$ , where  $N_{CSI}$  is the number of CSI reference signals configured per test.

#### B.4.4 Random beamforming for EPDCCH distributed transmission (Antenna port 107 and 109)

EPDCCH distributed transmission on antenna port 107 and antenna port 109 is defined by using a pair of precoder vectors  $W_1(i)$  and  $W_2(i)$  each of size  $2 \times 1$ , which are not identical and randomly selected per EPDCCH PRB pair with the number of layers  $\nu = 1$  from Table 6.3.4.2.3-1 in [4], as beamforming weights. This precoder takes as an input the signal  $y^{(p)}(i)$ ,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , for antenna port  $p \in \{107, 109\}$ , with  $M_{\text{symb}}^{\text{ap}}$  the number of modulation symbols including the user-specific reference symbols (DMRS), and generates a block of signals  $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$ . When EPDCCH is associated with port 107, the transmitted block of signals is denoted as

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W_1(i) y^{(107)}(i).$$

When EPDCCH is associated with port 109, the transmitted block of signals is denoted as

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W_2(i) y^{(109)}(i).$$

#### B.4.5 Random beamforming for EPDCCH localized transmission (Antenna port 107, 108, 109 or 110)

EPDCCH localized transmission on antenna port 107, 108, 109 or 110 is defined by using a precoder vector  $W(i)$  of size  $2 \times 1$  randomly selected with the number of layers  $\nu = 1$  from Table 6.3.4.2.3-1 in [4] as beamforming weights. This precoder takes as an input the signal  $y^{(p)}(i)$ ,  $i = 0, 1, \dots, M_{\text{symb}}^{\text{ap}} - 1$ , for antenna port  $p \in \{107, 108, 109, 110\}$ , with  $M_{\text{symb}}^{\text{ap}}$  the number of modulation symbols including the user-specific reference symbols (DMRS), and generates a block of signals  $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$  the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W(i) y^{(p)}(i).$$

## B.4.6 Beamforming model for CRI test

The transmission on antenna port(s)  $p = 7, 8, \dots, \nu + 6$  is defined by using a precoder matrix  $W(i)$  of size  $N_{CSI} \times \nu$ , where  $N_{CSI}$  is the number of CSI reference signals configured per test and  $\nu$  is the number of spatial layers. This precoder takes as an input a block of signals for antenna port(s)  $p = 7, 8, \dots, \nu + 6$ ,

$y^{(p)}(i) = [y^{(7)}(i) \quad y^{(8)}(i) \quad \dots \quad y^{(6+\nu)}(i)]$ ,  $i = 0, 1, \dots, M_{\text{symp}}^{\text{ap}} - 1$ , with  $M_{\text{symp}}^{\text{ap}}$  being the number of modulation symbols per antenna port including the user-specific reference symbols (DM-RS), and generates a block of signals  $y_{bf}^{(q)}(i) = [y_{bf}^{(0)}(i) \quad y_{bf}^{(1)}(i) \quad \dots \quad y_{bf}^{(N_{CSI}-1)}(i)]^T$  the elements of which are to be mapped onto the same time-frequency index pair  $(k, l)$  but transmitted on different physical antenna elements:

$$\begin{bmatrix} y_{bf}^{(0)}(i) \\ y_{bf}^{(1)}(i) \\ \vdots \\ y_{bf}^{(N_{CSI}-1)}(i) \end{bmatrix} = \alpha(n)W(i) \begin{bmatrix} y^{(7)}(i) \\ y^{(8)}(i) \\ \vdots \\ y^{(6+\nu)}(i) \end{bmatrix}$$

- $W(i)$  is precoder matrix
- $\alpha(n)$  is amplitude scaling factor for CRI test,  $\alpha(n) = 10^{P_{\theta_m}(n)/20}$
- $P_{\theta_m}(n)$  is power scaling factor as following definition:
  - $P_{\theta_m}(n) = A \cos\left(\theta_m + \frac{2\pi n}{K}\right) + B$ ,  $A = 5$  dB,  $B = -1.3351$  dB.
  - $\theta_m$  controls the phase variation, and the phase for m-th subframe is denoted by  $\theta_m = \theta_0 + \Delta\theta \cdot m$ , where  $\theta_0$  is the random start value with the uniform distribution, i.e.,  $\theta_0 \in [0, 2\pi]$ ,  $\Delta\theta$  is the step of phase variation which is defined in Table B.4.6-1, and m is the linear increment of 1 for every sub-frame throughout the simulation.
  - K is the number of configured CSI-RS resources
  - $n \in \{0, 1, \dots, K - 1\}$
- For following CRI with multiple CSI-RS resources configured,  $n$  equals to CRI value reported by UE
- For fixed CRI with single CSI-RS resource configure,  $n$  equals to 0.

**Table B.4.6-1: The step of phase variation**

| Variation Step | Value (rad/subframe)    |
|----------------|-------------------------|
| $\Delta\theta$ | $1.2566 \times 10^{-3}$ |

The physical antenna elements are identified by indices  $j = 0, 1, \dots, N_{ANT} - 1$ , where  $N_{ANT} = N_{CSI}$  is the number of physical antenna elements configured per test.

Modulation symbols  $y_{bf}^{(q)}(i)$  with  $q \in \{0, 1, \dots, N_{CSI} - 1\}$  (i.e. beamformed PDSCH and DM-RS) are mapped to the physical antenna index  $j = q$ .

For the k-th configured CSI-RS resource, modulation symbols  $a_{k,l}^{(p)}$  with  $p \in \{15, 16, \dots, 14 + N_{CSI}\}$  (i.e. CSI-RS) are firstly multiplied by amplitude scaling factor  $\alpha(n)$  to generate power scaled symbols  $y_{k,l}^{(p)}$ :

$$y_{k,l}^{(p)} = \alpha(n)a_{k,l}^{(p)}$$

- $n$  equals to CSI-RS resource index (k-th)

And power scaled symbols  $y_{k,l}^{(p)}$  with  $p \in \{1, 5, 16, \dots, 14 + N_{CSI}\}$  (i.e. power scaled CSI-RS) are mapped to the physical antenna index  $j = p - 15$ , where  $N_{CSI}$  is the number of CSI reference signals configured per test.

Modulation symbols  $y^{(p)}(i)$  with  $p \in \{0, 1, \dots, P - 1\}$  (i.e. PBCH, PDCCH, PHICH, PCFICH) are mapped to the physical antenna index  $j = p$ , where  $P$  is the number of cell-specific reference signals configured per test.

Modulation symbols  $a_{k,l}^{(p)}$  with  $p \in \{0, 1, \dots, P - 1\}$  (i.e. CRS) are mapped to the physical antenna index  $j = p$ , where  $P$  is the number of cell-specific reference signals configured per test.

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## B.5 Interference models for enhanced performance requirements Type-A

This clause provides a description for the modelling of interfering cell transmissions for enhanced performance requirements Type-A including: definition of dominant interferer proportion, transmission mode 3, 4 and 9 type of interference modelling.

### B.5.1 Dominant interferer proportion

Each interfering cell involved in enhanced performance requirements Type-A is characterized by its associated dominant interferer proportion (DIP) value:

$$DIP_i = \frac{\hat{I}_{or(i+1)}}{N_{oc}'}$$

where  $\hat{I}_{or(i+1)}$  is the average received power spectral density from the  $i$ -th strongest interfering cell involved in the requirement scenario ( $\hat{I}_{or(1)}$  is assumed to be the power spectral density associated with the serving cell) and

$N_{oc}' = \sum_{j=2}^N \hat{I}_{or(j)} + N_{oc}$  where  $N_{oc}$  is the average power spectral density of a white noise source consistent with the

definition provided in subclause 3.2 and  $N$  is the total number of cells involved in a given requirement scenario.

### B.5.2 Transmission mode 3 interference model

This subclause provides transmission mode 3 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth. Transmitted physical channels shall include PSS, SSS and PBCH.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For rank-1 transmission over a subband, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For rank-2 transmission over a subband, precoding for spatial multiplexing with large delay CDD over two layers for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.2.2 of [4].



For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

### B.5.3 Transmission mode 4 interference model

This subclause provides transmission mode 4 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth according to the probabilities of occurrence. Transmitted physical channels shall include PSS, SSS and PBCH. Probabilities of occurrence in each subframe are as specified in the requirement scenario. If the probabilities of occurrence in each subframe are not specified in the requirement scenario, as default, they are equal to 1.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For each subframe and CQI subband, a precoding matrix for the number of layers  $\nu$  associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-1 of [4]. Note that codebook index 0 shall be excluded from random precoder selection when the number of layers is  $\nu = 2$ .

Precoding for spatial multiplexing with cell-specific reference signals for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.2.1 of [4] with the selected precoding matrices for each subframe and each CQI subband.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

### B.5.4 Transmission mode 9 interference model

This subclause provides transmission mode 9 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth according to the probabilities of occurrence. Transmitted physical channels shall include PSS, SSS and PBCH. Probabilities of occurrence in each subframe are as specified in the requirement scenario. If the probabilities of occurrence in each subframe are not specified in the requirement scenario, as default, they are equal to 1.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For each subframe and each CQI subband, a precoding matrix for the number of layers  $\nu$  associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-2 of [4].

The generic beamforming model in subclause B.4.3 shall be applied assuming cell-specific reference signals and CSI reference signals as specified in the requirement scenario. Random precoding with selected rank and precoding matrices for each subframe and each CQI subband shall be applied to 16QAM randomly modulated layer symbols including the user-specific reference symbols over antenna port 7 when the rank is one and antenna ports 7, 8 when the rank is two.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6 Interference models for enhanced performance requirements Type-B

This clause provides a description for the modelling of interfering cell transmissions for enhanced performance requirements Type-B including: transmission mode 2, 3, 4 and 9 type of interference modelling and a definition of the random interference model.

### B.6.1 Transmission mode 2 interference model

This subclause provides transmission mode 2 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

Precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

### B.6.2 Transmission mode 3 interference model

This subclause provides transmission mode 3 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined for each user defined in section B.6.6 with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For rank-1 transmission, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For rank-2 transmission, precoding for spatial multiplexing with large delay CDD over two layers for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.2.2 of [4].

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

### B.6.3 Transmission mode 4 interference model

This subclause provides transmission mode 4 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For each TTI, for each user defined in B.6.6, a single precoding matrix for the number of layers  $v$  associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-1 of [4]. Note that codebook index 0 shall be excluded from random precoder selection when the number of layers is  $v=2$ .

Precoding for spatial multiplexing with cell-specific reference signals for the number of antenna ports in the requirement scenario shall be applied to randomly modulated layer symbols, as specified in subclause 6.3.4.2.1 of [4] with the selected precoding matrices as specified in subclause B.6.6.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.4 Transmission mode 9 interference model

This subclause provides transmission mode 9 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For each TTI, for each user defined in B.6.6, a single precoding matrix for the number of layers  $v$  associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-1 of [4]. Note that codebook index 0 shall be excluded from random precoder selection when the number of layers is  $v=2$ .

The generic beamforming model in subclause B.4.3 shall be applied assuming cell-specific reference signals and CSI reference signals as specified in the requirement scenario. Random precoding with selected rank and precoding matrices for each subframe shall be applied to randomly modulated layer symbols including the user-specific reference symbols over antenna port 7 when the rank is one and antenna ports 7, 8 when the rank is two.

For each TTI, for each user defined in B.6.6, the scrambling ID value  $n_{SCID}$  is randomly assigned from the set of  $\{0,1\}$ .

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.5 CRS interference model

This subclause provides for the CRS interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe there is no PDSCH transmitted. Transmitted physical channels shall include PSS, SSS and PBCH.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.6 Random interference model

This subclause presents the interference model which defines the resource allocation, MCS and rank for the two interference cells. The model includes approximately 10% DTX on these interference cells. Table B.6.6-1 shows the resource allocation for four users in two different configurations for each of the two interferers. Table B.6.6-2 shows the resource allocation to be used for special subframes with TM9 interference. Table B.6.6-3 shows the probabilities for the MCS and rank for these users.

**Table B.6.6-1: Resource allocation for the random interference model**

|  |  | Resource allocation for random interference model | Probability |
|--|--|---|-------------|
|--|--|---|-------------|

| Resource allocation configurations Indexes | User Index | Resource allocation type | Bitmap for resource allocation (Note 1) |                  |                  |     |
|--|------------|--------------------------|---|------------------|------------------|-----|
|  |            |                          | 1st field bitmap                        | 2nd field bitmap | 3rd field bitmap |     |
| Configuration 1                            | User 0     | 1                        | 00                                      | 0                | 10101000101010   | 50% |
|  | User 1     | 1                        | 00                                      | 0                | 01010101010101   |     |
|  | User 2     | 0                        | 01001001001001001                       |                  |                  |     |
|  | User 3     | 0                        | 00100100100100100                       |                  |                  |     |
| Configuration 2                            | User 0     | 1                        | 00                                      | 0                | 10101010101010   | 50% |
|  | User 1     | 1                        | 00                                      | 1                | 01010100010101   |     |
|  | User 2     | 0                        | 01001001001001001                       |                  |                  |     |
|  | User 3     | 0                        | 00100100100100100                       |                  |                  |     |

Note 1: The 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> field bitmaps are only valid for resource allocation type 1 which was defined in [6].  
 Note 2: The resource allocation model is used for both 1<sup>st</sup> and 2<sup>nd</sup> interfering cells and the resource allocation is independent for each interfering cell.

**Table B.6.6-2: Resource allocation for the random interference model for TM9 special subframes**

| Resource allocation configurations Indexes | User Index | Resource allocation for random interference model |   |                  |                  | Probability |
|--|------------|---|---|------------------|------------------|-------------|
|  |            | Resource allocation type                          | Bitmap for resource allocation (Note 1) |                  |                  |             |
|  |            |   | 1st field bitmap                        | 2nd field bitmap | 3rd field bitmap |             |
| Configuration 1                            | User 0     | 1   | 00                                      | 0                | 10101000101010   | 50%         |
|  | User 1     | 1   | 00                                      | 0                | 01010101000001   |             |
|  | User 2     | 0   | 01001000001001001                       |                  |                  |             |
|  | User 3     | 0   | 00100100000100100                       |                  |                  |             |
| Configuration 2                            | User 0     | 1   | 00                                      | 0                | 10101000101010   | 50%         |
|  | User 1     | 1   | 00                                      | 1                | 01010000010101   |             |
|  | User 2     | 0   | 01001000001001001                       |                  |                  |             |
|  | User 3     | 0   | 00100100000100100                       |                  |                  |             |

Note 1: The 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> field bitmaps are only valid for resource allocation type 1 which was defined in [6].  
 Note 2: The resource allocation model is used for both 1<sup>st</sup> and 2<sup>nd</sup> interfering cells and the resource allocation is independent for each interfering cell.

**Table B.6.6-3 MCS and rank configuration for the random interference model**

| MCS probability |       |       | Rank probability |        |
|-----------------|-------|-------|------------------|--------|
| MCS5            | MCS14 | MCS25 | Rank 1           | Rank 2 |
| 50%             | 25%   | 25%   | 80%              | 20%    |

Note 1: The MCS and rank should follow the probability indicated in the table randomly per UE per TTI.  
 Note 2: The probabilities for MCS and rank configuration are used for both 1<sup>st</sup> and 2<sup>nd</sup> interfering cells. The MCS and rank configurations are independent for each interfering cell.

## B.7 Interference models for enhanced downlink control channel performance requirements Type A and B

This clause provides a description for the modelling of interfering cell transmissions for the enhanced downlink control channel performance requirements Type A and B.

### B.7.1 PDCCH, PCFICH and PHICH interference model

This subclause provides a description of the interfering cell transmissions model for the enhanced PDCCH/PCFICH and PHICH downlink control channel performance requirements Type A and B under synchronous network scenarios.

The transmitted physical signals and channels shall include CRS, PSS, SSS, PBCH and PCFICH. The PDCCH and PHICH transmit signals are emulated as virtual PDCCH signals described further in the clause.

The PDCCH signals are modelled with a per control channel element (CCE) level granularity and have guaranteed 50% CCE resource loading in each subframe. For each subframe the set of active and inactive CCEs is derived in accordance to the following procedure:

- 1) All available CCEs for the PDCCH and PHICH are marked as  $CCE_0, CCE_1, \dots, CCE_{N-1}$ .
- 2) For the given partial loading ratio  $X = 50\%$  the numbers of active CCEs  $M_{Active}$  and inactive CCEs  $M_{Inactive}$  are derived

$$M_{Inactive} = \lfloor N * (100 - X\%) \rfloor$$

$$M_{Active} = N - M_{Inactive}$$

- 3) The indexes of  $M_{Inactive}$  inactive CCEs are randomly selected out of the full set of CCEs.
- 4) The remaining  $M_{Active}$  CCEs are assigned to be active.

No signals are transmitted in the REs corresponding to the inactive CCEs. The PDCCH signals are transmitted in the REs corresponding to the active CCEs. For PDCCH REs, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio of the PDCCH REs in the active CCEs shall be derived in accordance to the following procedure:

- 1) For each generated active  $i$ -th CCE the PDCCH power boosting level  $P(i)$  shall be randomly generated using the uniform distribution in the  $[P_{min}, P_{max}]$  range. The  $P_{min}$  is equal to -6 dB, the  $P_{max}$  is equal to 6 dB. The random values should be derived in the dB scale.
- 2) Additional power normalization is applied for each generated  $i$ -th PDCCH power boosting level:

$$P_{norm}(i) = P(i) - \alpha$$

where  $P(i)$  and  $P_{norm}(i)$  are the PDCCH power boosting coefficients before and after normalization in the dB scale; the power normalization factor  $\alpha$  is equal to 1.3 dB.

- 3) The normalized PDCCH power boosting coefficients  $P_{norm}(i)$  are further applied to the PDCCH\_RA and PDCCH\_RB values to derive the EPRE ratio of the PDCCH signals transmitted in the REs corresponding the  $i$ -th CCE in each subframe.

## B.8 Burst transmission models for Frame structure type 3

This clause provides a description for burst transmission models for Frame structure type 3.

### B.8.1 Burst transmission model for one LAA SCell

One burst is defined as downlink transmissions which occupy one or more consecutive subframes. The burst transmission format is determined according to the steps below:

- 1) Select the number of subframes  $N$  randomly from a given set of the number of subframes  $S_1$  with equal probability as the total length of burst transmission format. The length includes both occupied OFDM symbols and non-occupied OFDM symbols within the burst format.  $S_1$  is given per test case.
- 2) If  $N$  is equal to 1, the subframe is set as fully occupied, otherwise:
  - For demodulation test, the starting position for the first subframe is randomly selected from OFDM symbol 0 and OFDM symbol 7 with equal probability. For CSI test, the starting position for the first subframe is OFDM symbol 0.
  - The configuration of occupied OFDM symbols in the last subframe is randomly selected from configuration set  $S_2$ .  $S_2$  is given per test case.

A uniform random variable from  $[0, 1]$  is generated. If the random variable is less than  $p$  which is given per test case,

- If both the last subframe of previous burst and first subframe of new burst format are fully occupied, start burst transmission after deferring one subframe from the last subframe of previous burst. Otherwise, start burst transmission at the end of last subframe of previous burst.

Otherwise, the burst transmission is muted and the muting duration is the same as the number of subframes for determined burst format.

## B.8.2 Burst transmission model for multiple LAA SCell(s)

This clause provides a description for burst transmission models for Frame structure type 3 when there are multiple LAA SCell(s) in the test.

One burst is defined as downlink transmissions which occupy one or more consecutive subframes. Assuming  $M$  carriers are configured, the burst transmission format is determined according to the steps below:

- 1) For each carrier  $c_m$  ( $m=0, \dots, M-1$ ), select the number of subframes  $N_m$  randomly from a given set of the number of subframes  $S_1$  with equal probability as the total length of burst transmission format used for carrier  $c_m$ . The length includes both occupied OFDM symbols and non-occupied OFDM symbols within the burst format.  $S_1$  is given per test case.
- 2) If any  $N_m$  is equal to 1, the first subframe is set as fully occupied for all carriers, otherwise:
  - For demodulation test, the starting position for the first subframe is randomly selected from OFDM symbol 0 and OFDM symbol 7 with equal probability. For CSI test, the starting position for the first subframe is OFDM symbol 0. The starting position is common for all carriers.
  - The configuration of occupied OFDM symbols in the last subframe is randomly selected from configuration set  $S_2$  for each carrier  $c_m$ .  $S_2$  is given per test case.

A uniform random variable  $p_m$  from  $[0, 1]$  is generated for each carrier  $c_m$  to determine whether the burst is transmitted or not on each carrier.

For each carrier  $c_m$ , if  $p_m$  is less than  $p$  which is given per test case,

- If both the last subframe of previous longest transmitted burst over  $M$  carriers and first subframe of new burst format are fully occupied, start burst transmission according to the determined burst transmission format for this carrier after deferring one subframe from the last subframe of previous longest transmitted burst. Otherwise, start burst transmission for this carrier at the end of last subframe of previous longest transmitted burst.

Otherwise, the burst transmission is muted and the muting duration is  $N_{max}$  and  $N_{max}$  is the maximum of  $N_j$  wherein  $j \in \{0, 1, \dots, M-1\}$  and  $p_j$  is less than  $p$ .

# Annex C (normative): Downlink Physical Channels

## C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

## C.2 Set-up

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

**Table C.2-1: Downlink Physical Channels required for connection set-up**

| Physical Channel |
|------------------|
| PBCH             |
| SSS              |
| PSS              |
| PCFICH           |
| PDCCH            |
| EPDCCH           |
| PHICH            |
| PDSCH            |

## C.3 Connection

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

### C.3.1 Measurement of Receiver Characteristics

Unless otherwise stated, Table C.3.1-1 is applicable for measurements on the Receiver Characteristics (clause 7).

**Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)**

| Physical Channel | EPRE Ratio       |
|------------------|------------------|
| PBCH             | PBCH_RA = 0 dB   |
|                  | PBCH_RB = 0 dB   |
| PSS              | PSS_RA = 0 dB    |
| SSS              | SSS_RA = 0 dB    |
| PCFICH           | PCFICH_RB = 0 dB |
| PDCCH            | PDCCH_RA = 0 dB  |
|                  | PDCCH_RB = 0 dB  |
| PDSCH            | PDSCH_RA = 0 dB  |
|                  | PDSCH_RB = 0 dB  |
| OCNG             | OCNG_RA = 0 dB   |
|                  | OCNG_RB = 0 dB   |

NOTE 1: No boosting is applied.

For measurements on cells in TDD Band 46, Table C.3.1-1a is applicable for measurements of Receiver Characteristics (clause 7).

Table C.3.1-1a: Downlink Physical Channels transmitted during a connection (TDD Band 46)

| Physical Channel                | EPRE Ratio       |
|---------------------------------|------------------|
| DRS                             | NOTE 1           |
| PSS                             | PSS_RA = 0 dB    |
| SSS                             | SSS_RA = 0 dB    |
| PCFICH                          | PCFICH_RB = 0 dB |
| PDCCH                           | PDCCH_RA = 0 dB  |
|                                 | PDCCH_RB = 0 dB  |
| PDSCH                           | PDSCH_RA = 0 dB  |
|                                 | PDSCH_RB = 0 dB  |
| OCNG                            | OCNG_RA = 0 dB   |
|                                 | OCNG_RB = 0 dB   |
| NOTE 1: No boosting is applied. |                  |

Table C.3.1-2: Power allocation for OFDM symbols and reference signals

| Parameter  | Unit       | Value         | Note   |
|--|------------|---------------|--|
| Transmitted power spectral density $I_{or}$                  | dBm/15 kHz | Test specific | 1. $I_{or}$ shall be kept constant throughout all OFDM symbols |
| Cell-specific reference signal power ratio $E_{RS} / I_{or}$ |            | 0 dB          |  |

## C.3.2 Measurement of Performance requirements

Table C.3.2-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.2-1: Downlink Physical Channels transmitted during a connection (FDD and TDD and Frame structure Type 3)

| Physical Channel    | EPRE Ratio                    |
|---------------------|-------------------------------|
| PBCH                | PBCH_RA = $\rho_A + \sigma$   |
|                     | PBCH_RB = $\rho_B + \sigma$   |
| PSS                 | PSS_RA = 0 (Note 3)           |
| SSS                 | SSS_RA = 0 (Note 3)           |
| PCFICH              | PCFICH_RB = $\rho_B + \sigma$ |
| PDCCH               | PDCCH_RA = $\rho_A + \sigma$  |
|                     | PDCCH_RB = $\rho_B + \sigma$  |
| EPDCCH              | EPDCCH_RA = $\rho_A + \delta$ |
|                     | EPDCCH_RB = $\rho_B + \delta$ |
| MPDCCH              | MPDCCH_RA = $\rho_A + \delta$ |
|                     | MPDCCH_RB = $\rho_B + \delta$ |
| SPDCCH (CRS-based)  | SPDCCH_RA = $\rho_A + \sigma$ |
|                     | SPDCCH_RB = $\rho_B + \sigma$ |
| SPDCCH (DMRS-based) | SPDCCH_RA = $\rho_A + \delta$ |
|                     | SPDCCH_RB = $\rho_B + \delta$ |
| PDSCH               | PDSCH_RA = $\rho_A$           |
|                     | PDSCH_RB = $\rho_B$           |
| PMCH                | PMCH_RA = $\rho_A$            |
|                     | PMCH_RB = $\rho_B$            |
| MBSFN RS            | MBSFN_RS_RA = $\rho_A$        |
|                     | MBSFN_RS_RB = $\rho_B$        |
| OCNG                | OCNG_RA = $\rho_A + \sigma$   |
|                     | OCNG_RB = $\rho_B + \sigma$   |



NOTE 1:  $\rho_A = \rho_B = 0$  dB means no RS boosting.

NOTE 2: MBSFN RS and OCNG are not defined downlink physical channels in [4].

NOTE 3: Assuming PSS and SSS transmitted on a single antenna port.

NOTE 4:  $\rho_A$ ,  $\rho_B$ ,  $\sigma$ , and  $\delta$  are test specific.

NOTE 5: Void.

NOTE 6: For Frame Structure Type 3, PBCH are not defined.

**Table C.3.2-2: Power allocation for OFDM symbols and reference signals**

| Parameter  | Unit       | Value         | Note   |
|--|------------|---------------|--|
| Total transmitted power spectral density $I_{or}$            | dBm/15 kHz | Test specific | 1. $I_{or}$ shall be kept constant throughout all OFDM symbols   |
| Cell-specific reference signal power ratio $E_{RS} / I_{or}$ |            | Test specific | 1. Applies for antenna port $p$  |
| Energy per resource element EPRE                             |            | Test specific | 1. The complex-valued symbols $y^{(p)}(i)$ and $a_{k,l}^{(p)}$ defined in [4] shall conform to the given EPRE value.<br>2. For TM8, TM9 and TM10 the reference point for EPRE is before the precoder in Annex B.4. |

### C.3.3 Aggressor cell power allocation for Measurement of Performance Requirements when ABS is Configured

For the performance requirements and channel state information reporting when ABS is configured, the power allocation for the physical channels of the aggressor cell in non-ABS and ABS is listed in Table C.3.3-1.

**Table C.3.3-1: Downlink physical channels transmitted in aggressor cell when ABS is configured in this cell**

| Physical Channel | Parameters | Unit | EPRE Ratio |        |
|------------------|------------|------|------------|--------|
|                  |            |      | Non-ABS    | ABS    |
| PBCH             | PBCH_RA    | dB   | $\rho_A$   | Note 1 |
|                  | PBCH_RB    | dB   | $\rho_B$   | Note 1 |
| PSS              | PSS_RA     | dB   | $\rho_A$   | Note 1 |
| SSS              | SSS_RA     | dB   | $\rho_A$   | Note 1 |
| PCFICH           | PCFICH_RB  | dB   | $\rho_B$   | Note 1 |
| PHICH            | PHICH_RA   | dB   | $\rho_A$   | Note 1 |
|                  | PHICH_RB   | dB   | $\rho_B$   | Note 1 |
| PDCCH            | PDCCH_RA   | dB   | $\rho_A$   | Note 1 |
|                  | PDCCH_RB   | dB   | $\rho_B$   | Note 1 |
| PDSCH            | PDSCH_RA   | dB   | N/A        | Note 1 |
|                  | PDSCH_RB   | dB   | N/A        | Note 1 |
| OCNG             | OCNG_RA    | dB   | $\rho_A$   | Note 1 |
|                  | OCNG_RB    | dB   | $\rho_B$   | Note 1 |

Note 1:  $-\infty$  dB is allocated for this channel in this test.

**Table C.3.3-2: Downlink physical channels transmitted in aggressor cell when ABS is configured in this cell when the CRS assistance information is provided**

| Physical Channel | Parameters | Unit | EPRE Ratio |          |
|------------------|------------|------|------------|----------|
|                  |            |      | Non-ABS    | ABS      |
| PBCH             | PBCH_RA    | dB   | $\rho_A$   | $\rho_A$ |
|                  | PBCH_RB    | dB   | $\rho_B$   | $\rho_B$ |
| PSS              | PSS_RA     | dB   | $\rho_A$   | $\rho_A$ |
| SSS              | SSS_RA     | dB   | $\rho_A$   | $\rho_A$ |
| PCFICH           | PCFICH_RB  | dB   | $\rho_B$   | Note 1   |
| PHICH            | PHICH_RA   | dB   | $\rho_A$   | Note 1   |
|                  | PHICH_RB   | dB   | $\rho_B$   | Note 1   |
| PDCCH            | PDCCH_RA   | dB   | $\rho_A$   | Note 1   |
|                  | PDCCH_RB   | dB   | $\rho_B$   | Note 1   |
| PDSCH            | PDSCH_RA   | dB   | N/A        | Note 1   |
|                  | PDSCH_RB   | dB   | N/A        | Note 1   |
| OCNG             | OCNG_RA    | dB   | $\rho_A$   | Note 1   |
|                  | OCNG_RB    | dB   | $\rho_B$   | Note 1   |

Note 1:  $-\infty$  dB is allocated for this channel in this test.

### C.3.4 Power Allocation for Measurement of Performance Requirements when Quasi Co-location Type B: same Cell ID

For the performance requirements related to quasi-colocation type B behaviour when transmission points share the same Cell ID, the power allocation for the physical channels of the serving cell is listed in Table C.3.4-1 and the power allocation for the physical channels of the cell transmitting PDSCH is listed in Table C.3.4-2

**Table C.3.4-1: Downlink physical channels transmitted in the serving cell (TP1)**

| Physical Channel | EPRE Ratio                    |
|------------------|-------------------------------|
| PBCH             | PBCH_RA = $\rho_A + \sigma$   |
|                  | PBCH_RB = $\rho_B + \sigma$   |
| PSS              | PSS_RA = 0 (Note 2)           |
| SSS              | SSS_RA = 0 (Note 2)           |
| PDSCH            | PDSCH_RA = $\rho_A$           |
|                  | PDSCH_RB = $\rho_B$           |
| PCFICH           | PCFICH_RB = $\rho_B + \sigma$ |
| PDCCH            | PDCCH_RA = $\rho_A + \sigma$  |
|                  | PDCCH_RB = $\rho_B + \sigma$  |

NOTE 1:  $\rho_A = \rho_B = 0$  dB means no RS boosting.

NOTE 2: Assuming PSS and SSS transmitted on a single antenna port.

NOTE 3:  $\rho_A$ ,  $\rho_B$  and  $\sigma$  are test specific.

**Table C.3.4-2: Downlink physical channels for the transmission point transmitting PDSCH (TP2)**

| Physical Channel | Value         |
|------------------|---------------|
| PDSCH            | Test Specific |

### C.3.5 Simplified CA testing method

For CA tests which require more than 16 independent faders, if a test system cannot support a throughput measurement with fading on all carriers simultaneously, the simplified CA testing method shall be used.

In the simplified CA testing method, the resulting propagation channel(s) shall be generated by considering a number of independent faders needed for one carrier and connecting them to the signal of randomly chosen carrier(s). The maximum number of channel faders on the test will be less than or equal to 16. The remaining carrier(s) shall be connected without a channel fader but with AWGN. The throughput is then collected only for the carrier(s) connected to channel faders.

In the simplified CA testing method, the test shall be repeated by choosing carrier(s) excluding already chosen carrier(s) until all the carrier(s) are tested under fading conditions. All the collected throughputs from each carrier shall be compared against the reference value of the requirements.

All supported carriers shall be configured and activated during the test.

### C.3.6 Measurement of Receiver Characteristics for Narrowband IoT

For the performance requirements for Narrowband IoT, the power allocation for the physical channels is listed in Table C.3.6-1

**Table C.3.6-1: Downlink Physical Channels transmitted during a connection**

| Physical Channel | EPRE Ratio for one NRS antenna port | EPRE Ratio for two NRS antenna ports |
|------------------|-------------------------------------|--------------------------------------|
| NPBCH            | 0 dB                                | -3 dB                                |
| NPDCCH           | 0 dB                                | -3 dB                                |
| NPDSCH           | 0 dB                                | -3 dB                                |
| NPSS             | 0 dB                                | 0 dB                                 |
| NSSS             | 0 dB                                | 0 dB                                 |

NOTE 1: Assuming NPSS and NSSS transmitted on one NRS antenna port.

**Table C.3.6-2: Power allocation for OFDM symbols and reference signals**

| Parameter  | Unit       | Value         | Note  |
|--|------------|---------------|---|
| Transmitted power spectral density $I_{or}$  | dBm/15 kHz | Test specific | $I_{or}$ shall be kept constant throughout all OFDM symbols |
| Cell-specific reference signal power ratio $E_{CRS} / I_{or}$                                  |            | 0 dB          | Applicable for In-band operation                            |
| Narrowband reference signal power ratio $E_{NRS} / I_{or}$                                     |            | 0 dB          | Applicable for Stand-alone and Guard-band operation         |
| Narrowband reference signal power over cell-specific reference signal power $E_{NRS} / E_{RS}$ |            | 0 dB          | Applicable for In-band operation                            |

## Annex D (normative): Characteristics of the interfering signal

### D.1 General

Unless otherwise stated, when the channel bandwidth is wider or equal to 5MHz, a modulated 5MHz full bandwidth E-UTRA downlink signal and CW signal are used as interfering signals when RF performance requirements for E-UTRA UE receiver are defined. For channel bandwidths below 5MHz, the bandwidth of modulated interferer should be equal to bandwidth of the received signal.

For Band 46, the bandwidth of interfering signal is 20MHz when RF performance requirements for E-UTRA UE receiver are defined.

### D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel bandwidth options.

**Table D.2-1: Description of modulated E-UTRA interferer**

|                          | Channel bandwidth |       |       |        |        |        |
|--------------------------|-------------------|-------|-------|--------|--------|--------|
|                          | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| BW <sub>Interferer</sub> | 1.4 MHz           | 3 MHz | 5 MHz | 5 MHz  | 5 MHz  | 5 MHz  |
| RB                       | 6                 | 15    | 25    | 25     | 25     | 25     |

Table D.2-2 describes the modulated interferer setting 2 for different channel bandwidth options for Band 46.

**Table D.2-2: Description of modulated E-UTRA interferer for Band 46**

|                          | Channel bandwidth |       |       |        |        |        |
|--------------------------|-------------------|-------|-------|--------|--------|--------|
|                          | 1.4 MHz           | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| BW <sub>Interferer</sub> |                   |       |       |        |        | 20 MHz |
| RB                       |                   |       |       |        |        | 100    |

# Annex E (normative): Environmental conditions

## E.1 General

This normative annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

## E.2 Environmental

The requirements in this clause apply to all types of UE(s).

### E.2.1 Temperature

The UE shall fulfil all the requirements in the full temperature range of:

**Table E.2.1-1**

|                  |   |
|------------------|---|
| +15 °C to +35 °C | for normal conditions (with relative humidity up to 75 %)       |
| -10 °C to +55 °C | for extreme conditions (see IEC publications 68-2-1 and 68-2-2) |

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation.

### E.2.2 Voltage

The UE shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shutdown voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

**Table E.2.2-1**

| Power source                | Lower extreme voltage | Higher extreme voltage | Normal conditions voltage |
|-----------------------------|-----------------------|------------------------|---------------------------|
| AC mains                    | 0,9 * nominal         | 1,1 * nominal          | nominal                   |
| Regulated lead acid battery | 0,9 * nominal         | 1,3 * nominal          | 1,1 * nominal             |
| Non regulated batteries:    |                       |                        |                           |
| Leclanché                   | 0,85 * nominal        | Nominal                | Nominal                   |
| Lithium                     | 0,95 * nominal        | 1,1 * Nominal          | 1,1 * Nominal             |
| Mercury/nickel & cadmium    | 0,90 * nominal        |                        | Nominal                   |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

## E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

**Table E.2.3-1**

| <b>Frequency</b> | <b>ASD (Acceleration Spectral Density) random vibration</b>           |
|------------------|---|
| 5 Hz to 20 Hz    | 0,96 m <sup>2</sup> /s <sup>3</sup>                                   |
| 20 Hz to 500 Hz  | 0,96 m <sup>2</sup> /s <sup>3</sup> at 20 Hz, thereafter -3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 36.101 for extreme operation.

## Annex F (normative): Transmit modulation

### F.1 Measurement Point

Figure F.1-1 shows the measurement point for the unwanted emission falling into non-allocated RB(s) and the EVM for the allocated RB(s).

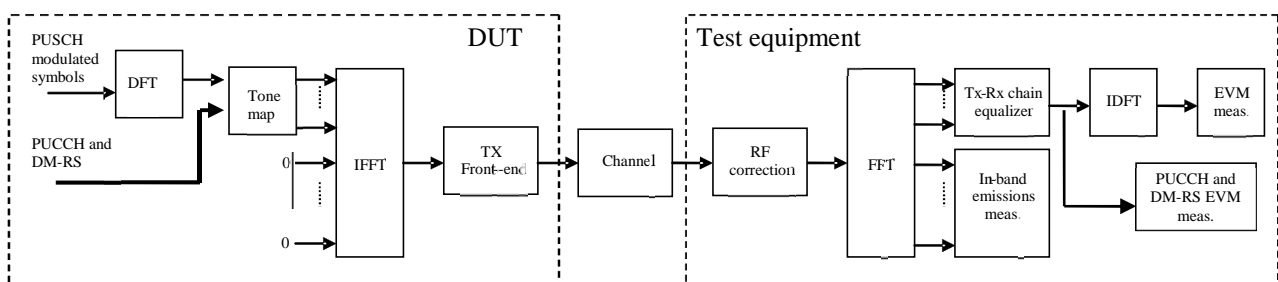


Figure F.1-1: EVM measurement points

### F.2 Basic Error Vector Magnitude measurement

The EVM is the difference between the ideal waveform and the measured waveform for the allocated RB(s)

$$EVM = \sqrt{\frac{\sum_{v \in T_m} |z'(v) - i(v)|^2}{|T_m| \cdot P_0}},$$

where

$T_m$  is a set of  $|T_m|$  modulation symbols with the considered modulation scheme being active within the measurement period,

$z'(v)$  are the samples of the signal evaluated for the EVM,

$i(v)$  is the ideal signal reconstructed by the measurement equipment, and

$P_0$  is the average power of the ideal signal. For normalized modulation symbols  $P_0$  is equal to 1.

The basic EVM measurement interval is defined over one slot in the time domain for PUCCH and PUSCH and over one preamble sequence for the PRACH.

## F.3 Basic in-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks. The in-band emission requirement is evaluated for PUCCH and PUSCH transmissions. The in-band emission requirement is not evaluated for PRACH transmissions.

The in-band emissions are measured as follows

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \frac{1}{|T_s|} \sum_{t \in T_s} \sum_{f_i + (12 \cdot \Delta_{RB} + 11) \cdot \Delta f}^{\max(f_{\min}, f_i + 12 \cdot \Delta_{RB} \cdot \Delta f)} |Y(t, f)|^2, \Delta_{RB} < 0 \\ \frac{1}{|T_s|} \sum_{t \in T_s} \sum_{f_h + (12 \cdot \Delta_{RB} - 11) \cdot \Delta f}^{\min(f_{\max}, f_h + 12 \cdot \Delta_{RB} \cdot \Delta f)} |Y(t, f)|^2, \Delta_{RB} > 0 \end{cases},$$

where

$T_s$  is a set of  $|T_s|$  SC-FDMA symbols with the considered modulation scheme being active within the measurement period,

$\Delta_{RB}$  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  $\Delta_{RB} = 1$  or  $\Delta_{RB} = -1$  for the first adjacent RB),

$f_{\min}$  (resp.  $f_{\max}$ ) is the lower (resp. upper) edge of the UL system BW,

$f_l$  and  $f_h$  are the lower and upper edge of the allocated BW, and

$Y(t, f)$  is the frequency domain signal evaluated for in-band emissions as defined in the subsection (ii)

The relative in-band emissions are, given by

$$Emissions_{relative}(\Delta_{RB}) = \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s| \cdot N_{RB}} \sum_{t \in T_s} \sum_{f_i}^{f_i + (12 \cdot N_{RB} - 1) \Delta f} |Y(t, f)|^2}$$

where

$N_{RB}$  is the number of allocated RBs

The basic in-band emissions measurement interval is defined over one slot in the time domain. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one SC-FDMA symbol, accordingly.

In the evaluation of in-band emissions, the timing is set according to  $\Delta \tilde{t} = \Delta \tilde{c}$ , where sample time offsets  $\Delta \tilde{t}$  and  $\Delta \tilde{c}$  are defined in subclause F.4.

## F.4 Modified signal under test

Implicit in the definition of EVM is an assumption that the receiver is able to compensate a number of transmitter impairments.

The PUSCH data or PRACH or Physical Sidelink Channel signal under test is modified and, in the case of PUSCH or Physical Sidelink Channel data signal, decoded according to:



$$Z'(t, f) = IDFT \left\{ \frac{FFT \left\{ z(v - \Delta\tilde{t}) \cdot e^{-j2\pi\Delta\tilde{f}v} \right\} e^{j2\pi f\Delta\tilde{t}}}{\tilde{a}(t, f) \cdot e^{j\tilde{\varphi}(t, f)}} \right\}$$

where

$z(v)$  is the time domain samples of the signal under test.

The PUCCH or PUSCH or Physical Sidelink Channel demodulation reference signal or PUCCH data signal under test is equalised and, in the case of PUCCH data signal decoded according to:

$$Z'(t, f) = \frac{FFT \left\{ z(v - \Delta\tilde{t}) \cdot e^{-j2\pi\Delta\tilde{f}v} \right\} e^{j2\pi f\Delta\tilde{t}}}{\tilde{a}(t, f) \cdot e^{j\tilde{\varphi}(t, f)}}$$

where

$z(v)$  is the time domain samples of the signal under test.

To minimize the error, the signal under test should be modified with respect to a set of parameters following the procedure explained below.

Notation:

$\Delta\tilde{t}$  is the sample timing difference between the FFT processing window in relation to nominal timing of the ideal signal.

$\Delta\tilde{f}$  is the RF frequency offset.

$\tilde{\varphi}(t, f)$  is the phase response of the TX chain.

$\tilde{a}(t, f)$  is the amplitude response of the TX chain.

In the following  $\Delta\tilde{c}$  represents the middle sample of the EVM window of length  $W$  (defined in the next subsections) or the last sample of the first window half if  $W$  is even.

The EVM analyser shall

- detect the start of each slot and estimate  $\Delta\tilde{t}$  and  $\Delta\tilde{f}$ ,
- determine  $\Delta\tilde{c}$  so that the EVM window of length  $W$  is centred
  - on the time interval determined by the measured cyclic prefix minus 16 samples of the considered OFDM symbol for symbol 0 for normal CP, i.e. the first 16 samples of the CP should not be taken into account for this step. In the determination of the number of excluded samples, a sampling rate of 30.72MHz was assumed. If a different sampling rate is used, the number of excluded samples is scaled linearly.
  - on the measured cyclic prefix of the considered OFDM symbol for symbol 1 to 6 for normal CP and for symbol 0 to 5 for extended CP.
  - on the measured preamble cyclic prefix for the PRACH

To determine the other parameters a sample timing offset equal to  $\Delta\tilde{c}$  is corrected from the signal under test. The EVM analyser shall then

- correct the RF frequency offset  $\Delta\tilde{f}$  for each time slot, and
- apply an FFT of appropriate size. The chosen FFT size shall ensure that in the case of an ideal signal under test, there is no measured inter-subcarrier interference.

The carrier leakage shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative carrier leakage power also has to satisfy the applicable requirement.

At this stage the allocated RBs shall be separated from the non-allocated RBs. In the case of PUCCH and PUSCH EVM, the signal on the non-allocated RB(s),  $Y(t, f)$ , is used to evaluate the in-band emissions.

Moreover, the following procedure applies only to the signal on the allocated RB(s).

- In the case of PUCCH and PUSCH and Physical Sidelink Channel, the UL EVM analyzer shall estimate the TX chain equalizer coefficients  $\tilde{a}(t, f)$  and  $\tilde{\varphi}(t, f)$  used by the ZF equalizer for all subcarriers by time averaging at each signal subcarrier of the amplitude and phase of the reference and data symbols. The time-averaging length is 1 slot. This process creates an average amplitude and phase for each signal subcarrier used by the ZF equalizer. The knowledge of data modulation symbols may be required in this step because the determination of symbols by demodulation is not reliable before signal equalization.
- In the case of PRACH, the UL EVM analyzer shall estimate the TX chain coefficients  $\tilde{a}(t)$  and  $\tilde{\varphi}(t)$  used for phase and amplitude correction and are selected so as to minimize the resulting EVM. The TX chain coefficients are not dependent on frequency, i.e.  $\tilde{a}(t, f) = \tilde{a}(t)$  and  $\tilde{\varphi}(t, f) = \tilde{\varphi}(t)$ . The TX chain coefficients are chosen independently for each preamble transmission and for each  $\Delta\tilde{t}$ .

At this stage estimates of  $\Delta\tilde{f}$ ,  $\tilde{a}(t, f)$ ,  $\tilde{\varphi}(t, f)$  and  $\Delta\tilde{c}$  are available.  $\Delta\tilde{t}$  is one of the extremities of the window  $W$ , i.e.  $\Delta\tilde{t}$  can be  $\Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$  or  $\Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$ , where  $\alpha = 0$  if  $W$  is odd and  $\alpha = 1$  if  $W$  is even. The EVM analyser shall then

- calculate  $\text{EVM}_l$  with  $\Delta\tilde{t}$  set to  $\Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$ ,
- calculate  $\text{EVM}_h$  with  $\Delta\tilde{t}$  set to  $\Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$ .

---

## F.5 Window length

### F.5.1 Timing offset

As a result of using a cyclic prefix, there is a range of  $\Delta\tilde{t}$ , which, at least in the case of perfect Tx signal quality, would give close to minimum error vector magnitude. As a first order approximation, that range should be equal to the length of the cyclic prefix. Any time domain windowing or FIR pulse shaping applied by the transmitter reduces the  $\Delta\tilde{t}$  range within which the error vector is close to its minimum.

### F.5.2 Window length

The window length  $W$  affects the measured EVM, and is expressed as a function of the configured cyclic prefix length. In the case where equalization is present, as with frequency domain EVM computation, the effect of FIR is reduced. This is because the equalization can correct most of the linear distortion introduced by the FIR. However, the time domain windowing effect can't be removed.

### F.5.3 Window length for normal CP

The table below specifies the EVM window length at channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz, for normal CP. The nominal window length for 3 MHz is rounded down one sample to allow the window to be centered on the symbol.

Table F.5.3-1 EVM window length for normal CP

| Channel Bandwidth MHz | Cyclic prefix length <sup>1</sup> $N_{cp}$ for symbol 0 | Cyclic prefix length <sup>1</sup> $N_{cp}$ for symbols 1 to 6 | Nominal FFT size | Cyclic prefix for symbols 1 to 6 in FFT samples | EVM window length $W$ in FFT samples | Ratio of $W$ to CP for symbols 1 to 6 <sup>2</sup> |
|-----------------------|---|---|------------------|---|--------------------------------------|--|
| 1.4                   | 160   | 144   | 128              | 9   | 5                                    | 55.6   |
| 3                     |   |   | 256              | 18  | 12                                   | 66.7   |
| 5                     |   |   | 512              | 36  | 32                                   | 88.9   |
| 10                    |   |   | 1024             | 72  | 66                                   | 91.7   |
| 15                    |   |   | 1536             | 108   | 102                                  | 94.4   |
| 20                    |   |   | 2048             | 144   | 136                                  | 94.4   |

Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed.  
Note 2: These percentages are informative and apply to symbols 1 through 6. Symbol 0 has a longer CP and therefore a lower percentage.

## F.5.4 Window length for Extended CP

The table below specifies the EVM window length at channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz, for extended CP. The nominal window lengths for 3 MHz and 15 MHz are rounded down one sample to allow the window to be centered on the symbol.

Table F.5.4-1 EVM window length for extended CP

| Channel Bandwidth MHz | Cyclic prefix length <sup>1</sup> $N_{cp}$ | Nominal FFT size | Cyclic prefix in FFT samples | EVM window length $W$ in FFT samples | Ratio of $W$ to CP <sup>2</sup> |
|-----------------------|--|------------------|------------------------------|--------------------------------------|---------------------------------|
| 1.4                   | 512  | 128              | 32                           | 28                                   | 87.5                            |
| 3                     |  | 256              | 64                           | 58                                   | 90.6                            |
| 5                     |  | 512              | 128                          | 124                                  | 96.9                            |
| 10                    |  | 1024             | 256                          | 250                                  | 97.4                            |
| 15                    |  | 1536             | 384                          | 374                                  | 97.4                            |
| 20                    |  | 2048             | 512                          | 504                                  | 98.4                            |

Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed.  
Note 2: These percentages are informative

## F.5.5 Window length for PRACH

The table below specifies the EVM window length for PRACH preamble formats 0-4.

Table F.5.5-1 EVM window length for PRACH

| Preamble format | Cyclic prefix length <sup>1</sup> $N_{cp}$ | Nominal FFT size <sup>2</sup> | EVM window length $W$ in FFT samples | Ratio of $W$ to CP* |
|-----------------|--|-------------------------------|--------------------------------------|---------------------|
| 0               | 3168                                       | 24576                         | 3072                                 | 96.7%               |
| 1               | 21024                                      | 24576                         | 20928                                | 99.5%               |
| 2               | 6240                                       | 49152                         | 6144                                 | 98.5%               |
| 3               | 21024                                      | 49152                         | 20928                                | 99.5%               |
| 4               | 448  | 4096                          | 432                                  | 96.4%               |

Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed  
Note 2: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied  
Note 3: These percentages are informative

## F.5.F Window length for category NB1

The EVM window length,  $W$ , for NPUSCH is set to 1 (in FFT samples where the nominal FFT size is 128 for 15 kHz sub-carrier spacing and 512 for 3.75 kHz sub-carrier spacing).

The EVM window length,  $W$ , for NPRACH is set to 110 for preamble format 0 and to 494 for preamble format 1 (both in FFT samples where the nominal FFT size is 512).

---

## F.6 Averaged EVM

The general EVM is averaged over basic EVM measurements for  $n$  slots in the time domain.

$$\overline{EVM} = \sqrt{\frac{1}{n} \sum_{i=1}^n EVM_i^2},$$

where  $n$  is

$n = 20$  for PUCCH, PUSCH, PSDCH, PSCCH, and PSSCH,

$n = 48$  for PBSCH.

The EVM requirements shall be tested against the maximum of the RMS average at the window  $W$  extremities of the EVM measurements:

Thus  $\overline{EVM}_l$  is calculated using  $\Delta\tilde{t} = \Delta\tilde{t}_l$  in the expressions above and  $\overline{EVM}_h$  is calculated using  $\Delta\tilde{t} = \Delta\tilde{t}_h$ .

Thus we get:

$$EVM = \max(\overline{EVM}_l, \overline{EVM}_h)$$

The calculation of the EVM for the demodulation reference signal,  $EVM_{DMRS}$ , follows the same procedure as calculating the general EVM, with the exception that the modulation symbol set  $T_m$  defined in clause F.2 is restricted to symbols containing uplink demodulation reference signals.

The basic  $EVM_{DMRS}$  measurements are first averaged over 20 slots in the time domain to obtain an intermediate average  $\overline{EVM}_{DMRS}$ .

$$\overline{EVM}_{DMRS} = \sqrt{\frac{1}{20} \sum_{i=1}^{20} EVM_{DMRS,i}^2}$$

In the determination of each  $EVM_{DMRS,i}$ , the timing is set to  $\Delta\tilde{t} = \Delta\tilde{t}_l$  if  $\overline{EVM}_l > \overline{EVM}_h$ , and it is set to  $\Delta\tilde{t} = \Delta\tilde{t}_h$  otherwise, where  $\overline{EVM}_l$  and  $\overline{EVM}_h$  are the general average EVM values calculated in the same 20 slots over which the intermediate average  $\overline{EVM}_{DMRS}$  is calculated. Note that in some cases, the general average EVM may be calculated only for the purpose of timing selection for the demodulation reference signal EVM.

Then the results are further averaged to get the EVM for the demodulation reference signal,  $EVM_{DMRS}$ ,

$$EVM_{DMRS} = \sqrt{\frac{1}{6} \sum_{j=1}^6 \overline{EVM}_{DMRS,j}^2}$$

The PRACH EVM,  $EVM_{PRACH}$ , is averaged over two preamble sequence measurements for preamble formats 0, 1, 2, 3, and it is averaged over 10 preamble sequence measurements for preamble format 4.

The EVM requirements shall be tested against the maximum of the RMS average at the window  $W$  extremities of the EVM measurements:

Thus  $\overline{EVM}_{\text{PRACH,l}}$  is calculated using  $\Delta\tilde{f} = \Delta\tilde{f}_l$  and  $\overline{EVM}_{\text{PRACH,h}}$  is calculated using  $\Delta\tilde{f} = \Delta\tilde{f}_h$ .

Thus we get:

$$EVM_{\text{PRACH}} = \max(\overline{EVM}_{\text{PRACH,l}}, \overline{EVM}_{\text{PRACH,h}})$$

## F.6.F Averaged EVM for category NB1

The general EVM for category NB1 is calculated using the procedure defined in Annex F.6 with the exception that the general EVM is averaged over basic EVM measurements for  $240/L_{\text{Ctone}}$  slots in the time domain, where  $L_{\text{Ctone}} = \{1, 3, 6, 12\}$  is the number of subcarriers for the transmission.

The calculation of the EVM for the demodulation reference symbols for category NB1 follows the procedure defined for DMRS in Annex F.6 with the exception that the basic  $EVM_{\text{DMRS}}$  measurements are first averaged over  $240/L_{\text{Ctone}}$  slots to obtain the intermediate average EVM.

The calculation of the NPRACH EVM for both formats follows the procedure defined for PRACH in Annex F.6 with the exception that  $EVM_{\text{PRACH}}$  is averaged over 64 preamble measurements.

---

## F.7 Spectrum Flatness

The data shall be taken from FFT coded data symbols and the demodulation reference symbols of the allocated resource block.

## Annex G (informative): Reference sensitivity level in lower SNR

This annex contains information on typical receiver sensitivity when HARQ transmission is enabled allowing operation in lower SNR regions (HARQ is disabled in conformance testing), thus representing the configuration normally used in live network operation under noise-limited conditions.

### G.1 General

The reference sensitivity power level  $P_{\text{SENS}}$  with HARQ retransmission enabled (operation in lower SNR) is the minimum mean power applied to both the UE antenna ports at which the residual BLER after HARQ shall meet the requirements for the specified reference measurement channel. The residual BLER after HARQ transmission is defined as follows:

$$BLER_{\text{residual}} = 1 - \frac{A}{B}$$

$A$ : Number of correctly decoded MAC PDUs

$B$ : Number of transmitted MAC PDUs (Retransmitted MAC PDUs are not counted)

### G.2 Typical receiver sensitivity performance (QPSK)

The residual BLER after HARQ shall be lower than 1% for the reference measurement channels as specified in Annexes G.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table G.2-1 and Table G.2-2

**Table G.2-1: Reference sensitivity QPSK  $P_{\text{SENS}}$**

| E-UTRA Band | Channel bandwidth |             |             |              |              |              | Duplex Mode |
|-------------|-------------------|-------------|-------------|--------------|--------------|--------------|-------------|
|             | 1.4 MHz (dBm)     | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |             |
| 1           |                   |             |             | [-102]       |              |              | FDD         |
| 2           |                   |             |             | TBD          |              |              | FDD         |
| 3           |                   |             |             | TBD          |              |              | FDD         |
| 4           |                   |             |             | TBD          |              |              | FDD         |
| 5           |                   |             |             | TBD          |              |              | FDD         |
| 6           |                   |             |             | TBD          |              |              | FDD         |
| 7           |                   |             |             | TBD          |              |              | FDD         |
| 8           |                   |             |             | TBD          |              |              | FDD         |
| 9           |                   |             |             | TBD          |              |              | FDD         |
| 10          |                   |             |             | TBD          |              |              | FDD         |
| 11          |                   |             |             | TBD          |              |              | FDD         |
| 12          |                   |             |             | TBD          |              |              | FDD         |
| 13          |                   |             |             | TBD          |              |              | FDD         |
| 14          |                   |             |             | TBD          |              |              | FDD         |
| ...         |                   |             |             |              |              |              |             |
| 17          |                   |             |             | TBD          |              |              | FDD         |
| 18          |                   |             |             | TBD          |              |              | FDD         |
| 19          |                   |             |             | TBD          |              |              | FDD         |
| 20          |                   |             |             | TBD          |              |              | FDD         |
| 21          |                   |             |             | TBD          |              |              | FDD         |
| 22          |                   |             |             | TBD          |              |              | FDD         |

|         |   |  |     |        |  |  |     |
|---------|---|--|-----|--------|--|--|-----|
| 23      |   |  |     | TBD    |  |  | FDD |
| 24      |   |  |     | TBD    |  |  | FDD |
| 26      |   |  |     | TBD    |  |  | FDD |
| 27      |   |  |     | TBD    |  |  | FDD |
| 28      |   |  |     | TBD    |  |  | FDD |
| 30      |   |  |     | TBD    |  |  | FDD |
| 31      |   |  | TBD |        |  |  | FDD |
| ...     |   |  |     |        |  |  |     |
| 33      |   |  |     | [-102] |  |  | TDD |
| 34      |   |  |     | [-102] |  |  | TDD |
| 35      |   |  |     | [-102] |  |  | TDD |
| 36      |   |  |     | [-102] |  |  | TDD |
| 37      |   |  |     | [-102] |  |  | TDD |
| 38      |   |  |     | [-102] |  |  | TDD |
| 39      |   |  |     | [-102] |  |  | TDD |
| 40      |   |  |     | [-102] |  |  | TDD |
| 42      |   |  |     | [-102] |  |  | TDD |
| 43      |   |  |     | [-102] |  |  | TDD |
| 44      |   |  |     | [-102] |  |  | TDD |
| 45      |   |  |     | [-102] |  |  | TDD |
| ...     |   |  |     |        |  |  |     |
| 65      |   |  |     | TBD    |  |  | FDD |
| 70      |   |  |     | TBD    |  |  | FDD |
| 71      |   |  |     | TBD    |  |  | FDD |
| 87      |   |  | TBD |        |  |  | FDD |
| 88      |   |  | TBD |        |  |  | FDD |
| Note 1: | The transmitter shall be set to $P_{UMAX}$ as defined in clause 6.2.5   |  |     |        |  |  |     |
| Note 2: | Reference measurement channel is G.3 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 |  |     |        |  |  |     |
| Note 3: | The signal power is specified per port  |  |     |        |  |  |     |
| Note 4: | For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.                                    |  |     |        |  |  |     |
| Note 5: | For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.                                  |  |     |        |  |  |     |

Table G.2-2 specifies the minimum number of allocated uplink resource blocks for which the reference receive sensitivity requirement in lower SNR must be met.

**Table G.2-2: Minimum uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / NRB / Duplex mode |         |       |       |                  |        |        |             |
|---|---------|-------|-------|------------------|--------|--------|-------------|
| E-UTRA Band   | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz           | 15 MHz | 20 MHz | Duplex Mode |
| 1   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 2   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 3   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 4   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 5   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 6   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 7   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 8   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 9   |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 10  |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 11  |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 12  |         |       |       | [6] <sup>1</sup> |        |        | FDD         |
| 13  |         |       |       | [6] <sup>1</sup> |        |        | FDD         |

|         |  |  |                  |                  |  |  |     |
|---------|--|--|------------------|------------------|--|--|-----|
| 14      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| ...     |  |  |                  |                  |  |  |     |
| 17      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 18      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 19      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 20      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 22      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 21      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 23      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 24      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 26      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 27      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 28      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 30      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 31      |  |  | [5] <sup>4</sup> |                  |  |  | FDD |
| ...     |  |  |                  |                  |  |  |     |
| 33      |  |  |                  | 50               |  |  | TDD |
| 34      |  |  |                  | 50               |  |  | TDD |
| 35      |  |  |                  | 50               |  |  | TDD |
| 36      |  |  |                  | 50               |  |  | TDD |
| 37      |  |  |                  | 50               |  |  | TDD |
| 38      |  |  |                  | 50               |  |  | TDD |
| 39      |  |  |                  | 50               |  |  | TDD |
| 40      |  |  |                  | 50               |  |  | TDD |
| 42      |  |  |                  | 50               |  |  | TDD |
| 43      |  |  |                  | 50               |  |  | TDD |
| 44      |  |  |                  | 50               |  |  | TDD |
| 45      |  |  |                  | 50               |  |  | TDD |
| ...     |  |  |                  |                  |  |  |     |
| 65      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| ...     |  |  |                  |                  |  |  |     |
| 70      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 71      |  |  |                  | [6] <sup>1</sup> |  |  | FDD |
| 87      |  |  | [5] <sup>4</sup> |                  |  |  | FDD |
| 88      |  |  | [5] <sup>4</sup> |                  |  |  | FDD |
| Note 1: | The UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).            |  |                  |                  |  |  |     |
| Note 2: | For the UE which supports both Band 11 and Band 21 the minimum uplink configuration for reference sensitivity is FFS.  |  |                  |                  |  |  |     |
| Note 3: | For Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RBstart_11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RBstart_16 |  |                  |                  |  |  |     |
| Note 4: | For Band 31, 87, 88; in the case of 5MHz channel bandwidth, the UL resource blocks shall be located at RBstart_10  |  |                  |                  |  |  |     |

Unless given by Table G.2-3, the minimum requirements specified in Tables G.2-1 and G.2-2 shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

**Table G.2-3: Network Signalling Value for reference sensitivity**

| Network Signalling value | E-UTRA Band              |
|--------------------------|--------------------------|
| NS_03                    | 2, 4, 10, 23, 35, 36, 70 |
| NS_06                    | 12,13,14,17              |
| NS_08                    | 19                       |



|       |    |
|-------|----|
| NS_09 | 21 |
| NS_21 | 30 |
| NS_35 | 71 |
| NS_56 | 24 |

## G.3 Reference measurement channel for REFSENSE in lower SNR

Tables G.3-1 and G.3-2 are applicable for Annex G.2 (Reference sensitivity level in lower SNR).

**Table G.3-1 Fixed Reference Channel for Receiver Requirements (FDD)**

| Parameter                                    | Unit   | Value      |            |
|--|--|------------|------------|
|  |  |            |            |
| Channel bandwidth                            | MHz  | 5          | 10         |
| Allocated resource blocks                    |  | 25         | 50         |
| Subcarriers per resource block               |  | 12         | 12         |
| Allocated subframes per Radio Frame          |  | 9          | 9          |
| Modulation                                   |  | QPSK       | QPSK       |
| Target Coding Rate                           |  | 1/3        | 1/3        |
| Number of HARQ Processes                     | Processes  | 8          | 8          |
| Maximum number of HARQ transmissions         |  | [4]        | [4]        |
| Information Bit Payload per Sub-Frame        |  |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 2216       | 4392       |
| For Sub-Frame 5                              | Bits   | N/A        | N/A        |
| For Sub-Frame 0                              | Bits   | 1800       | 4392       |
| Transport block CRC                          | Bits   | 24         | 24         |
| Number of Code Blocks per Sub-Frame (Note 4) |  |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 1          | 1          |
| For Sub-Frame 5                              | Bits   | N/A        | N/A        |
| For Sub-Frame 0                              | Bits   | 1          | 1          |
| Binary Channel Bits Per Sub-Frame            |  |            |            |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits   | 6300       | 13800      |
| For Sub-Frame 5                              | Bits   | N/A        | N/A        |
| For Sub-Frame 0                              | Bits   | 5460       | 12960      |
| Max. Throughput averaged over 1 frame        | kbps   | 1952.<br>8 | 3952.<br>8 |
| UE Category                                  |  | 1-8        | 1-8        |
| Note 1:                                      | 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz |            |            |
| Note 2:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]  |            |            |
| Note 3:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)                           |            |            |
| Note 4:                                      | Redundancy version coding sequence is {0, 1, 2, 3} for QPSK.   |            |            |

**Table G.3-2 Fixed Reference Channel for Receiver Requirements (TDD)**

| Parameter                                 | Unit      | Value |      |
|---|-----------|-------|------|
|   |           |       |      |
| Channel Bandwidth                         | MHz       |       | 10   |
| Allocated resource blocks                 |           |       | 50   |
| Uplink-Downlink Configuration (Note 5)    |           |       | 1    |
| Allocated subframes per Radio Frame (D+S) |           |       | 4+2  |
| Number of HARQ Processes                  | Processes |       | 7    |
| Maximum number of HARQ transmission       |           |       | [4]  |
| Modulation                                |           |       | QPSK |
| Target coding rate                        |           |       | 1/3  |
| Information Bit Payload per Sub-Frame     | Bits      |       |      |
| For Sub-Frame 4, 9                        |           |       | 4392 |
| For Sub-Frame 1, 6                        |           |       | 3240 |

|  |   |  |  |  |        |  |  |
|--|---|--|--|--|--------|--|--|
| For Sub-Frame 5                              |   |  |  |  | N/A    |  |  |
| For Sub-Frame 0                              |   |  |  |  | 4392   |  |  |
| Transport block CRC                          | Bits  |  |  |  | 24     |  |  |
| Number of Code Blocks per Sub-Frame (Note 5) |   |  |  |  |        |  |  |
| For Sub-Frame 4, 9                           |   |  |  |  | 1      |  |  |
| For Sub-Frame 1, 6                           |   |  |  |  | 1      |  |  |
| For Sub-Frame 5                              |   |  |  |  | N/A    |  |  |
| For Sub-Frame 0                              |   |  |  |  | 1      |  |  |
| Binary Channel Bits Per Sub-Frame            | Bits  |  |  |  |        |  |  |
| For Sub-Frame 4, 9                           |   |  |  |  | 13800  |  |  |
| For Sub-Frame 1, 6                           |   |  |  |  | 11256  |  |  |
| For Sub-Frame 5                              |   |  |  |  | N/A    |  |  |
| For Sub-Frame 0                              |   |  |  |  | 13104  |  |  |
| Max. Throughput averaged over 1 frame        | kbps  |  |  |  | 1965.6 |  |  |
| UE Category                                  |   |  |  |  | 1-5    |  |  |
| Note 1:                                      | For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs. |  |  |  |        |  |  |
| Note 2:                                      | For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance  |  |  |  |        |  |  |
| Note 3:                                      | Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]   |  |  |  |        |  |  |
| Note 4:                                      | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).   |  |  |  |        |  |  |
| Note 5:                                      | As per Table 4.2-2 in TS 36.211 [4]   |  |  |  |        |  |  |
| Note 6:                                      | Redundancy version coding sequence is {0, 1, 2, 3} for QPSK.  |  |  |  |        |  |  |

# Annex H (normative): Modified MPR behavior

## H.1 Indication of modified MPR behavior

This annex contains the definitions of the bits in the field *modifiedMPRbehavior* indicated in the IE UE Radio Access Capability [7] by a UE supporting an MPR or A-MPR modified in a later release of this specification.

**Table H.1-1: Definitions of the bits in the field *modifiedMPRbehavior***

| Index of field<br>(bit number) | Definition<br>(description of the supported functionality if indicator set to one)   | Notes  |
|--------------------------------|--|--|
| 0 (leftmost bit)               | - The MPR for intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation specified in Clause 6.2.3A in version 12.5.0 of this specification | - This bit shall be set to 1 by a UE supporting intra-band contiguous CA bandwidth class C           |
| 1                              | - The A-MPR associated with NS_05 for Band 1 in Clause 6.2.4 in version 12.10.0 of this specification.   | - This bit shall be set to 1 by a UE supporting A-MPR associated to NS_05 for Band 1.                |
| 2                              | The A-MPR associated with NS_04 for Band 41 in Table 6.2.4-4 in version 14.1.0 of this specification.  | - This bit shall be set to 1 by a power class 3 UE supporting A-MPR associated to NS_04 for Band 41. |
| 3                              | The A-MPR associated with NS_31 for Band 46 in Table 6.2.4-26 in version 15.3.0 of this specification.   | - This bit shall be set to 1 by a UE supporting A-MPR associated to NS_31 for Band 46.               |

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# Annex I (normative): Supported Post Antenna Gain

## I.1 Declared Supported Post Antenna Gain for UE

For V2X service at band 47, some regional requirements (region 1) are defined per effective isotropic radiated power (EIRP), which is a combination of the transmitted power (or in some cases spectral density) and the effective antenna gain.

Due to large form factor, V2X UE can have external antenna placed far away from the chipset unit. In this case, the effective antenna gain is a UE specific condition. This effective antenna gain includes the feeding loss of all components after the chipset unit antenna connector and the peak directional gain of the external antenna and hence will be call the post connector gain  $G_{\text{post connector}}$ .

The 3GPP specifications mandate UE manufacturer declarations of at least one supported value of the post connector gain  $G_{\text{post connector}}$  as a way to accommodate the refered regional requirement without putting requirements on the UE specific condtion.

The possible values of declared supported post connector gains are: 0, 1, 2, 3, 4, 5, 6, 7 dBi. If no value is declared, or if external antenna is not used, the default value of 0dBi will be used.

The regional requirements in  $P_{\text{EIRP}}$  in Subclauses 6.2.2G, 6.2.5G, 6.6.2.2.4, 6.6.3.2 and 7.9.1 will be converted to conducted requirements by subtracting  $G_{\text{post connector}}$  as.

$$P_{\text{Conducted}} = P_{\text{EIRP}} - G_{\text{post connector}}$$

# Annex J (informative): Change history

**Table J.1: Change History**

| Date    | Meeting | TDoc      | CR    | Rev | Ca<br>t | Subject/Comment   | New<br>version |
|---------|---------|-----------|-------|-----|---------|---|----------------|
| 11-2007 | R4#45   | R4-72206  |       |     |         | TS36.101V0.1.0 approved by RAN4   |                |
| 12-2007 | RP#38   | RP-070979 |       |     |         | Approved version at TSG RAN #38   | 8.0.0          |
| 03-2008 | RP#39   | RP-080123 | 3     |     |         | TS36.101 - Combined updates of E-UTRA UE requirements                             | 8.1.0          |
| 05-2008 | RP#40   | RP-080325 | 4     |     |         | TS36.101 - Combined updates of E-UTRA UE requirements                             | 8.2.0          |
| 09-2008 | RP#41   | RP-080638 | 5r1   |     |         | Addition of Ref Sens figures for 1.4MHz and 3MHz Channel bandwidths               | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 7r1   |     |         | Transmitter intermodulation requirements  | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 10    |     |         | CR for clarification of additional spurious emission requirement                  | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 15    |     |         | Correction of In-band Blocking Requirement  | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 18r1  |     |         | TS36.101: CR for section 6: NS_06   | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 19r1  |     |         | TS36.101: CR for section 6: Tx modulation   | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 20r1  |     |         | TS36.101: CR for UE minimum power   | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 21r1  |     |         | TS36.101: CR for UE OFF power   | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 24r1  |     |         | TS36.101: CR for section 7: Band 13 Rx sensitivity                                | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 26    |     |         | UE EVM Windowing  | 8.3.0          |
| 09-2008 | RP#41   | RP-080638 | 29    |     |         | Absolute ACLR limit   | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 23r2  |     |         | TS36.101: CR for section 6: UE to UE co-existence                                 | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 30    |     |         | Removal of [ ] for UE Ref Sens figures  | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 31    |     |         | Correction of PA, PB definition to align with RAN1 specification                  | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 37r2  |     |         | UE Spurious emission band UE co-existence   | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 44    |     |         | Definition of specified bandwidths  | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 48r3  |     |         | Addition of Band 17   | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 50    |     |         | Alignment of the UE ACS requirement   | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 52r1  |     |         | Frequency range for Band 12   | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 54r1  |     |         | Absolute power tolerance for LTE UE power control                                 | 8.3.0          |
| 09-2008 | RP#41   | RP-080731 | 55    |     |         | TS36.101 section 6: Tx modulation   | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 6r2   |     |         | DL FRC definition for UE Receiver tests   | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 46    |     |         | Additional UE demodulation test cases   | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 47    |     |         | Updated descriptions of FRC   | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 49    |     |         | Definition of UE transmission gap   | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 51    |     |         | Clarification on High Speed train model in 36.101                                 | 8.3.0          |
| 09-2008 | RP#41   | RP-080732 | 53    |     |         | Update of symbol and definitions  | 8.3.0          |
| 09-2008 | RP#41   | RP-080743 | 56    |     |         | Addition of MIMO (4x2) and (4x4) Correlation Matrices                             | 8.3.0          |
| 12-2008 | RP#42   | RP-080908 | 94r2  |     |         | CR TX RX channel frequency separation   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 105r1 |     |         | UE Maximum output power for Band 13   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 60    |     |         | UL EVM equalizer definition   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 63    |     |         | Correction of UE spurious emissions   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 66    |     |         | Clarification for UE additional spurious emissions                                | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 72    |     |         | Introducing ACLR requirement for coexistence with UTRA 1.6MHZ channel from 36.803 | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 75    |     |         | Removal of [ ] from Section 6 transmitter characteristics                         | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 81    |     |         | Clarification for PHS band protection   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 101   |     |         | Alignment for the measurement interval for transmit signal quality                | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 98r1  |     |         | Maximum power   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 57r1  |     |         | CR UE spectrum flatness   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 71r1  |     |         | UE in-band emission   | 8.4.0          |
| 12-2008 | RP#42   | RP-080909 | 58r1  |     |         | CR Number of TX exceptions  | 8.4.0          |
| 12-2008 | RP#42   | RP-080951 | 99r2  |     |         | CR UE output power dynamic  | 8.4.0          |
| 12-2008 | RP#42   | RP-080951 | 79r1  |     |         | LTE UE transmitter intermodulation  | 8.4.0          |
| 12-2008 | RP#42   | RP-080910 | 91    |     |         | Update of Clause 8  | 8.4.0          |
| 12-2008 | RP#42   | RP-080950 | 106r1 |     |         | Structure of Clause 9 including CSI requirements for PUCCH mode 1-0               | 8.4.0          |
| 12-2008 | RP#42   | RP-080911 | 59    |     |         | CR UE ACS test frequency offset   | 8.4.0          |
| 12-2008 | RP#42   | RP-080911 | 65    |     |         | Correction of spurious response parameters  | 8.4.0          |

|         |       |           |       |  |   |       |
|---------|-------|-----------|-------|--|---|-------|
| 12-2008 | RP#42 | RP-080911 | 80    |  | Removal of LTE UE narrowband intermodulation  | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 90r1  |  | Introduction of Maximum Sensitivity Degradation   | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 103   |  | Removal of [ ] from Section 7 Receiver characteristic   | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 62    |  | Alignment of TB size n Ref Meas channel for RX characteristics  | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 78    |  | TDD Reference Measurement channel for RX characteristics  | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 73r1  |  | Addition of 64QAM DL reference measurement channel  | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 74r1  |  | Addition of UL Reference Measurement Channels   | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 104   |  | Reference measurement channels for PDSCH performance requirements (TDD)   | 8.4.0 |
| 12-2008 | RP#42 | RP-080913 | 68    |  | MIMO Correlation Matrix Corrections   | 8.4.0 |
| 12-2008 | RP#42 | RP-080915 | 67    |  | Correction to the figure with the Transmission Bandwidth configuration  | 8.4.0 |
| 12-2008 | RP#42 | RP-080916 | 77    |  | Modification to EARFCN  | 8.4.0 |
| 12-2008 | RP#42 | RP-080917 | 85r1  |  | New Clause 5 outline  | 8.4.0 |
| 12-2008 | RP#42 | RP-080919 | 102   |  | Introduction of Bands 12 and 17 in 36.101   | 8.4.0 |
| 12-2008 | RP#42 | RP-080927 | 84r1  |  | Clarification of HST propagation conditions   | 8.4.0 |
| 03-2009 | RP#43 | RP-090170 | 156r2 |  | A-MPR table for NS_07   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 170   |  | Corrections of references (References to tables and figures)  | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 108   |  | Removal of [ ] from Transmitter Intermodulation   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 155   |  | E-UTRA ACLR for below 5 MHz bandwidths  | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 116   |  | Clarification of PHS band including the future plan   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 119   |  | Spectrum emission mask for 1.4 MHz and 3 MHz bandwidths   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 120   |  | Removal of "Out-of-synchronization handling of output power" heading  | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 126   |  | UE uplink power control   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 128   |  | Transmission BW Configuration   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 130   |  | Spectrum flatness   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 132r2 |  | PUCCH EVM   | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 134   |  | UL DM-RS EVM  | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 140   |  | Removal of ACLR2bis requirements  | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 113   |  | In-band blocking  | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 127   |  | In-band blocking and sensitivity requirement for band 17  | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 137r1 |  | Wide band intermodulation   | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 141   |  | Correction of reference sensitivity power level of Band 9   | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 109   |  | AWGN level for UE DL demodulation performance tests   | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 124   |  | Update of Clause 8: additional test cases   | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 139r1 |  | Performance requirement structure for TDD PDSCH   | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 142r1 |  | Performance requirements and reference measurement channels for TDD PDSCH demodulation with UE-specific reference symbols | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 145   |  | Number of information bits in DwPTS   | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 160r1 |  | MBSFN-Unicast demodulation test case  | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 163r1 |  | MBSFN-Unicast demodulation test case for TDD  | 8.5.0 |
| 03-2009 | RP#43 | RP-090173 | 162   |  | Clarification of EARFCN for 36.101  | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 110   |  | Correction to UL Reference Measurement Channel  | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 114   |  | Addition of MIMO (4x4, medium) Correlation Matrix   | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 121   |  | Correction of 36.101 DL RMC table notes   | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 125   |  | Update of Clause 9  | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 138r1 |  | Clarification on OCNG   | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 161   |  | CQI reference measurement channels  | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 164   |  | PUCCH 1-1 Static Test Case  | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 111   |  | Reference Measurement Channel for TDD   | 8.5.0 |
| 03-2009 | RP#44 |           |       |  | Editorial correction in Table 6.2.4-1   | 8.5.1 |

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|---------|-------|-----------|-------|--|---|-------|
| 05-2009 | RP#44 | RP-090540 | 167   |  | Boundary between E-UTRA fOoB and spurious emission domain for 1.4 MHz and 3 MHz bandwidths. (Technically Endorsed CR in R4-50bis - R4-091205) | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 168   |  | EARFCN correction for TDD DL bands. (Technically Endorsed CR in R4-50bis - R4-091206)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 169   |  | Editorial correction to in-band blocking table. (Technically Endorsed CR in R4-50bis - R4-091238)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 171   |  | CR PRACH EVM. (Technically Endorsed CR in R4-50bis - R4-091308)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 172   |  | CR EVM correction. (Technically Endorsed CR in R4-50bis - R4-091309)  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 177   |  | CR power control accuracy. (Technically Endorsed CR in R4-50bis - R4-091418)  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 179   |  | Correction of SRS requirements. (Technically Endorsed CR in R4-50bis - R4-091426)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 186   |  | Clarification for EVM. (Technically Endorsed CR in R4-50bis - R4-091512)  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 187   |  | Removal of [ ] from band 17 Refsens values and ACS offset frequencies   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 191   |  | Completion of band17 requirements   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 192   |  | Removal of 1.4 MHz and 3 MHz bandwidths from bands 13, 14 and 17.   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 223   |  | CR: 64 QAM EVM  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 201   |  | CR In-band emissions  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 203   |  | CR EVM exclusion period   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 204   |  | CR In-band emissions timing   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 206   |  | CR Minimum Rx exceptions  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 207   |  | CR UL DM-RS EVM   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 218r1 |  | A-MPR table for NS_07   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 205r1 |  | CR In-band emissions in shortened subframes   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 200r1 |  | CR PUCCH EVM  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 178r2 |  | No additional emission mask indication. (Technically Endorsed CR in R4-50bis - R4-091421)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 220r1 |  | Spectrum emission requirements for band 13  | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 197r2 |  | CR on aggregate power tolerance   | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 196r2 |  | CR: Rx IP2 performance  | 8.6.0 |
| 05-2009 | RP#44 | RP-090541 | 198r1 |  | Maximum output power relaxation   | 8.6.0 |
| 05-2009 | RP#44 | RP-090542 | 166   |  | Update of performance requirement for TDD PDSCH with MBSFN configuration. (Technically Endorsed CR in R4-50bis - R4-091180)                   | 8.6.0 |
| 05-2009 | RP#44 | RP-090542 | 175   |  | Adding AWGN levels for some TDD DL performance requirements. (Technically Endorsed CR in R4-50bis - R4-091406)                                | 8.6.0 |
| 05-2009 | RP#44 | RP-090542 | 182   |  | OCNG Patterns for Single Resource Block FRC Requirements. (Technically Endorsed CR in R4-50bis - R4-091504)                                   | 8.6.0 |
| 05-2009 | RP#44 | RP-090542 | 170r1 |  | Update of Clause 8: PHICH and PMI delay. (Technically Endorsed CR in R4-50bis - R4-091275)  | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 183   |  | Requirements for frequency-selective fading test. (Technically Endorsed CR in R4-50bis - R4-091505)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 199   |  | CQI requirements under AWGN conditions  | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 188r1 |  | Adaptation of UL-RMC-s for supporting more UE categories  | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 193r1 |  | Correction of the LTE UE downlink reference measurement channels  | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 184r1 |  | Requirements for frequency non-selective fading tests. (Technically Endorsed CR in R4-50bis - R4-091506)                                      | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 185r1 |  | Requirements for PMI reporting. (Technically Endorsed CR in R4-50bis - R4-091510)   | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 221r1 |  | Correction to DL RMC-s for Maximum input level for supporting more UE-Categories  | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 216   |  | Addition of 15 MHz and 20 MHz bandwidths into band 38   | 8.6.0 |
| 05-2009 | RP#44 | RP-090559 | 180   |  | Introduction of Extended LTE800 requirements. (Technically Endorsed CR in R4-50bis - R4-091432)   | 9.0.0 |
| 09-2009 | RP#45 | RP-090826 | 239   |  | A-MPR for Band 19   | 9.1.0 |
| 09-2009 | RP#45 | RP-090822 | 225   |  | LTE UTRA ACLR1 centre frequency definition for 1.4 and 3 MHz BW   | 9.1.0 |
| 09-2009 | RP#45 | RP-090822 | 227   |  | Harmonization of text for LTE Carrier leakage   | 9.1.0 |
| 09-2009 | RP#45 | RP-090822 | 229   |  | Sensitivity requirements for Band 38 15 MHz and 20 MHz bandwidths   | 9.1.0 |
| 09-2009 | RP#45 | RP-090822 | 236   |  | Operating band edge relaxation of maximum output power for Band 18 and 19   | 9.1.0 |
| 09-2009 | RP#45 | RP-090822 | 238   |  | Addition of 5MHz channel bandwidth for Band 40  | 9.1.0 |

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|---------|-------|-----------|-------|--|--|-------|
| 09-2009 | RP#45 | RP-090822 | 245   |  | Removal of unnecessary requirements for 1.4 and 3 MHz bandwidths on bands 13 and 17                            | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 261   |  | Correction of LTE UE ACS test parameter  | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 263R1 |  | Correction of LTE UE ACLR test parameter   | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 286   |  | Uplink power and RB allocation for receiver tests  | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 320   |  | CR Sensitivity relaxation for small BW   | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 324   |  | Correction of Band 3 spurious emission band UE co-existence  | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 249R1 |  | CR Pcm <sub>ax</sub> definition (working assumption)   | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 330   |  | Spectrum flatness clarification  | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 332   |  | Transmit power: removal of TC and modification of REFSENS note   | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 282R1 |  | Additional SRS relative power requirement and update of measurement definition                                 | 9.1.0 |
| 09-2009 | RP#45 | RP-090877 | 284R1 |  | Power range applicable for relative tolerance  | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 233   |  | TDD UL/DL configurations for CQI reporting   | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 235   |  | Further clarification on CQI test configurations   | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 243   |  | Corrections to UL- and DL-RMC-s  | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 247   |  | Reference measurement channel for multiple PMI requirements  | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 290   |  | CQI reporting test for a scenario with frequency-selective interference  | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 265R2 |  | CQI reference measurement channels   | 9.1.0 |
| 09-2009 | RP#45 | RP-090878 | 321R1 |  | CR RI Test   | 9.1.0 |
| 09-2009 | RP#45 | RP-090875 | 231   |  | Correction of parameters for demodulation performance requirement  | 9.1.0 |
| 09-2009 | RP#45 | RP-090875 | 241R1 |  | UE categories for performance tests and correction to RMC references   | 9.1.0 |
| 09-2009 | RP#45 | RP-090875 | 333   |  | Clarification of $\hat{E}_s$ definition in the demodulation requirement  | 9.1.0 |
| 09-2009 | RP#45 | RP-090875 | 326   |  | Editorial corrections and updates to PHICH PBCH test cases.  | 9.1.0 |
| 09-2009 | RP#45 | RP-090875 | 259R3 |  | Test case numbering in section 8 Performance tests   | 9.1.0 |
| 12-2009 | RP-46 | RP-091264 | 335   |  | Test case numbering in TDD PDSCH performance test (Technically endorsed at RAN 4 52bis in R4-093523)           | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 337   |  | Adding beamforming model for user-specific reference signal (Technically endorsed at RAN 4 52bis in R4-093525) | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 339R1 |  | Adding redundancy sequences to PMI test (Technically endorsed at RAN 4 52bis in R4-093581)                     | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 341   |  | Throughput value correction at FRC for Maximum input level (Technically endorsed at RAN 4 52bis in R4-093660)  | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 343   |  | Correction to the modulated E-UTRA interferer (Technically endorsed at RAN 4 52bis in R4-093662)               | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 345R1 |  | OCNG: Patterns and present use in tests (Technically endorsed at RAN 4 52bis in R4-093664)                     | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 347   |  | OCNG: Use in receiver and performance tests (Technically endorsed at RAN 4 52bis in R4-093666)                 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 349   |  | Miscellaneous corrections on CSI requirements (Technically endorsed at RAN 4 52bis in R4-093676)               | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 351   |  | Removal of RLC modes (Technically endorsed at RAN 4 52bis in R4-093677)  | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 353   |  | CR Rx diversity requirement (Technically endorsed at RAN 4 52bis in R4-093703)                                 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 355   |  | A-MPR notation in NS_07 (Technically endorsed at RAN 4 52bis in R4-093706)                                     | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 359   |  | Single- and multi-PMI requirements (Technically endorsed at RAN 4 52bis in R4-093846)                          | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 363   |  | CQI reference measurement channel (Technically endorsed at RAN 4 52bis in R4-093970)                           | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 364   |  | LTE MBSFN Channel Model (Technically endorsed at RAN 4 52bis in R4-094020)                                     | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 367   |  | Numbering of PDSCH (User-Specific Reference Symbols) Demodulation Tests  | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 369   |  | Numbering of PDCCH/PCFICH, PHICH, PBCH Demod Tests   | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 371   |  | Remove [ ] from Reference Measurement Channels in Annex A  | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 373R1 |  | Corrections to RMC-s for Maximum input level test for low UE categories  | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 377   |  | Correction of UE-category for R.30   | 9.2.0 |
| 12-2009 | RP-46 | RP-091286 | 378   |  | Introduction of Extended LTE1500 requirements for TS36.101   | 9.2.0 |



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|---------|-------|-----------|-------|--|---|-------|
| 12-2009 | RP-46 | RP-091262 | 384   |  | CR: Removal of 1.4 MHz and 3 MHz channel bandwidths from additional spurious emissions requirements for Band 1 PHS protection | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 386R3 |  | Clarification of measurement conditions of spurious emission requirements at the edge of spurious domain                      | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 390   |  | Spurious emission table correction for TDD bands 33 and 38.   | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 392R2 |  | 36.101 Symbols and abbreviations for P <sub>cm</sub>  | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 394   |  | UTRA ACLR1 requirement definition for 1.4 and 3 MHz BW completed  | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 396   |  | Introduction of the ACK/NACK feedback modes for TDD requirements  | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 404R3 |  | CR Power control exception R8   | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 416R1 |  | Relative power tolerance: special case for receiver tests   | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 420R1 |  | CSI reporting: test configuration for CQI fading requirements   | 9.2.0 |
| 12-2009 | RP-46 | RP-091284 | 421R1 |  | Inclusion of Band 20 UE RF parameters   | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 425   |  | Editorial corrections and updates to Clause 8.2.1 FDD demodulation test cases   | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 427   |  | CR: time mask   | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 430   |  | Correction of the payload size for PDCCH/PCFICH performance requirements  | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 432   |  | Transport format and test point updates to RI reporting test cases  | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 434   |  | Transport format and test setup updates to frequency-selective interference CQI tests   | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 436   |  | CR RI reporting configuration in PUCCH 1-1 test   | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 438   |  | Addition of R.11-1 TDD references   | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 439   |  | Performance requirements for LTE MBMS   | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 442R1 |  | In Band Emissions Requirements Correction CR  | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 444R1 |  | PCMAX definition  | 9.2.0 |
| 03-2010 | RP-47 | RP-100246 | 453r1 |  | Corrections of various errors in the UE RF requirements   | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 462r1 |  | UTRA ACLR measurement bandwidths for 1.4 and 3 MHz  | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 493   |  | Band 8 Coexistence Requirement Table Correction   | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 489r1 |  | Rel 9 CR for Band 14  | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 485r1 |  | CR Band 1- PHS coexistence  | 9.3.0 |
| 03-2010 | RP-47 | RP-100247 | 501   |  | Fading CQI requirements for FDD mode  | 9.3.0 |
| 03-2010 | RP-47 | RP-100247 | 499   |  | CR correction to RI test  | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 451   |  | Reporting mode, Reporting Interval and Editorial corrections for demodulation   | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 464r1 |  | Corrections to 1PRB PDSCH performance test in presence of MBSFN.  | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 458r1 |  | OCNG corrections  | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 467   |  | Addition of ONCG configuration in DRS performance test  | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 465r1 |  | PDSCH performance tests for low UE categories   | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 460r1 |  | Use of OCNG in CSI tests  | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 491r1 |  | Corrections to CQI test configurations  | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 469r1 |  | Corrections of some CSI test parameters   | 9.3.0 |
| 03-2010 | RP-47 | RP-100251 | 456r1 |  | TBS correction for RMC UL TDD 16QAM full allocation BW 1.4 MHz  | 9.3.0 |
| 03-2010 | RP-47 | RP-100262 | 449   |  | Editorial corrections on Band 19 REFSENS  | 9.3.0 |
| 03-2010 | RP-47 | RP-100263 | 470r1 |  | Band 20 UE RF requirements  | 9.3.0 |
| 03-2010 | RP-47 | RP-100264 | 446r1 |  | A-MPR for Band 21   | 9.3.0 |
| 03-2010 | RP-47 | RP-100264 | 448   |  | RF requirements for UE in later releases  | 9.3.0 |
| 03-2010 | RP-47 | RP-100268 | 445   |  | 36.101 CR: Editorial corrections on LTE MBMS reference measurement channels   | 9.3.0 |
| 03-2010 | RP-47 | RP-100268 | 454   |  | The definition of the Doppler shift for LTE MBSFN Channel Model   | 9.3.0 |
| 03-2010 | RP-47 | RP-100239 | 478r3 |  | Modification of the spectral flatness requirement and some editorial corrections  | 9.3.0 |
| 06-2010 | RP-48 | RP-100619 | 559   |  | Corrections of tables for Additional Spectrum Emission Mask   | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 538   |  | Correction of transient time definition for EVM requirements  | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 557r2 |  | CR on UE coexistence requirement  | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 547r1 |  | Correction of antenna configuration and beam-forming model for DRS  | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 536r1 |  | CR: Corrections on MIMO demodulation performance requirements   | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 528r1 |  | Corrections on the definition of PCMAX  | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 568   |  | Relaxation of the PDSCH demodulation requirements due to control channel errors   | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 566   |  | Correction of the UE output power definition for RX tests   | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 505r1 |  | Fading CQI requirements for TDD mode  | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 521   |  | Correction to FRC for CQI index 0   | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 516r1 |  | Correction to CQI test configuration  | 9.4.0 |

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| 06-2010 | RP-48 | RP-100620 | 532   |  | Correction of CQI and PMI delay configuration description for TDD                                  | 9.4.0  |
| 06-2010 | RP-48 | RP-100620 | 574   |  | Correction to FDD and TDD CSI test configurations  | 9.4.0  |
| 06-2010 | RP-48 | RP-100620 | 571   |  | Minimum requirements for Rank indicator reporting  | 9.4.0  |
| 06-2010 | RP-48 | RP-100628 | 563   |  | LTE MBMS performance requirements (FDD)  | 9.4.0  |
| 06-2010 | RP-48 | RP-100628 | 564   |  | LTE MBMS performance requirements (TDD)  | 9.4.0  |
| 06-2010 | RP-48 | RP-100629 | 553r2 |  | Performance requirements for dual-layer beamforming  | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 524r2 |  | CR: low Category CSI requirement   | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 519   |  | Correction of FRC reference and test case numbering  | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 526   |  | Correction of carrier frequency and EARFCN of Band 21 for TS36.101                                 | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 508r1 |  | Addition of PDSCH TDD DRS demodulation tests for Low UE categories                                 | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 539   |  | Specification of minimum performance requirements for low UE category                              | 9.4.0  |
| 06-2010 | RP-48 | RP-100630 | 569   |  | Addition of minimum performance requirements for low UE category TDD CRS single-antenna port tests | 9.4.0  |
| 06-2010 | RP-48 | RP-100631 | 549r3 |  | Introduction of sustained downlink data-rate performance requirements                              | 9.4.0  |
| 06-2010 | RP-48 | RP-100683 | 530r1 |  | Band 20 Rx requirements  | 9.4.0  |
| 09-2010 | RP-49 | RP-100920 | 614r2 |  | Add OCNG to MBMS requirements  | 9.5.0  |
| 09-2010 | RP-49 | RP-100916 | 599   |  | Correction of PDCCH content for PHICH test   | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 597r1 |  | Beamforming model for transmission on antenna port 7/8   | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 600r1 |  | Correction of full correlation in frequency-selective CQI test                                     | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 601   |  | Correction on single-antenna transmission fixed reference channel                                  | 9.5.0  |
| 09-2010 | RP-49 | RP-100914 | 605   |  | Reference sensitivity requirements for the 1.4 and 3 MHz bandwidths                                | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 608r1 |  | CR for DL sustained data rate test   | 9.5.0  |
| 09-2010 | RP-49 | RP-100919 | 611   |  | Correction of references in section 10 (MBMS performance requirements)                             | 9.5.0  |
| 09-2010 | RP-49 | RP-100914 | 613   |  | Band 13 and Band 14 spurious emission corrections  | 9.5.0  |
| 09-2010 | RP-49 | RP-100919 | 617r1 |  | Rx Requirements  | 9.5.0  |
| 09-2010 | RP-49 | RP-100926 | 576r1 |  | Clarification on DL-BF simulation assumptions  | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 582r1 |  | Introduction of additional Rel-9 scenarios   | 9.5.0  |
| 09-2010 | RP-49 | RP-100925 | 575r1 |  | Correction to band 20 ue to ue Co-existence table  | 9.5.0  |
| 09-2010 | RP-49 | RP-100916 | 581r1 |  | Test configuration corrections to CQI reporting in AWGN  | 9.5.0  |
| 09-2010 | RP-49 | RP-100916 | 595   |  | Corrections to RF OCNG Pattern OP.1 and 2  | 9.5.0  |
| 09-2010 | RP-49 | RP-100919 | 583   |  | Editorial corrections of 36.101  | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 586   |  | Addition of minimum performance requirements for low UE category TDD tests                         | 9.5.0  |
| 09-2010 | RP-49 | RP-100914 | 590r1 |  | Downlink power for receiver tests  | 9.5.0  |
| 09-2010 | RP-49 | RP-100920 | 591   |  | OCNG use and power in beamforming tests  | 9.5.0  |
| 09-2010 | RP-49 | RP-100916 | 593   |  | Throughput for multi-datastreams transmissions   | 9.5.0  |
| 09-2010 | RP-49 | RP-100914 | 588   |  | Missing note in Additional spurious emission test with NS_07                                       | 9.5.0  |
| 09-2010 | RP-49 | RP-100927 | 596r2 |  | CR LTE_TDD_2600_US spectrum band definition additions to TS 36.101                                 | 10.0.0 |
| 12-2010 | RP-50 | RP-101309 | 680   |  | Demodulation performance requirements for dual-layer beamforming                                   | 10.1.0 |
| 12-2010 | RP-50 | RP-101325 | 672   |  | Correction on the statement of TB size and subband selection in CSI tests                          | 10.1.0 |
| 12-2010 | RP-50 | RP-101327 | 652   |  | Correction to Band 12 frequency range  | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 630   |  | Removal of [ ] from TDD Rank Indicator requirements  | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 635r1 |  | Test configuration corrections to CQI TDD reporting in AWGN (Rel-10)                               | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 645   |  | EVM window length for PRACH  | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 649   |  | Removal of NS signalling from TDD REFSENS tests  | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 642r1 |  | Correction of Note 4 In Table 7.3.1-1: Reference sensitivity QPSK PREFSENS                         | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 627   |  | Add 20 RB UL Ref Meas channel  | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 654r1 |  | Additional in-band blocking requirement for Band 12  | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 678   |  | Further clarifications for the Sustained Downlink Data Rate Test                                   | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 673r1 |  | Correction on MBMS performance requirements  | 10.1.0 |
| 12-2010 | RP-50 | RP-101349 | 667r3 |  | CR Removing brackets of Band 41 reference sensitivity to TS 36.101                                 | 10.1.0 |
| 12-2010 | RP-50 | RP-101356 | 666r2 |  | Band 42 and 43 parameters for UMTS/LTE 3500 (TDD) for TS 36.101                                    | 10.1.0 |
| 12-2010 | RP-50 | RP-101359 | 646r1 |  | CR for CA, UL-MIMO, eDL-MIMO, CPE  | 10.1.0 |
| 12-2010 | RP-50 | RP-101361 | 620r1 |  | Introduction of L-band in TS 36.101  | 10.1.0 |
| 12-2010 | RP-50 | RP-101379 | 670r1 |  | Correction on the PMI reporting in Multi-Layer Spatial Multiplexing performance test               | 10.1.0 |
| 12-2010 | RP-50 | RP-101380 | 679r1 |  | Adding antenna configuration in CQI fading test case   | 10.1.0 |

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| 01-2011 |       |           |       |  | Clause numbering correction   | 10.1.1 |
| 03-2011 | RP-51 | RP-110359 | 695   |  | Removal of E-UTRA ACLR for CA   | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 699   |  | PDCCH and PHICH performance: OCNG and power settings  | 10.2.0 |
| 03-2011 | RP-51 | RP-110336 | 706r1 |  | Spurious emissions measurement uncertainty  | 10.2.0 |
| 03-2011 | RP-51 | RP-110352 | 707r1 |  | REFSENSE in lower SNR   | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 710   |  | PMI performance: Power settings and precoding granularity                                   | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 715r2 |  | Definition of configured transmitted power for Rel-10                                       | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 717   |  | Introduction of requirement for adjacent intraband CA image rejection                       | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 719   |  | Minimum requirements for the additional Rel-9 scenarios                                     | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 723   |  | Corrections to power settings for Single layer beamforming with simultaneous transmission   | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 726r1 |  | Correction to the PUSCH3-0 subband tests for Rel-10   | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 730   |  | Removing the square bracket for TS36.101  | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 739   |  | Removal of square brackets for dual-layer beamforming demodulation performance requirements | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 751   |  | CR: Maximum input level for intra band CA   | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 754r2 |  | UE category coverage for dual-layer beamforming   | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 756r1 |  | Further clarifications for the Sustained Downlink Data Rate Test                            | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 759   |  | Removal of square brackets in sustained data rate tests                                     | 10.2.0 |
| 03-2011 | RP-51 | RP-110337 | 762r1 |  | Clarification to LTE relative power tolerance table   | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 764   |  | Introducing UE-selected subband CQI tests   | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 765   |  | Verification framework for PUSCH 2-2 and PUCCH 2-1 reporting                                | 10.2.0 |
| 04-2011 |       |           |       |  | Editorial: Spec Title correction, removal of "Draft"  | 10.2.1 |
| 06-2011 | RP-52 | RP-110804 | 766   |  | Add Expanded 1900MHz Band (Band 25) in 36.101   | 10.3.0 |
| 06-2011 | RP-52 | RP-110795 | 768   |  | Fixing Band 24 inclusion in TS 36.101   | 10.3.0 |
| 06-2011 | RP-52 | RP-110788 | 772   |  | CR: Corrections for UE to UE co-existence requirements of Band 3                            | 10.3.0 |
| 06-2011 | RP-52 | RP-110812 | 774   |  | Add 2GHz S-Band (Band 23) in 36.101   | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 782   |  | CR: Band 19 A-MPR refinement  | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 787   |  | REFSENS in lower SNR  | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 805   |  | Clarification for MBMS reference signal levels  | 10.3.0 |
| 06-2011 | RP-52 | RP-110792 | 810   |  | FDD MBMS performance requirements for 64QAM mode  | 10.3.0 |
| 06-2011 | RP-52 | RP-110787 | 814   |  | Correction on CQI mapping index of RI test  | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 824   |  | Corrections to in-band blocking table   | 10.3.0 |
| 06-2011 | RP-52 | RP-110794 | 826   |  | Correction of TDD Category 1 DRS and DMRS RMCs  | 10.3.0 |
| 06-2011 | RP-52 | RP-110794 | 828   |  | TDD MBMS performance requirements for 64QAM mode  | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 829   |  | Correction of TDD RMC for Low SNR Demodulation test   | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 830   |  | Informative reference sensitivity requirements for Low SNR for TDD                          | 10.3.0 |
| 06-2011 | RP-52 | RP-110787 | 778r1 |  | Minor corrections to DL-RMC-s for Maximum input level                                       | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 832   |  | PDCCH and PHICH performance: OCNG and power settings  | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 818r1 |  | Correction on 2-X PMI test for R10  | 10.3.0 |
| 06-2011 | RP-52 | RP-110791 | 816r1 |  | Addition of performance requirements for dual-layer beamforming category 1 UE test          | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 834   |  | Performance requirements for PUCCH 2-0, PUCCH 2-1 and PUSCH 2-2 tests                       | 10.3.0 |
| 06-2011 | RP-52 | RP-110807 | 835r1 |  | CR for UL MIMO and CA   | 10.3.0 |
| 09-2011 | RP-53 | RP-111248 | 862r1 |  | Removal of unnecessary channel bandwidths from REFSENS tables                               | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 869r1 |  | Clarification on BS precoding information field for RI FDD and PUCCH 2-1 PMI tests          | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 872r1 |  | CR for B14Rx requirement Rrel 10  | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 890r1 |  | CR to TS36.101: Correction on the accuracy test of CQI.                                     | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 893   |  | CR to TS36.101: Correction on CQI mapping index of TDD RI test                              | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 904   |  | Correction of code block numbers for some RMCs  | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 907   |  | Correction to UL RMC for FDD and TDD  | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 914r1 |  | Adding codebook subset restriction for single layer closed-loop spatial multiplexing test   | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 883   |  | Sustained data rate: Correction of the ACK/NACK feedback mode                               | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 929   |  | 36.101 CR on MBSFN FDD requirements(R10)  | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 938   |  | TDD MBMS performance requirements for 64QAM mode  | 10.4.0 |
| 09-2011 | RP-53 | RP-111252 | 895   |  | Further clarification for the dual-layer beamforming demodulation requirements              | 10.4.0 |
| 09-2011 | RP-53 | RP-111255 | 908r1 |  | Introduction of Band 22   | 10.4.0 |
| 09-2011 | RP-53 | RP-111255 | 939   |  | Modifications of Band 42 and 43   | 10.4.0 |
| 09-2011 | RP-53 | RP-111260 | 944   |  | CR for TS 36.101 Annex B: Static channels for CQI tests                                     | 10.4.0 |
| 09-2011 | RP-53 | RP-111262 | 878r1 |  | Correction of CSI reference channel subframe description                                    | 10.4.0 |

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| 09-2011 | RP-53 | RP-111262 | 887    |  | Correction to UL MIMO  | 10.4.0 |
| 09-2011 | RP-53 | RP-111262 | 926r1  |  | Power control accuracy for intra-band carrier aggregation  | 10.4.0 |
| 09-2011 | RP-53 | RP-111262 | 927r1  |  | In-band emissions requirements for intra-band carrier aggregation  | 10.4.0 |
| 09-2011 | RP-53 | RP-111262 | 930r1  |  | Adding the operating band for UL-MIMO  | 10.4.0 |
| 09-2011 | RP-53 | RP-111265 | 848    |  | Corrections to intra-band contiguous CA RX requirements  | 10.4.0 |
| 09-2011 | RP-53 | RP-111265 | 863    |  | Intra-band contiguous CA MPR requirement refinement  | 10.4.0 |
| 09-2011 | RP-53 | RP-111265 | 866r1  |  | Intra-band contiguous CA EVM   | 10.4.0 |
| 09-2011 | RP-53 | RP-111266 | 935    |  | Introduction of the downlink CA demodulation requirements  | 10.4.0 |
| 09-2011 | RP-53 | RP-111266 | 936r1  |  | Introduction of CA UE demodulation requirements for TDD  | 10.4.0 |
| 12-2011 | RP-54 | RP-111684 | 947    |  | Corrections of UE categories of Rel-10 reference channels for RF requirements  | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 948    |  | Alternative way to define channel bandwidths per operating band for  | 10.5.0 |
| 12-2011 | RP-54 | RP-111686 | 949    |  | CR for TS36.101: Adding note to the function of MPR  | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 950    |  | Clarification on applying CSI reports during rank switching in RI FDD test - Rel-10  | 10.5.0 |
| 12-2011 | RP-54 | RP-111734 | 953r1  |  | Corrections for Band 42 and 43 introduction  | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 956    |  | UE spurious emissions  | 10.5.0 |
| 12-2011 | RP-54 | RP-111682 | 959    |  | Add scrambling identity n_SCID for MU-MIMO test  | 10.5.0 |
| 12-2011 | RP-54 | RP-111690 | 960r1  |  | P-MPR definition   | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 962    |  | Pcmax,c Computation Assumptions  | 10.5.0 |
| 12-2011 | RP-54 | RP-111733 | 963r1  |  | Correction of frequency range for spurious emission requirements   | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 966    |  | General review of the reference measurement channels   | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 945    |  | Corrections of Rel-10 demodulation performance requirements<br>This CR is only partially implemented due to confliction with CR 966  | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 946    |  | Corrections of UE categories for Rel-10 CSI requirements<br>This CR is only partially implemented due to confliction with CR 966     | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 982r2  |  | Introduction of SDR TDD test scenario for CA UE demodulation<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 971r1  |  | CR on Colliding CRS for non-MBSFN ABS  | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 972r1  |  | Introduction of eICIC demodulation performance requirements for FDD and TDD  | 10.5.0 |
| 12-2011 | RP-54 | RP-111686 | 985    |  | Adding missing UL configuration specification in some UE receiver requirements for case of 1 CC UL capable UE                        | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 998    |  | Correction and maintenance on CQI and PMI requirements (Rel-10)  | 10.5.0 |
| 12-2011 | RP-54 | RP-111735 | 1004   |  | MPR for CA Multi-cluster   | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 1005   |  | CA demodulation performance requirements for LTE FDD   | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1006   |  | CQI reporting accuracy test on frequency non-selective scheduling on eDL MIMO  | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1007   |  | CQI reporting accuracy test on frequency-selective scheduling on eDL MIMO  | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1008   |  | PMI reporting accuracy test for TDD on eDL MIMO  | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1009r1 |  | CR for TS 36.101: RI performance requirements  | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1010r1 |  | CR for TS 36.101: Introduction of static CQI tests (Rel-10)  | 10.5.0 |
| 03-2012 | RP-55 | RP-120291 | 1014   |  | RF: Updates and corrections to the RMC-s related annexes (Rel-10)  | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1015r1 |  | On eICIC ABS pattern   | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1016r1 |  | On eICIC interference models   | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1017r1 |  | TS36.101 CR: on eDL-MIMO channel model using cross-polarized antennas  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1020r1 |  | TS36.101 CR: Correction to MBMS Performance Test Parameters  | 10.6.0 |
| 03-2012 | RP-55 | RP-120303 | 1021   |  | Harmonic exceptions in LTE UE to UE co-ex tests  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1023   |  | Unified titles for Rel-10 CSI tests  | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1033r1 |  | Introduction of reference channel for eICIC demodulation   | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1040r1 |  | Correction of Actual code rate for CSI RMCs  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1041r1 |  | Definition of synchronized operation   | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1048r1 |  | Intra band contiguous CA Ue to Ue Co-ex  | 10.6.0 |

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| 03-2012 | RP-55 | RP-120296 | 1049r<br>1 |  | REL-10 CA specification editorial consistency   | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1053       |  | Beamforming model for TM9   | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1054       |  | Requirement for CA demodulation with power imbalance  | 10.6.0 |
| 03-2012 | RP-55 | RP-120298 | 1057       |  | Updating Band 23 duplex specifications  | 10.6.0 |
| 03-2012 | RP-55 | RP-120298 | 1058r<br>1 |  | Correcting UE Coexistence Requirements for Band 23  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1059r<br>1 |  | CA demodulation performance requirements for LTE TDD  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1061       |  | Requirement for CA SDR FDD test scenario  | 10.6.0 |
| 03-2012 | RP-55 | RP-120293 | 1064r<br>1 |  | TS36.101 RF editorial corrections Rel 10  | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1067r<br>1 |  | Introduction of TM9 demodulation performance requirements   | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1071r<br>1 |  | Introduction of a CA demodulation test for UE soft buffer management testing  | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1072       |  | MPR formula correction For intra-band contiguous CA Bandwidth Class C   | 10.6.0 |
| 03-2012 | RP-55 | RP-120303 | 1077r<br>1 |  | CR for 36.101: B41 REFSENS and MOP changes to accommodate single filter architecture  | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1082       |  | TM3 tests for eICIC   | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1083r<br>1 |  | Introduction of requirements of CQI reporting definition for eICIC  | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1084       |  | eDL MIMO CSI requirements   | 10.6.0 |
| 03-2012 | RP-55 | RP-120306 | 1070r<br>1 |  | Introduction of Band 26/XXVI to TS 36.101   | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1074       |  | Band 41 CA CR for TS36.101, section 5   | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1075r<br>1 |  | Band 41 CA CR for TS36.101, section 6   | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1076       |  | Band 41 CA CR for TS36.101, section 7   | 11.0.0 |
|         |       |           | 1085r<br>2 |  |   |        |
| 06-2012 | RP-56 | RP-120795 |            |  | Modulator specification tightening  | 11.1.0 |
| 06-2012 | RP-56 | RP-120777 | 1087r<br>1 |  | Carrier aggregation Relative power tolerance, removal of TBD.   | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1089       |  | UE spurious emissions for Band 7 and Band 38 coexistence  | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1092       |  | Deleting square brackets in Reference Measurement Channels  | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1097       |  | CR to TS36.101: Correction on parameters for the eDL-MIMO CQI and PMI tests   | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1098r<br>1 |  | CR to TS36.101: Fixed reference channel for PDSCH demodulation performance requirements on eDL-MIMO – NOT implemented as it is based on a wrong version of the spec | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1107       |  | RMC correction on eDL-MIMO RI test  | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1108r<br>1 |  | FRC correction on frequency selective CQI and PMI test (Rel-11)   | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1111       |  | Correction on test point for PMI test (Rel-11)  | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1114r<br>1 |  | Corrections and clarifications on eICIC demodulation test   | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1117r<br>1 |  | Corrections and clarifications on eICIC CSI tests   | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1119r<br>1 |  | Corrections on UE performance requirements  | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1120       |  | Introduction of CA band combination Band1 + Band19 to TS 36.101   | 11.1.0 |
| 06-2012 | RP-56 | RP-120769 | 1127       |  | Addition of ETU30 channel model   | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1140       |  | Addition of Maximum Throughput for R.30-1 TDD RMC   | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1141       |  | CR for 36.101: The clarification of MPR and A-MPR for CA  | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1142       |  | Corrections for eICIC demod test case with MBSN ABS   | 11.1.0 |
| 06-2012 | RP-56 | RP-120785 | 1144       |  | Removing brackets of contiguous allocation A-MPR for CA_NS_04   | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1149r<br>1 |  | Introduction of PDCCH test with colliding RS on MBSFN-ABS   | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1153r<br>1 |  | Some clarifications and OCNG pattern for eICIC demodulation requirements  | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1155       |  | Introduction of TDD CA Soft Buffer Limitation   | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1156       |  | B26 and other editorial corrections   | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1161       |  | Corrections on CQI and PMI test   | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1163       |  | FRC for TDD PMI test  | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1165r<br>1 |  | Clean-up of UL-MIMO for TS36.101  | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1171       |  | Removal of unnecessary references to single carrier requirements from Interband CA subclauses   | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1174       |  | PDCCH wrong detection in receiver spurious emissions test   | 11.1.0 |
| 06-2012 | RP-56 | RP-120776 | 1184       |  | Corrections to 3500 MHz   | 11.1.0 |

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| 06-2012 | RP-56 | RP-120793 | 1189r<br>2 |  | Introduction of Band 44   | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1193r<br>1 |  | Target SNR setting for eCIC demodulation requirement  | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1196       |  | Editorial simplification to CA REFSENS UL allocation table  | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1199       |  | Correction of wrong table refernces in CA receiver tests  | 11.1.0 |
| 06-2012 | RP-56 | RP-120791 | 1200r<br>1 |  | Introduction of e850_LB (Band 27) to TS 36.101  | 11.1.0 |
| 06-2012 | RP-56 | RP-120764 | 1212       |  | Correction of PHS protection requirements for TS 36.101   | 11.1.0 |
| 06-2012 | RP-56 | RP-120793 | 1213r<br>1 |  | Introduction of Band 28 into TS36.101   | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1215r<br>1 |  | Proposed revision of subclause 4.3A for TS36.101  | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1217r<br>1 |  | Proposed revision on subclause 6.3.4A for TS36.101  | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1219r<br>1 |  | Aligning requirements between Band 18 and Band 26 in TS36.101   | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1221       |  | SNR definition  | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1223       |  | Correction of CSI configuraion for CA TM4 tests R11   | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1225       |  | CR on CA UE receiver timing window R11  | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1226       |  | Extension of static eCIC CQI test   | 11.1.0 |
| 09-2012 | RP-57 | RP-121294 | 1230       |  | Correct Transport Block size in 9RB 16QAM Uplink Reference Measurement Channel                              | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1233r<br>1 |  | RF: Corrections to power allocation parameters for transmission mode 8 (Rel-11)                             | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1235       |  | RF-CA: non-CA notation and applicability of test points in scenarios without and with CA operation (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1237       |  | ACK/NACK feedback modes for FDD and TDD TM4 CA demodulation requirements (Rel-11)                           | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1239       |  | Correction of feedback mode for CA TDD demodulation requirements (resubmission of R4-63AH-0194 for Rel-11)  | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1241       |  | ABS pattern setup for MBSFN ABS test (resubmission of R4-63AH-0204 for Rel-11)                              | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1243       |  | CR on eCIC CQI definition test (resubmission of R4-63AH-0205 for Rel-11)                                    | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1245       |  | Transmission of CQI feedback and other corrections (Rel-11)   | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1247       |  | Target SNR setting for eCIC MBSFN-ABS demodulation requirements (Rel-11)                                    | 11.2.0 |
| 09-2012 | RP-57 | RP-121335 | 1248       |  | Introduction of CA_1_21 RF requirements into TS36.101   | 11.2.0 |
| 09-2012 | RP-57 | RP-121300 | 1251       |  | Corrections of spurious emission band UE co-existence applicable in Japan                                   | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1253       |  | Correction on RMC for frequency non-selective CQI test  | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1255       |  | Requirements for the eDL-MIMO CQI test  | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1257       |  | Clarification on PDSCH test setup under MBSFN ABS   | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1258       |  | Update of Band 28 requirements  | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1262       |  | Applicability of statement allowing RBW < Meas BW for spurious  | 11.2.0 |
| 09-2012 | RP-57 | RP-121298 | 1265       |  | Clarification of RB allocation for DRS demodulation tests   | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1267       |  | Removal of brackets for CA Tx   | 11.2.0 |
| 09-2012 | RP-57 | RP-121337 | 1268r<br>1 |  | TS 36.101 CR for CA_38  | 11.2.0 |
| 09-2012 | RP-57 | RP-121327 | 1269       |  | Introduction of CA_B7_B20 in 36.101   | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1271       |  | Corrections of FRC subframe allocations and other minor problems  | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1274       |  | Introduction of requirements for TDD CA Soft Buffer Limitation  | 11.2.0 |
| 09-2012 | RP-57 | RP-121307 | 1276       |  | Correction of eDL-MIMIO CSI RMC tables and references   | 11.2.0 |
| 09-2012 | RP-57 | RP-121307 | 1278       |  | Correction of MIMO channel model for polarized antennas   | 11.2.0 |
| 09-2012 | RP-57 | RP-121303 | 1280       |  | Addition of 15 and 20MHz Bandwidths for Band 23 to TS 36.101 (Rel-11)                                       | 11.2.0 |
| 09-2012 | RP-57 | RP-121334 | 1283r<br>1 |  | Add requirements for inter-band CA of B_1-18 and B_11-18 in TS36.101  | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1285r<br>1 |  | CR for MPR mask for multi-clustered simultaneous transmission in single CC in Rel-11                        | 11.2.0 |
| 09-2012 | RP-57 | RP-121447 | 1288r<br>2 |  | Introduction of Japanese Regulatory Requirements to LTE Band 8(R11)   | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1289       |  | CR for Band 27 MOP  | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1290       |  | CR for Band 27 A-MPR  | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1291       |  | CR to replace protected frequency range with new band number 27   | 11.2.0 |
| 09-2012 | RP-57 | RP-121215 | 1292r<br>1 |  | Introduction of CA band combination Band3 + Band5 to TS 36.101  | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1300r<br>1 |  | Requirements for eDL-MIMO RI test   | 11.2.0 |

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| 09-2012 | RP-57 | RP-121306 | 1304       |  | Corrections to TM9 demodulation tests   | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1306       |  | Correction to PCFICH power parameter setting  | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1310r<br>1 |  | Correction on frequency non-selective CQI test  | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1313r<br>1 |  | eDL-MIMO CQI/PMI test   | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1316       |  | Correction of the definition of unsynchronized operation                              | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1320r<br>1 |  | Correction to Transmit Modulation Quality Tests for Intra-Band CA                     | 11.2.0 |
| 09-2012 | RP-57 | RP-121338 | 1324r<br>2 |  | 36.101 CR for LTE_CA_B7   | 11.2.0 |
| 09-2012 | RP-57 | RP-121331 | 1325       |  | Introduction of CA_3_20 RF requirements into TS36.101                                 | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1326       |  | A-MPR table correction for NS_18  | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1332r<br>1 |  | Bandwidth combination sets for intra-band and inter-band carrier aggregation          | 11.2.0 |
| 09-2012 | RP-57 | RP-121325 | 1339       |  | Introduction of LTE Advanced Carrier Aggregation of Band 4 and Band 13                | 11.2.0 |
| 09-2012 | RP-57 | RP-121326 | 1340r<br>1 |  | Introduction of CA configurations CA-12A-4A and CA-17A-4A                             | 11.2.0 |
| 09-2012 | RP-57 | RP-121324 | 1341       |  | Introduction of CA_B3_B7 in 36.101  | 11.2.0 |
| 09-2012 | RP-57 | RP-121328 | 1343       |  | Introduction of Band 2 + Band 17 inter-band CA configuration into 36.101              | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1351       |  | FRC for TM9 FDD   | 11.2.0 |
| 09-2012 | RP-57 | RP-121295 | 1352       |  | Random precoding granularity in PMI tests   | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1358       |  | Introduction of RI test for eICIC   | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1360       |  | Notes for deltaTib and deltaRib tables  | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1361       |  | CR for A-MPR masks for NS_CA_1C   | 11.2.0 |
| 12-2012 | RP-58 | RP-121884 | 1362       |  | Introduction of CA_3_8 RF requirements to TS 36.101                                   | 11.3.0 |
| 12-2012 | RP-58 | RP-121870 | 1363       |  | Removal of square brackets for Band 27 in Table 5.6.1-1                               | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1366       |  | Some changes related to CA tests and overview table of DL measurement channels        | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1368       |  | Correction of eICIC CQI tests   | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1370       |  | Correction of eICIC demodulation tests  | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1374       |  | Correction on CSI-RS subframe offset parameter  | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1376       |  | Correction on FRC table in CSI test   | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1382       |  | Correction of reference channel table for TDD eDL-MIMO RI test                        | 11.3.0 |
| 12-2012 | RP-58 | RP-121850 | 1386       |  | OCNG patterns for Sustained Data rate testing   | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1388r<br>1 |  | Introduction of one periodic CQI test for CA deployments                              | 11.3.0 |
| 12-2012 | RP-58 | RP-121894 | 1396       |  | Introduction of CA_B5_B12 in 36.101   | 11.3.0 |
| 12-2012 | RP-58 | RP-121850 | 1401       |  | Introducing the additional frequency bands of 5 MHz x 2 in 1.7 GHz in Japan to Band 3 | 11.3.0 |
| 12-2012 | RP-58 | RP-121887 | 1406r<br>1 |  | Reference sensitivity for the small bandwidth of CA_4-12                              | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1407       |  | CR on eICIC RI test   | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1409       |  | Cleaning of 36.101 Performance sections Rel-11  | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1416       |  | Out-of-band blocking requirements for inter-band carrier aggregation                  | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1418       |  | Adding missed SNR reference values for CA soft buffer tests                           | 11.3.0 |
| 12-2012 | RP-58 | RP-121890 | 1422       |  | Introduction of CA_4A-5A into 36.101  | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1431       |  | Clean up of specification R11   | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1436       |  | Band 1 to Band 33 and Band 39 UE coexistence requirements                             | 11.3.0 |
| 12-2012 | RP-58 | RP-121871 | 1437r<br>1 |  | Editorial corrections for Band 26   | 11.3.0 |
| 12-2012 | RP-58 | RP-121896 | 1438       |  | Introduction of Band 5 + Band 17 inter-band CA configuration into 36.101              | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1442       |  | Correction of eDL-MIMO RI test and RMC table for the CSI test                         | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1444       |  | Minor correction to ceiling function example - rel11                                  | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1449       |  | Correction of SNR definition  | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1450       |  | Brackets clean up for eICIC CSI/demodulation  | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1455       |  | CR on eICIC RI testing (Rel-11)   | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1459       |  | Correction on FRC table   | 11.3.0 |
| 12-2012 | RP-58 | RP-121879 | 1461r<br>1 |  | CR for LTE_B14 HPUE (Power Class 1)   | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1464       |  | Adding references to the appropriate beamforming model (Rel-11)                       | 11.3.0 |
| 12-2012 | RP-58 | RP-121898 | 1465r<br>1 |  | Introduction of CA_8_20 RF requirements into TS36.101                                 | 11.3.0 |
| 12-2012 | RP-58 | RP-121882 | 1468r<br>1 |  | Introduction of inter-band CA_11-18 into TS36.101                                     | 11.3.0 |

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| 12-2012 | RP-58 | RP-121903 | 1472r<br>1 |  | Introduction of advanced receivers demodulation performance (FDD)   | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1473r<br>1 |  | Introduction of performance requirements for verifying the receiver type for advanced receivers (FDD/TDD) | 11.3.0 |
| 12-2012 | RP-58 | RP-121886 | 1474       |  | CR to remove the square bracket of A-MPR in TS36.101  | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1476       |  | Correction of some errors in reference sensitivity for CA in TS 36.101 (R11)                              | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1480r<br>1 |  | Introduction of Advanced Receivers Test Cases for TDD   | 11.3.0 |
| 12-2012 | RP-58 | RP-121901 | 1490r<br>1 |  | Introduction of Band 29   | 11.3.0 |
| 12-2012 | RP-58 | RP-121849 | 1494       |  | Low-channel Band 1 coexistence with PHS   | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1498r<br>1 |  | Completion of the tables of bandwidth combinations specified for CA                                       | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1499r<br>1 |  | Exceptions to REFSENS requirements for class A2 CA combinations   | 11.3.0 |
| 12-2012 | RP-58 | RP-121892 | 1500       |  | Introduction of carrier aggregation configuration CA_4-7  | 11.3.0 |
| 12-2012 | RP-58 | RP-121870 | 1504       |  | Editorial corrections to Band 27 specifications   | 11.3.0 |
| 12-2012 | RP-58 | RP-121878 | 1505       |  | Band 28 AMPR for DTV protection   | 11.3.0 |
| 12-2012 | RP-58 | RP-121852 | 1509r<br>1 |  | UE-UE coexistence between bands with small frequency separation   | 11.3.0 |
| 12-2012 | RP-58 | RP-121911 | 1510       |  | Adding UE-UE Coexistence Requirement for Band 3 and Band 26   | 11.3.0 |
| 12-2012 | RP-58 | RP-121866 | 1513       |  | Maintenance of Band 23 UE Coexistence   | 11.3.0 |
| 12-2012 | RP-58 | RP-121851 | 1515       |  | Corrections to TM4 rank indicator Test 3  | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1517       |  | Correction of test configuraitons and FRC for CA demodulation with power imbalance                        | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1518       |  | Applicable OFDM symbols of Noc_2 for PDCCH/PCFICH ABS-MBSFN test cases                                    | 11.3.0 |
| 03-2013 | RP-59 | RP-130279 | 1519       |  | OCNG patterns for Enhanced Performance Requirements Type A  | 11.4.0 |
| 03-2013 | RP-59 | RP-130277 | 1520       |  | Corrections on in-band blocking for Band 29 for carrier aggregation                                       | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1523       |  | Brackets removal in Rel-11 TM4 rank indicator Test 3  | 11.4.0 |
| 03-2013 | RP-59 | RP-130279 | 1524r<br>1 |  | Cleanup of Advanced Receivers requirement scenarios for demodulation and CSI (FDD/TDD)                    | 11.4.0 |
| 03-2013 | RP-59 | RP-130258 | 1528       |  | Corrections to CQI reporting  | 11.4.0 |
| 03-2013 | RP-59 | RP-130262 | 1536       |  | Corrections for eICIC performance requirements (rel-11)   | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1539       |  | Correction of CA power imbalance performance requirements   | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1543       |  | Correction of a symbol for MPR in single carrier for TS 36.101(R11)                                       | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1544r<br>1 |  | Correction of some inter-band CA requiements for TS 36.101 (R11)  | 11.4.0 |
| 03-2013 | RP-59 | RP-130276 | 1546       |  | Correction of contiguous allocation A-MPR for CA_NS_05  | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1547r<br>1 |  | Clarification of spurious emission domain for CA in TS 36.101 (R11)                                       | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1548       |  | CR for CA performance requirements  | 11.4.0 |
| 03-2013 | RP-59 | RP-130284 | 1553r<br>1 |  | Introduction of downlink non-contiguous CA into REL -11 TS 36.101   | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1557       |  | CA_1C: CA_NS_02 and CA_NS_03 A-MPR REL-11   | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1560       |  | Editorial corrections to subclause 5  | 11.4.0 |
| 03-2013 | RP-59 | RP-130267 | 1562       |  | Addition of UE Regional Requirements to Band 23 Based on New Regulatory Order in the US                   | 11.4.0 |
| 03-2013 | RP-59 | RP-130272 | 1567       |  | Band 26: modification of A-MPR for 'NS_15'  | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1571r<br>1 |  | Band 41 requirements for operation in China and Japan   | 11.4.0 |
| 03-2013 | RP-59 | RP-130260 | 1574       |  | Remove [ ] from CSI test case parameters  | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1575       |  | Corrections to UE co-existence  | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1579       |  | UE-UE co-existence between Band 1 and Band 33/39  | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1580       |  | Correction on reference to note for Band 7 and 38 co-existence  | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1584r<br>1 |  | Cleanup for CA UE RF requirements   | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1586       |  | Corrections on UL configuration for CA UE receiver requirements   | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1588       |  | Correction of Transmit modulation quality requirements for CA   | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1590       |  | Revision of Common Test Parameters for User-specific Demodulation Tests                                   | 11.4.0 |
| 03-2013 | RP-59 | RP-130278 | 1595       |  | Correction for a Band 27 A-MPR table  | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1597       |  | Correction of CA CQI test setup   | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1600r<br>1 |  | Correction of B12 DL Specification in Table 5.5A-2  | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1602       |  | Correction of table reference   | 11.4.0 |



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| 06-2013 | RP-60 | RP-130765 | 1604r<br>1 |  | Complementary description for definition of MIMO Correlation Matrices using cross polarized antennas    | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1607       |  | Correction of transport format parameters for CQI index 10 (15 RBs) - Rel 11                            | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1610       |  | Maintenance of Band 23 A-MPR (NS_11) in TS 36.101 (Rel-11)  | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1613       |  | CR for 36.101 : Adding the definition of CA_NS_05 and CA_NS_06 for additional spurious emissions for CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1619       |  | CR for introducing UE TM3 demodulation performance requirements under high speed                        | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1623       |  | Correction of test parameters for eICIC performance requirements  | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1625       |  | Correction of test parameters for eICIC CSI requirements  | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1627       |  | Correction of resource allocation for the multiple PMI Cat 1 UE test                                    | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1629       |  | Removal of note 2 from band 28  | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1641       |  | Correction of the CSI-RS parameter configuration  | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1650r<br>1 |  | Addition of Band 41 for intra-band non-contiguous CA for 36.101   | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1654r<br>1 |  | MPR for intra-band non-contiguous CA  | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1656       |  | Modification of configured output power to account for larger tolerance                                 | 11.5.0 |
| 06-2013 | RP-60 | RP-130769 | 1658r<br>1 |  | Missing symbols in the NS_15 table  | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1673       |  | Corrections to Rx requirements for inter-band CA configurations with REFSENS exceptions                 | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1681r<br>1 |  | Correction for TS 36.101  | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1684       |  | RF: Corrections to RMC-s for sustained data rate test   | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1685       |  | Non-contiguous intraband CA channel spacing   | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1689       |  | Carrier aggregation in multi RAT and multiple band combination terminals                                | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1691       |  | Completion of out-of-band blocking requirements for inter-band CA with one UL                           | 11.5.0 |
| 06-2013 | RP-60 | RP-130767 | 1695r<br>1 |  | CR on the bandwidth coverage issue of CA demodulation performance (Rel-11)                              | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1697       |  | Correction on UE maximum output power for intra-band CA (R11)   | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1698r<br>1 |  | CR for introduction of FelCIC demodulation performance requirements                                     | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1701       |  | Removing bracket from CA_11A-18A requirements   | 11.5.0 |
| 06-2013 | RP-60 | RP-130767 | 1703       |  | CR on the bandwidth coverage issue of CA CQI performance (Rel-11)                                       | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1705       |  | Corrections to ACLR for Rel-11 CA   | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1716       |  | Corrections to NS_11 A-MPR Table  | 11.5.0 |
| 06-2013 | RP-60 | RP-130769 | 1717       |  | Corrections to NS_12 A-MPR Table  | 11.5.0 |
| 06-2013 | RP-60 | RP-130771 | 1532r<br>1 |  | Introduction of CA 1+8 into TS36.101(Rel-12)  | 12.0.0 |
| 06-2013 | RP-60 | RP-130781 | 1545r<br>1 |  | Introduction of LTE Advanced inter-band Carrier Aggregation of Band 3 and Band 28 to TS 36.101          | 12.0.0 |
| 06-2013 | RP-60 | RP-130785 | 1608r<br>1 |  | Introduction of LTE Advanced inter-band Carrier Aggregation of Band 23 and Band 29 to TS 36.101         | 12.0.0 |
| 06-2013 | RP-60 | RP-130777 | 1642r<br>1 |  | Introduction of CA B3+19 into TS36.101(Rel-12)  | 12.0.0 |
| 06-2013 | RP-60 | RP-130787 | 1687       |  | Introduction of CA_4A-4A into 36.101  | 12.0.0 |
| 06-2013 | RP-60 | RP-130795 | 1712       |  | Adding 5MHz CBW for B3 of Inter band CA of B3+26  | 12.0.0 |
| 06-2013 | RP-60 | RP-130775 | 1713r<br>1 |  | Introduction of LTE Advanced Inter-Band Carrier Aggregation of Band 2 and Band 13                       | 12.0.0 |
| 06-2013 | RP-60 | RP-130790 | 1723r<br>1 |  | Introduction of the LTE 450 band to TS 36.101   | 12.0.0 |
| 06-2013 | RP-60 | RP-130791 | 1724r<br>1 |  | Introduction of the WCS band to TS 36.101   | 12.0.0 |
| 06-2013 | RP-60 | RP-130784 | 1707r<br>1 |  | Introduction of CA 19+21 into TS36.101(Rel-12)  | 12.0.0 |
| 09-2013 | RP-61 | RP-131300 | 1730r<br>1 |  | 36.101 CR for LTE_CA_C_B3   | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1732       |  | CR on performance requirements of CA soft buffer management (Rel-12)                                    | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1733r<br>1 |  | CR to introduce TM3 and TM4 test for 5MHz channel bandwidth   | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1736       |  | CR on applicability of CA sustained data rate tests (Rel-12)  | 12.1.0 |
| 09-2013 | RP-61 | RP-131293 | 1739       |  | Performance requirement for UE under EVA200   | 12.1.0 |
| 09-2013 | RP-61 | RP-131290 | 1743       |  | CR for introduction of FelCIC PBCH performance requirement  | 12.1.0 |

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| 09-2013 | RP-61 | RP-131290 | 1745   |  | CR for introduction of FelCIC RI reporting requirements   | 12.1.0 |
| 09-2013 | RP-61 | RP-131292 | 1747   |  | Beamforming model for EPDCCH test   | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1748   |  | CR to introduce CSI tests for LTE450  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1749   |  | CR to extend UE category of the existing 5MHz performance requirements  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1767   |  | UE REFSSENS when supporting intra-band CA and inter-band CA   | 12.1.0 |
| 09-2013 | RP-61 | RP-131279 | 1772   |  | Correlation matrix for high speed train demodulation scenarios (Rel-12)   | 12.1.0 |
| 09-2013 | RP-61 | RP-131280 | 1776   |  | Corrections to sustained data rate test (Rel-12)  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1781   |  | CR to introduce a new PHICH test based on 5MHz  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1782   |  | CR placeholder for applicability of new 5MHz tests  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1783r1 |  | CR : Proposal of applicability of new 5MHz tests  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1784   |  | CR: PHICH tests for 5MHz  | 12.1.0 |
| 09-2013 | RP-61 | RP-131290 | 1786   |  | CR for introduction of FelCIC CQI requirements  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1794   |  | Clarification of multi-cluster transmission   | 12.1.0 |
| 09-2013 | RP-61 | RP-131294 | 1800r1 |  | CA UE Coexistence Table update (Release 12)   | 12.1.0 |
| 09-2013 | RP-61 | RP-131302 | 1802   |  | Coexistence between Band 27 and Band 38 (Release 12)  | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1803   |  | Additional requirement for CA_1A-18A into TS36.101  | 12.1.0 |
| 09-2013 | RP-61 | RP-131296 | 1804   |  | Add requirements for CA_1A-26A into TS36.101  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1807   |  | Incorrect REFSSENS UL allocation for CA_1C  | 12.1.0 |
| 09-2013 | RP-61 | RP-131297 | 1808r1 |  | Introduction of CA_2A-4A into 36.101  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1811   |  | Contiguous intraband CA REFSSENS with one UL  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1822   |  | The P <sub>max</sub> clauses restructured: This CR was NOT implemented as it was based on the wrong version of the spec | 12.1.0 |
| 09-2013 | RP-61 | RP-131298 | 1824   |  | Introduction of inter-band CA Band 2+5  | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1831   |  | MPR for intra-band non-contiguous CA  | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1832   |  | Correction to Rel-10 A-MPR for CA_NS_04   | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1834   |  | CR for 36.101 : Add the definition of 5+20MHz for spectrum emission mask for CA   | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1839   |  | CR to introduce CSI tests for LTE450  | 12.1.0 |
| 09-2013 | RP-61 | RP-131293 | 1840   |  | Remained Transmitter requirements for intra-band non-contiguous CA  | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1841   |  | CR to introduce TM3 and TM4 test for 5MHz channel bandwidth   | 12.1.0 |
| 12-2013 | RP-62 | RP-131928 | 1847r1 |  | Corrections to the notes in the band UE co-existence requirements table (Rel-12)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 1852   |  | Clean-up of uplink reference measurement channels (Rel-12)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131946 | 1857   |  | Introduction of CA band combination Band2 + Band12 to TS 36.101   | 12.2.0 |
| 12-2013 | RP-62 | RP-131954 | 1858   |  | Introduction of CA band combination Band12 + Band25 to TS 36.101  | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1867   |  | CA_NS_05 Emissions  | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1869   |  | NS signaling for CA refsens   | 12.2.0 |
| 12-2013 | RP-62 | RP-131965 | 1870   |  | Introduction of CA_23A-23A RF requirements into 36.101  | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1877r2 |  | Intraband CA channel bandwidth combination table restructuring  | 12.2.0 |
| 12-2013 | RP-62 | RP-131940 | 1878   |  | Addition of CA_3C missing UE to UE co-existence requirement and corection to SEM  | 12.2.0 |
| 12-2013 | RP-62 | RP-131959 | 1885   |  | Introduction of LTE_CA_C B27 to 36.101  | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1887   |  | CR on correction of definition on Fraction of Maximum Throughput for CA   | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1889   |  | CR on correction of test configurations of CA soft buffer tests   | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1893   |  | CR for FelCIC demodulation performance requirements   | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1895r1 |  | CR on FelCIC PBCH performance requirement   | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1897r1 |  | CR on RI reporting requirement  | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1899   |  | Beamforming model for EPDCCH localized test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1901   |  | Downlink physical setup for EPDCCH test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131926 | 1904   |  | Correction on the UE category for eICIC CQI test  | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1906   |  | CR for receiver type verification test of CSI-RS based advanced receivers (Rel-12)                                      | 12.2.0 |
| 12-2013 | RP-62 | RP-131956 | 1910r1 |  | Spurious emission band UE co-existence requirements for cross-region issue  | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1916r2 |  | Allowed power reductions for multiple transmissions in a subframe   | 12.2.0 |

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| 12-2013 | RP-62 | RP-131967 | 1917r<br>1 |  | The coexistence requirements between Band 39 and Band 3   | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 1918r<br>1 |  | The P <sub>max</sub> clauses restructured and removal of addition of $\Delta T_c$ to P-MPR            | 12.2.0 |
| 12-2013 | RP-62 | RP-131956 | 1919       |  | Configured maximum output power for multiple TAG transmission   | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1927r<br>1 |  | Configured maximum output power for multiple TAG transmission   | 12.2.0 |
| 12-2013 | RP-62 | RP-131927 | 1934       |  | CR on correction of FRC of power imbalance test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131927 | 1937       |  | UE-UE coexistence for Band 40   | 12.2.0 |
| 12-2013 | RP-62 | RP-131957 | 1955r<br>1 |  | Introduction of LTE Advanced intra-band contiguous Carrier Aggregation in Band 23 to TS 36.101        | 12.2.0 |
| 12-2013 | RP-62 | RP-131961 | 1956r<br>1 |  | Introduction of CA_3A-3A into TS 36.101   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1957       |  | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)     | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1958       |  | CR Minimum requirement with Same Cell ID (with multiple NZP CSI-RS resources)                         | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1962       |  | Introduction of reference SNR-s for FeICIC demodulation performance requirements                      | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1964       |  | OCNG pattern for EPDCCH test  | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1965       |  | CA performance requirements for TDD intra-band NC CA  | 12.2.0 |
| 12-2013 | RP-62 | RP-131958 | 1966r<br>1 |  | CA performance requirements for TDD intra-band NC CA  | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1968       |  | Introduction of UE TM3 demodulation performance requirements under ETU300                             | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1970       |  | Introduction of test 1-A for CoMP   | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1972       |  | Modification of TM9 test to verify correct SNR estimation   | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1984       |  | Correction to blocking requirements and use of Delta_RIB  | 12.2.0 |
| 12-2013 | RP-62 | RP-131950 | 1985       |  | Introduction of CA band combination Band5 + Band25 to TS 36.101                                       | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1988r<br>1 |  | CR on test point clarification for CA demodulation test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1994       |  | CR to Introduce fading CQI test for CoMP (TDD)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1996       |  | CR to Introduce channel model for CoMP fading CQI tests   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1998       |  | CR to Introduce RI test for CoMP (FDD)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2001r<br>1 |  | Distributed EPDCCH Demodulation Test  | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2003r<br>1 |  | Localized EPDCCH Demodulation Test  | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2005r<br>1 |  | Localized EPDCCH Demodulation Test  | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2007       |  | Introduction of DL CoMP FDD static CQI test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2009       |  | Introduction of DL CoMP TDD static CQI test   | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 2014       |  | P-max for Band 38 to Band 7 coexistence   | 12.2.0 |
| 12-2013 | RP-62 | RP-131948 | 2015       |  | Introduction of CA band combination B5 + B7 to TS 36.101  | 12.2.0 |
| 12-2013 | RP-62 | RP-131952 | 2017       |  | Introduction of CA band combination B7 + B28 to TS 36.101   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2024       |  | Minimum requirement with Same Cell ID (with multiple NZP CSI-RS resources) TDD                        | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2026       |  | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource) TDD | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 2028       |  | Editorial change on FeICIC PBCH Noc setup   | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2032       |  | Introduction of test 1-A for CoMP   | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 2035r<br>1 |  | Correction of nominal guard bands for bandwidth classes A, B and C                                    | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2042       |  | CR to Introduce RI test for CoMP (TDD)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2043       |  | CR to Introduce fading CQI test for CoMP (FDD)  | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 2045       |  | Correction of TDD PCFICH/PDCCH test parameter table   | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 2047       |  | Add EVA200 to table of channel model parameters   | 12.2.0 |
| 12-2013 | RP-62 | RP-131963 | 2050r<br>1 |  | Introduction of CA_7A-7A into TS 36.101   | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 2057       |  | Band 41 deployment in Japan   | 12.2.0 |
| 12-2013 | RP-62 | RP-131926 | 2059       |  | CA_1C: Correction on CA_NS_02 A-MPR table   | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 2060       |  | Simplification of Band 12/17 in-band blocking test cases  | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 2064       |  | Correction of duplicated notes on table 7.3.1A-3  | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2066       |  | Introduction of EPDCCH TM10 localized test R-12   | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2068       |  | Introduction of SDR test for PDSCH with EPDCCH scheduling   | 12.2.0 |
| 03-2014 | RP-63 | RP-140377 | 2115       |  | Editorial Correction for TS36.101 Rel-12  | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2108       |  | UL-DL configuration and other parameters for FeICIC TDD CQI fading test (Rel-12)                      | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2097       |  | CR on TM9 localized ePDCCH test   | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2101       |  | CR on reference measurement channel for ePDCCH test   | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2110       |  | CR for TS36.101 COMP demodulation requirements  | 12.3.0 |

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| 03-2014 | RP-63 | RP-140371 | 2113       |  | CR for Combinations of channel model parameters  | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2114       |  | CR for EPDCCH power allocation (Rel-12)  | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2106       |  | Cleanup of the specification for FeICIC (Rel-12)   | 12.3.0 |
| 03-2014 | RP-63 | RP-140375 | 2089       |  | CR for introduction of 15MHz based single carrier and CA SDR tests in Rel-12                                 | 12.3.0 |
| 03-2014 | RP-63 | RP-140375 | 2080r<br>1 |  | CR on TM3 demodulation and soft buffer management test   | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2086       |  | CR on reference measurement channel for TM10 PDSCH demodulation test   | 12.3.0 |
| 03-2014 | RP-63 | RP-140241 | 2174       |  | Introduction of 3MHz in Band 8 for CA_8_20 RF requirements into TS36.101                                     | 12.3.0 |
| 03-2014 | RP-63 | RP-140417 | 2173r<br>1 |  | Addition of bandwidth combination set for CA_2A-29A and CA_4A-29A  | 12.3.0 |
| 03-2014 | RP-63 | RP-140387 | 2071r<br>1 |  | Introduction of TDD inter-band CA_B39_B41 into 36.101  | 12.3.0 |
| 03-2014 | RP-63 | RP-140378 | 2069       |  | CA_3C is adding 100RB+75RB uplink configuration for reference sensitivity                                    | 12.3.0 |
| 03-2014 | RP-63 | RP-140388 | 2070       |  | CR for TS36.101 on CA_C_B39  | 12.3.0 |
| 03-2014 | RP-63 | RP-140386 | 2072       |  | Introduction of CA band B3+B27 to TS36.101   | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2074       |  | CR of EPDCCH localized test with TM10 QCL Type-B configuration (Rel-12)                                      | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2142       |  | Clarification of contiguous and non-contiguous intra-band UE capabilities in the same band                   | 12.3.0 |
| 03-2014 | RP-63 | RP-140385 | 2161       |  | Introduction of additional bandwidth combination set for CA_2A-4A  | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2131r<br>1 |  | CR to finalize RI test for CoMP  | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2147       |  | Correction of coding rate for 18RBs in UL RMC table  | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2144       |  | Channel spacing for non-contiguous intra-band carrier aggregation  | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2163       |  | Distributed EPDCCH Demodulation Test   | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2137       |  | Configured transmitted power for CA  | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2122       |  | CR for 36.101. Editorial correction on OCNG pattern  | 12.3.0 |
| 03-2014 | RP-63 | RP-140370 | 2160       |  | Correction of table notes for NS_12-NS_15 spurious emissions requirements                                    | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2129r<br>1 |  | CR to finalize fading CQI test for CoMP  | 12.3.0 |
| 03-2014 | RP-63 | RP-140375 | 2119       |  | Introduction of requirements for SNR test for TM9  | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2125       |  | CR on correction of downlink SDR tests with EPDCCH scheduling  | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2127       |  | Correction on DL CoMP static CQI tests (Rel 12)  | 12.3.0 |
| 06-2014 | RP-64 | RP-140909 | 2177r<br>3 |  | RF: Corrections to spurious emission requirements with NS different than NS_01 (Rel-12)                      | 12.4.0 |
| 06-2014 | RP-64 | RP-140932 | 2187r<br>1 |  | Additional bandwidth combination set for LTE Advanced inter-band Carrier Aggregation of Band 3 and Band 20   | 12.4.0 |
| 06-2014 | RP-64 | RP-140934 | 2188       |  | Additional bandwidth combination set for LTE Advanced inter-band Carrier Aggregation of Band 7 and Band 20   | 12.4.0 |
| 06-2014 | RP-64 | RP-140943 | 2195r<br>1 |  | CR for TS 36.101 on introduction CA_41D  | 12.4.0 |
| 06-2014 | RP-64 | RP-140943 | 2196r<br>3 |  | CR to TS 36.101 on introduction of CA BW class D requirements  | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2198       |  | CR on correction on TDD IRC CQI test   | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2207       |  | CR of EPDCCH localized test with TM10 QCL Type-B configuration (Rel-12): correction of CSI-RS configurations | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2209       |  | Clean up of TM9 SNR tests  | 12.4.0 |
| 06-2014 | RP-64 | RP-140933 | 2210r<br>1 |  | Introduction of band B4+B27 CA to TS36.101   | 12.4.0 |
| 06-2014 | RP-64 | RP-140942 | 2213       |  | Introduction of CA band combination B1+B20 to TS 36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2216       |  | CR for EPDCCH test (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2218       |  | CR of modification on FeICIC rank testing (Rel-12)   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2220       |  | CR on FeICIC PBCH performance requirement (Rel-12)   | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2222       |  | Correction on out-of-band blocking for CA  | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2226       |  | Update demodulation performance requirements with new UE categories  | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2228       |  | Correction for CA sustained data rate test (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2229       |  | Correction on wrong annotation for close-loop spatial multiplexing performance                               | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2233       |  | Clarification of Intra-band contiguous CA class C Narrow band blocking requirements                          | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2239       |  | Correction for CA soft buffer test (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2241       |  | CR on OCNG and propagation conditions for dual layer TM9 test (Rel-12)                                       | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2247       |  | Remove [ ] from eICIC TDD RI requirement   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2256       |  | Verification of exceptions of REFSENS requirements for carrier aggregation                                   | 12.4.0 |

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| 06-2014 | RP-64 | RP-140914 | 2258       |  | Applicability of exceptions to reference sensitivity requirements for CA                                       | 12.4.0 |
| 06-2014 | RP-64 | RP-140909 | 2269       |  | In-band blocking case numbering re-establishment   | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2273       |  | CR for TS36.101 FRC tables for COMP demodulation requirements  | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2277       |  | Editorial correction of note in clause 4.4   | 12.4.0 |
| 06-2014 | RP-64 | RP-140926 | 2282r<br>1 |  | Editorial correction of note in clause 4.4   | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2283       |  | Introduction of new bandwidth combination set for CA_1A-5A UE  | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2286       |  | CR for finalizing DL COMP CSI reporting requirements   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2288       |  | CR for adding DL CoMP CSI RMC tables (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140921 | 2291       |  | Simplification of 36.101 Table 5.6A.1-1 for LTE_CA_C_B27   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2293       |  | Finalization of CoMP demodulation test cases   | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2294       |  | Editorial corrections for UE performance requirements for R12  | 12.4.0 |
| 06-2014 | RP-64 | RP-140937 | 2295       |  | Introduction of CA performance requirements for Band 27 CA   | 12.4.0 |
| 06-2014 | RP-64 | RP-140931 | 2296       |  | Introduction of CA 1+11 to 36.101 (Rel-12)   | 12.4.0 |
| 06-2014 | RP-64 | RP-140994 | 2309       |  | Inclusion of the out of band emission limit concluded in CEPT into band 28                                     | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2314       |  | UE to UE co-existence between B42/B43  | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2318       |  | Perf: Corrections to CA (Class C) performance with power imbalance (Rel-12)                                    | 12.4.0 |
| 06-2014 | RP-64 | RP-140920 | 2319       |  | Introduction of CA performance requirements for Band 23 CA   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2321       |  | CR of modification on FeICIC rank testing (Rel-12)   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2323       |  | CR of introducing FeICIC TM9 testing (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2325       |  | CR for EPDCCH SDR test (Rel-12)  | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2328       |  | Clean-up CR for demodulation requirements (Rel-12)   | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2330r<br>1 |  | Additional updates of UE categories for demodulation performance requirements (Rel-12)                         | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2333       |  | Throughput calculation for eICIC demodulation requirements   | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2335r<br>1 |  | Introduction of Band 28 requirements for flexible operation in Japan   | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2337r<br>1 |  | Add missing Uplink downlink configuration to eICIC TDD RI requirement  | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2338       |  | Add static propagation condition matrix for 1 x 2  | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2341       |  | Cleanup of terminology for Rx requirements   | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2344       |  | CR on separating CA UE demodulation tests from single carrier tests in Rel-12                                  | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2351       |  | Test configuration for intra-band contiguous carrier aggregation power control                                 | 12.4.0 |
| 06-2014 | RP-64 | RP-140935 | 2358       |  | Addition of bandwidth combination sets for CA_2A-29A, CA_3A-5A, CA_4A-5A, CA_4A-12A, and CA_4A-29A into 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2362       |  | Correction of test configurations for intra-band non-contiguous aggregation                                    | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2365       |  | Clarification on CA bandwidth classes  | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2374       |  | CR on correction of downlink SDR tests with EPDCCH scheduling  | 12.4.0 |
| 06-2014 | RP-64 | RP-140922 | 2377       |  | Correction on LTE_CA_C_B39   | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2378       |  | Corrections on CA CQI tests  | 12.4.0 |
| 06-2014 | RP-64 | RP-140930 | 2381r<br>1 |  | Introduction of LTE-Advanced CA of Band 8 and Band 40 to TS36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140927 | 2382r<br>1 |  | FRC for DL MIMO enhancement PMI requirements   | 12.4.0 |
| 06-2014 | RP-64 | RP-140603 | 2384r<br>2 |  | CR for TS 36.101 on introduction CA_40D  | 12.4.0 |
| 06-2014 | RP-64 | RP-140944 | 2385r<br>1 |  | CR to TS 36.101 on introduction of 3DL intra-band non-contiguous CA requirements                               | 12.4.0 |
| 06-2014 | RP-64 | RP-140938 | 2387       |  | Introduction of CA_2A-2A into TS 36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140927 | 2392       |  | Introduction of 4Tx beam steering model  | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2394       |  | CA_7C A-MPR Corrections  | 12.4.0 |
| 06-2014 | RP-64 | RP-140936 | 2395r<br>2 |  | Introduction of a new CA_7C bandwidth combination set into 36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2398       |  | CR for TS36.101 CSI RMC table  | 12.4.0 |
| 06-2014 | RP-64 | RP-140940 | 2413       |  | Introduction of LTE_CA_NC_B42 into 36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140942 | 2420       |  | Introduction of CA band combination B1+B20 to TS 36.101  | 12.4.0 |
| 06-2014 | RP-64 | RP-140919 | 2422       |  | CA_3C is deleting 75RB+75RB uplink configuration for reference sensitivity                                     | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2425       |  | CR on correction for TM10 CSI reporting requirements   | 12.4.0 |
| 09-2014 | RP-65 | RP-141197 | 2458r<br>1 |  | Introduction of CA_B1_B3_B19 into TS 36.101  | 12.5.0 |

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| 09-2014 | RP-65 | RP-141428 | 2568   |  | Updated REFSENS requirements for band combinations with Band 4 and Band 12                                      | 12.5.0 |
| 09-2014 | RP-65 | RP-141468 | 2508r1 |  | Introduction of 3 DL CA for Band 1+3+20   | 12.5.0 |
| 09-2014 | RP-65 | RP-141469 | 2571   |  | Correction to CA in Band 1+20   | 12.5.0 |
| 09-2014 | RP-65 | RP-141525 | 2504r1 |  | Perf: Cleanup and better description of DL-RMC-s with dynamic coding rate for CSI requirements (Rel-12)         | 12.5.0 |
| 09-2014 | RP-65 | RP-141525 | 2565   |  | Corrections to UE coex table  | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2434   |  | Correction on support of a bandwidth combination set  | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2452r1 |  | Remove the redundant table for FDD 4Tx multi-layer tests and correct the test case number (Rel-12)              | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2466   |  | Unequal DL CC RB allocations in Maximum input level   | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2469   |  | Intra-band contiguous CA ACS case 2 test clarification  | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2484   |  | Corrections on delta Tc for UE MOP for intra-band contiguous CA   | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2487   |  | Removal of Class B in UE TX requirement   | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2516r1 |  | CR for CA applicability rule in 36.101 in Rel-12  | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2519r1 |  | Editorial CR for CA performance tests in 36.101 in Rel-12   | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2548   |  | Correction to NS_20 A-MPR for Band 23   | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2447   |  | CR of introducing FeICIC TM9 testing (Rel-12)   | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2454   |  | Maintenance of CoMP demodulation performance requirements (Rel-12)  | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2456   |  | Clean-up CR for EPDCCH and FeICIC PBCH (Rel-12)   | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2471   |  | Throughput calculation for feICIC demodulation requirements   | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2439   |  | CR on correction on CQI reporting TDD CSI meas in case two CSI subframe sets with CRS test (Rel-12)             | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2441   |  | CR on correction on RI reporting CSI meas in case two CSI subframe sets with CRS tests (Rel-12)                 | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2444   |  | Clarification of high speed train scenario in 36.101 (Rel-12)   | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2478   |  | CQI reporting under fading: CQI indices in set  | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2490   |  | Correction on A-MPR table   | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2499   |  | RF: Corrections to spurious emission band co-existence requirement for Band 44                                  | 12.5.0 |
| 09-2014 | RP-65 | RP-141535 | 2559   |  | Addition of E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA for Band 4 and 27 | 12.5.0 |
| 09-2014 | RP-65 | RP-141537 | 2541   |  | Band 42 contiguous CA channel bandwidth correction  | 12.5.0 |
| 09-2014 | RP-65 | RP-141546 | 2463r1 |  | Introduction of PMI reporting requirements for DL MIMO enhancement  | 12.5.0 |
| 09-2014 | RP-65 | RP-141548 | 2457r2 |  | Introduction of CA_B1_B3 into TS 36.101   | 12.5.0 |
| 09-2014 | RP-65 | RP-141549 | 2556   |  | Addition of bandwidth combination set for CA_2A-4A  | 12.5.0 |
| 09-2014 | RP-65 | RP-141550 | 2566   |  | Addition of 3MHz bandwidth for Band 12, in the B2+B12 CA combination  | 12.5.0 |
| 09-2014 | RP-65 | RP-141551 | 2445   |  | Introduction of CA 8+11 to 36.101 (Rel-12)  | 12.5.0 |
| 09-2014 | RP-65 | RP-141553 | 2491r1 |  | Introduction of a new bandwidth combination set for CA_25A-25A into 36.101                                      | 12.5.0 |
| 09-2014 | RP-65 | RP-141554 | 2533r1 |  | Introduction of requirements for 3DL inter-band carrier aggregation (FDD)                                       | 12.5.0 |
| 09-2014 | RP-65 | RP-141554 | 2534   |  | Introduction of requirements for 3DL combinations with Band 30 (FDD)  | 12.5.0 |
| 09-2014 | RP-65 | RP-141557 | 2461r1 |  | Introduction of CA_B19_B42_B42 into TS 36.101   | 12.5.0 |
| 09-2014 | RP-65 | RP-141559 | 2460r1 |  | Introduction of CA_B1_B42_B42 into TS 36.101  | 12.5.0 |
| 09-2014 | RP-65 | RP-141560 | 2427   |  | Adding 15MHz channel BW to B40 3DL and new bandwidth combination set for the 2DL                                | 12.5.0 |
| 09-2014 | RP-65 | RP-141561 | 2488r1 |  | Corrections on Maximum input level for intra-band non-contiguous 3DL  | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2436   |  | Corrections on Maximum input level and ACS for intra-band CA  | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2481r1 |  | Introduction of CA band combination B41+ B42 to TS 36.101   | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2522   |  | CR on CA power imbalance tests in Rel-12  | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2560   |  | CR Reducing MPR for Contiguous CA with Non-Contiguous Resource Allocations                                      | 12.5.0 |
| 09-2014 | RP-65 | RP-141563 | 2555r1 |  | UL configuration for CA_4A-12A reference sensitivity  | 12.5.0 |
| 09-2014 | RP-65 | RP-141563 | 2557   |  | Addition of bandwidth combination set for CA_4A-12A   | 12.5.0 |
| 09-2014 | RP-65 | RP-141612 | 2494r2 |  | Introduction of inter-band CA_18-28 into TS36.101   | 12.5.0 |

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| 09-2014 | RP-65 | RP-141635 | 2552r<br>2 |  |  | Introduction of CA_1A-7A into 36.101(Rel-12)  | 12.5.0 |
| 09-2014 | RP-65 | RP-141636 | 2480r<br>2 |  |  | Introduction of 3DLs CA band combination of Band1 +5 + 7 to TS 36.101 Rel-12                                      | 12.5.0 |
| 09-2014 | RP-65 | RP-141653 | 2435r<br>3 |  |  | Introduction of 3 Band Carrier Aggregation (3DL/1UL) of Band 1, Band 3 and Band 8 to TS 36.101                    | 12.5.0 |
| 09-2014 | RP-65 | RP-141682 | 2570r<br>1 |  |  | Introduction of CA band combination B1+B7+B20 to TS 36.101  | 12.5.0 |
| 09-2014 | RP-65 | RP-141708 | 2492r<br>3 |  |  | Introduction of 3 Band Carrier Aggregation of Band 1,Band 3 and Band 5 to TS 36.101                               | 12.5.0 |
| 12-2014 | RP-66 | RP-142147 | 2671       |  |  | Correction of CoMP TDD CSI tests (Rel-12)   | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2574       |  |  | CR for REFSENSE in lower SNR and change history   | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2581       |  |  | CR on 4Tx codebook PMI testing  | 12.6.0 |
| 12-2014 | RP-66 | RP-142142 | 2587       |  |  | CR for 1 PRB allocation performance in presence of MBSFN (rel-12)   | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2590       |  |  | Maintenance of CA demodulation performance requirements (Rel-12)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2592       |  |  | Clean up for FeICIC demodulation performance requirements (Rel-12)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142166 | 2600       |  |  | Correction of placement of CA_40D in Table  | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2601       |  |  | CQI test for TDD CL_C 20MHz+15MHz in Rel-12   | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2602       |  |  | Sustained downlink data rate test for TDD CL_C 20MHz+15MHz in Rel-12  | 12.6.0 |
| 12-2014 | RP-66 | RP-142165 | 2611       |  |  | Removal of square brackets for CA_B1_B3 and CA_B1_B3_B19  | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2620       |  |  | CQI reporting in AWGN: CQI indices in set   | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2629       |  |  | CR to fix error of CA capability for CA performance tests in 36.101 in Rel-12                                     | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2637       |  |  | Definition of the bits in the bitmap for indication of modified MPR behavior                                      | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2641       |  |  | Applicability of in-gap and out-of-gap measurements for intra-band NC CA  | 12.6.0 |
| 12-2014 | RP-66 | RP-142183 | 2642       |  |  | Introduction of additional bandwidth combination set for CA_2A-5A   | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2643       |  |  | Corrections for 3DL inter-band CA band combinations   | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2661       |  |  | Maintenance of TM10 demodulation test configurations on PQI set and ZP-CSIRS ( Rel-12 test 8.3.1.3.2, 8.3.2.4.2 ) | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2582r<br>1 |  |  | Introduction of PUSCH 3-2 requirements into TS36.101  | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2603r<br>1 |  |  | Normal demodulation test for TDD CL_C 20MHz+15MHz in Rel-12   | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2576r<br>1 |  |  | Corrections on Out-of-band blocking requirements for CA Class B and D   | 12.6.0 |
| 12-2014 | RP-66 | RP-142149 | 2678       |  |  | CR to specify applicability of CoMP RI test (Rel-12)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2688       |  |  | Removal of bracket for UL MIMO  | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2689       |  |  | Corection of B29 REFSENS for CA_2A-29A-30A and CA_4A-29A-30A  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2700       |  |  | Delete the incorrect notes for FDD DMRS demodulation tests (Rel-12)   | 12.6.0 |
| 12-2014 | RP-66 | RP-142160 | 2594r<br>3 |  |  | Correcting requirements for inter-band CA_18-28 in TS36.101   | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2705       |  |  | CR of modification on PMI reporting requirements for DL MIMO enhancement  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2720       |  |  | Band 22 correction in UE to UE co-existence table.  | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2722       |  |  | Correction to non-contiguous downlink intraband CA receiver requirements  | 12.6.0 |
| 12-2014 | RP-66 | RP-142159 | 2752       |  |  | Removal of dRib from CA_1A-7A   | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2723       |  |  | Correction to table format of allowed channel bandwidths of non-contiguous intraband CA                           | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2643r<br>1 |  |  | Corrections for 3DL inter-band CA band combinations   | 12.6.0 |
| 12-2014 | RP-66 | RP-142146 | 2731       |  |  | Modifications for NS_12 and NS_13   | 12.6.0 |
| 12-2014 | RP-66 | RP-142189 | 2739       |  |  | Introduction of CA_5-13 into 36.101   | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2706r<br>1 |  |  | CR of reference measurement channel for PUSCH3-2 test   | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2727r<br>1 |  |  | CR for CA applicability rule in 36.101 in Rel-12  | 12.6.0 |
| 12-2014 | RP-66 | RP-142188 | 2676r<br>1 |  |  | CR to remove CA capability column in CA performance test tables (Rel-12)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | r3         |  |  | Introduction of PUSCH 3-2 requirements into TS36.101  | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2690r<br>1 |  |  | CR on sustained data rate test for 3DL CA   | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2681r<br>2 |  |  | CR on normal demodulation test for 3DL CA   | 12.6.0 |

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| 12-2014 | RP-66 | RP-142147 | 2747r<br>1 |  |  | TS36.101 removal of brackets (RF)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2755       |  |  | Correction to Transmit Modulation Quality for CA   | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2710r<br>1 |  |  | Clarification on UL and DL CA  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2717r<br>1 |  |  | Clarification of notes relating to interferer offsets in intraband CA receiver requirement tables. | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2735r<br>1 |  |  | Band 28 and NS_24  | 12.6.0 |
| 12-2014 | RP-66 | RP-142179 | 2684r<br>1 |  |  | CR for UE requirements for 256QAM  | 12.6.0 |
| 12-2014 | RP-66 | RP-142180 | 2729r<br>1 |  |  | Introduction of Dual Connectivity to TS 36.101 Rel-12, RF part                                     | 12.6.0 |
| 12-2014 | RP-66 | RP-142184 | 2680r<br>1 |  |  | Introduction of dual uplink inter-band CA in TS 36.101 rel-12                                      | 12.6.0 |
| 12-2014 | RP-66 | RP-142182 | 2701r<br>1 |  |  | Introduction of inter-band CA_1-28 into TS36.101   | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2758       |  |  | Correction to Note 2 of Harmonic Signal Exceptions in Spurious Emissions                           | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2751r<br>2 |  |  | Removal of brackets and TBD from CA feature  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2697r<br>1 |  |  | Maintenance of CA performance requirements (Rel-12)  | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2679r<br>2 |  |  | CR to introduce CQI test for 3 DL CA   | 12.6.0 |
| 12-2014 | RP-66 | RP-142185 | 2721r<br>1 |  |  | Addition of 2UL non-contiguous intraband CA feature  | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2704r<br>2 |  |  | UE to UE co-existence between B42/B43  | 12.6.0 |
| 12-2014 | RP-66 | RP-142176 | 2685r<br>2 |  |  | Introduction of LC MTC into TS 36.101  | 12.6.0 |
| 12-2014 | RP-66 | RP-142190 | 2759r<br>1 |  |  | Introduction of additional band combinations for 3DL inter-band CA                                 | 12.6.0 |
| 03-2015 | RP-67 | RP-150387 | 2760r<br>2 |  |  | Introduce additional bands of LC MTC   | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2761       |  |  | CR on corrections to Dual-Layer Spatial Multiplexing with multiple CSI-RS config Rel-12            | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2765r<br>1 |  |  | CR for applicability and test rules for TDD-FDD CA performance requirements                        | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2766       |  |  | Introduction of CQI tests for TDD-FDD CA   | 12.7.0 |
| 03-2015 | RP-67 | RP-150395 | 2767r<br>1 |  |  | CR to introduce the SU-MIMO whitening verification test  | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2768r<br>1 |  |  | CR on power imbalance test for 3DL CA  | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2769       |  |  | CR on sustained data rate test for TDD FDD CA  | 12.7.0 |
| 03-2015 | RP-67 | RP-150394 | 2770r<br>1 |  |  | CR for introduction of 256QAM demodulation performance requirements                                | 12.7.0 |
| 03-2015 | RP-67 | RP-150393 | 2772r<br>1 |  |  | CR: DC UE performance requirements   | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2773r<br>1 |  |  | CR: MTC demodulation performance requirements  | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2774r<br>1 |  |  | CR: MTC CSI requirements   | 12.7.0 |
| 03-2015 | RP-67 | RP-150396 | 2775r<br>1 |  |  | Introduction of the eIMTA functional PDSCH demodulation test                                       | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2776r<br>3 |  |  | CR on RF core requirements for D2D   | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2777       |  |  | Modification of CSI reference measurement channel Rel-12   | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2779       |  |  | Editorial correction for CA_18A-28A  | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2781       |  |  | Removing brackets for CA_1A-28A MSD requirements   | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2783       |  |  | Editorial correction on symbols for enhanced performance requirements type A                       | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2784       |  |  | Corrections on reference measurement channel   | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2792       |  |  | Correction of TS 36.101 for the Pcell support of 25+41   | 12.7.0 |
| 03-2015 | RP-67 | RP-150395 | 2793r<br>1 |  |  | CR for single cell demodulation test for SU-MIMO   | 12.7.0 |
| 03-2015 | RP-67 | RP-150391 | 2794       |  |  | Introduction of CA_3A-42A and CA_3A-42C into 36.101  | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2797       |  |  | UL HARQ in PDSCH and PDCCH/PCFICH demod test cases for eCIC/felCIC with MBSFN ABS                  | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2800       |  |  | Correction to eCIC aggressor cell configurations   | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2801       |  |  | R4-73AH-0040: Correction for uplik CA configuration in TS 36.101 Rel-12                            | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2802r<br>1 |  |  | Correction of MSD levels for CA_1A-8A in TS 36.101 rel-12  | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2805       |  |  | Removal of eDL-MIMO term from specification  | 12.7.0 |



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| 03-2015 | RP-67 | RP-150388 | 2809       |  | Clarification of 2UL/3DL contiguous intraband CA REFSSENS test  | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2811r<br>1 |  | CR on TM4 normal demodulation test for 3DL CA   | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2812       |  | CR on introducing new DL referece measurement channels  | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2813r<br>1 |  | CR on normal demodulation test for TDD-FDD CA   | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2815       |  | Additions of bandwidth combination set reference  | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2816       |  | Correction of band number in Table 5.6A.1-2a for LTE_CA_B4_B12_B30  | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2819       |  | UE to UE co-existence between B42/B43   | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2822       |  | Corrections to CA in-band emissions requirement   | 12.7.0 |
| 03-2015 | RP-67 | RP-150381 | 2830       |  | Uplink RMCs for sustained data rate test  | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2833       |  | Corrections to the CA power imbalance test  | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2839r<br>1 |  | CR for soft buffer tests for TDD-FDD CA in 36.101 in Rel-12   | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2842       |  | Editorial CR for CA UE performance tests in 36.101 in Rel-12  | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2847       |  | UE spurious emissions structure correction for CA   | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2850       |  | Correction of PCMAX for uplink inter-band and intra-band carrier aggregation                                | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2851       |  | Exceptions for spurious response for UL CA  | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2852r<br>1 |  | Correction of REFSSENS, OOB and uplink configuration for 3DL/1UL CA   | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2853       |  | SNR definition for category 0 UE  | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2854r<br>1 |  | FRC for category 0 UE PDSCH performance requirements  | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2855r<br>1 |  | Introduction of new PHICH and PBCH performance requirements for category 0 UE                               | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2861       |  | Correction to FOOB reference in definition of MPR for contiguous CA with non-contiguous resource allocation | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2862       |  | Band 31 update  | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2867       |  | Implementation of CA configurations specified in later releases   | 12.7.0 |
| 06-2015 | RP-68 | RP-150958 | 2870r<br>2 |  | Intra-band contiguous CA reference sensitivity definition for Class D                                       | 12.8.0 |
| 06-2015 | RP-68 | RP-150961 | 2881r<br>2 |  | CR on MTC CQI tests   | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2882r<br>2 |  | CR on 256QAM demodulation performance requirements  | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2883r<br>3 |  | CR on 256QAM sustained data rate tests for single carrier and TDD or FDD CA                                 | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2885r<br>4 |  | CR on 256QAM CQI test   | 12.8.0 |
| 06-2015 | RP-68 | RP-150963 | 2886r<br>3 |  | CR on DC SDR tests  | 12.8.0 |
| 06-2015 | RP-68 | RP-150963 | 2887r<br>2 |  | Maintenance CR for DC demodulation performance requirements   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2888       |  | CR to restore R.10-2 FDD  | 12.8.0 |
| 06-2015 | RP-68 | RP-150961 | 2889r<br>3 |  | Introduction of UE category 0 PDSCH/PHICH/PBCH performance requirements                                     | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2901       |  | UE to UE co-existence between B42/B43   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2902       |  | Correction of maximum aggregated bandwidth for CA_26A-41A   | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2903r<br>2 |  | Introduction of TDD SU-MIMO whitening verification test   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2904       |  | Correction of FRC table for CA demodulation with power imbalance  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2905r<br>1 |  | Add SCell power levels for 2DL CA power imbalance test  | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2907       |  | Corrections on UL transmit power for CA receiver requirements   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2909       |  | Corrections to the CA power imbalance test  | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2910r<br>1 |  | Clarification on RMC for D2D UE   | 12.8.0 |
| 06-2015 | RP-68 | RP-150960 | 2911       |  | Correction on TDD eIMTA PDSCH functionality test  | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2931       |  | 3.5 GHz out-of-band blocking  | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2933       |  | Correction of FRC names   | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2936       |  | Correction of the 3DL CA REFSSENS   | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2939r<br>1 |  | CR on 256QAM sustained data rate tests for TDD FDD CA   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2940r<br>1 |  | Maintenance CR for 3DL CA performance requirements  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2941r<br>1 |  | Maintenance CR for TDD FDD CA demodulation performance requirements   | 12.8.0 |

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| 06-2015 | RP-68 | RP-150965 | 2944   |  | Corrections on 2UL intra-band non-contiguous CA requirements  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2947   |  | Updates to the definitions of CA capability (Rel-12)  | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2950   |  | Clarification of PDSCH allocation in CSI PUSCH 3-0 felCIC tests (Rel-12)                                      | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2956   |  | NS value for intra-band contiguous CA configurations not allowed A-MPR  | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2958   |  | Receiver spurious emissions requirements for downlink-only bands  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2959   |  | Amendments to MPR for uplink inter-band and intra-band non-contiguous CA                                      | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2960r1 |  | NS values for secondary cells of non-contiguous CA configurations   | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2961r1 |  | Corrections to test configurations for intra-band non-contiguous CA   | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2962   |  | Corrections to test configurations for 3DL inter-band CA  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2967   |  | Adding REFSENS exception requirements for 1+3+26  | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2971   |  | Corrections to NS_22 and NS_23  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2972   |  | Corrections to 41D fallback   | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2972   |  | Corrections to EVM requirements for ProSe and Annex F of 36.101   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2976   |  | Removal of B27 from 2UL CA_7A_20A co-existence protected band list  | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2977r1 |  | CR on corrections to D2D RF core requirements   | 12.8.0 |
| 06-2015 | RP-68 | RP-150963 | 2978r1 |  | CR on corrections to D2D RF core requirements   | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2979   |  | CR clarification of RMC for DL category 0 UE HD-FDD   | 12.8.0 |
| 06-2015 | RP-68 | RP-150960 | 2980r1 |  | Introduction of TDD eIMTA CQI requirement   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2985   |  | Change of 1.4MHz single carrier SNR values for multiple CA configurations                                     | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2992   |  | Clarification to spurious emission requirement for the edge of spurious domain                                | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2996   |  | Correction to CA_7C A-MPR in CA-NS_06   | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2998r1 |  | CR to update UE performance tests for UE DL category in 36.101 in Rel-12                                      | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2999   |  | CR to update Annex for new DL category in 36.101 in Rel-12  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 3002   |  | CR for updating CA applicability rule in 36.101 in Rel-12   | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 3005r1 |  | CR for Rel-12 NAICS - Definitions   | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 3012r1 |  | Clarification on uplink configuration for reference sensitivity of inter-band CA                              | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 3018   |  | EVM for Intra-band contiguous UL CA for non-equal Channel BWs   | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 3019   |  | A-MPR correction for CA_39C CA_NS_07  | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2780r3 |  | Introduction of dual uplink CA into 36.101  | 13.0.0 |
| 06-2015 | RP-68 | RP-150646 | 2785r2 |  | Introduction of intra-band CA_42D to TS 36.101  | 13.0.0 |
| 06-2015 | RP-68 | RP-150968 | 2951r2 |  | Introduction of additional 2DL inter-band CA  | 13.0.0 |
| 06-2015 | RP-68 | RP-150972 | 2952r1 |  | Introduction of additional 3DL inter-band CA  | 13.0.0 |
| 06-2015 | RP-68 | RP-150974 | 2953r2 |  | Introduction of 4DL inter-band CA   | 13.0.0 |
| 06-2015 | RP-68 | RP-150975 | 2994r1 |  | Introduction of non-contiguous Carrier Aggregation (CA) in Band 42 for 3DL                                    | 13.0.0 |
| 06-2015 | RP-68 | RP-150967 | 3011r1 |  | CR to 36.101: New CA bandwidth classes for FeCA   | 13.0.0 |
| 06-2015 | RP-68 | RP-150668 | 3021   |  | Introduction of CA_3A-40A to TS 36.101  | 13.0.0 |
| 06-2015 | RP-68 | RP-150673 | 3022   |  | Introduction of CA_3A-40C to TS 36.101  | 13.0.0 |
| 09-2015 | RP-69 | RP-151479 | 3028   |  | Table 7.3.1A-0f (2UL CA MSD) notes numbering correction   | 13.1.0 |
| 09-2015 | RP-69 | RP-151505 | 3029   |  | Additional bandwidth combination set for LTE Advanced intra-band non-contiguous Carrier Aggregation in Band 4 | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3031   |  | Correction to TDD FDD CA  | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3033   |  | Alignment of CA Receiver requirements parameters  | 13.1.0 |
| 09-2015 | RP-69 | RP-151476 | 3036   |  | Correction to CoMP demodulation requirements  | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3040   |  | Correction to RI test parameters in TS 36.101 (Rel-13)  | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3050   |  | UE co-existence requirements between Band 42 and Japanese bands   | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3052   |  | Introduction of relaxation rule for multiple 3DL inter-band CA configurations                                 | 13.1.0 |

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| 09-2015 | RP-69 | RP-151491 | 3056r1 |  | Adding CA_42D to the out of band blocking requirement exception                                  | 13.1.0 |
| 09-2015 | RP-69 | RP-151501 | 3057r1 |  | Introduction of finished 4DL inter-band CAs to TS 36.101   | 13.1.0 |
| 09-2015 | RP-69 | RP-151487 | 3060r1 |  | Corrections on CA reference sensitivity requirements   | 13.1.0 |
| 09-2015 | RP-69 | RP-151476 | 3064   |  | Correction to RC.2 TDD Nr. HARQ Proc. into TS36.101  | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3065   |  | Corrections to CSI PUCCH 1-0 static test 4 and PUSCH 3-2 tests                                   | 13.1.0 |
| 09-2015 | RP-69 | RP-151488 | 3066   |  | Corrections in Table 5.6A.1-2, 7.3.1-1A and 7.3.1-1B.  | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3068   |  | Corrections of Spurious emission band UE co-existence for interband 2UL CA in Table 6.6.3.2A-0   | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3070   |  | Revisions of Spurious emission band UE co-existence in Table 6.6.3.2-1                           | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3076   |  | Correction to PDCCH/PCFICH test parameters in TS 36.101 (Rel-13)                                 | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3080   |  | Correction to PMI delay in PMI test for TDD  | 13.1.0 |
| 09-2015 | RP-69 | RP-151503 | 3081r1 |  | Introduction of dual uplink CA into 36.101   | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3083   |  | Maintenance CR for MTC CSI performance requirements  | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3085   |  | Maintenance CR for SCE demodulation and CSI requirements   | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3087   |  | Maintenance CR for DC demodulation performance requirements and SDR tests                        | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3089   |  | Cleanup of TDD-FDD CA demodulation performance requirements                                      | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3091   |  | Cleanup of R12 SU-MIMO Enhanced Performance Type C requirements                                  | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3102   |  | Correction on UE maximum output power class of Band 22 for UL MIMO                               | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3104   |  | Removal of square brackets for Cat-0 UE demodulation requirements                                | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3106   |  | Removal of square brackets for LTE-CA_B41_B42  | 13.1.0 |
| 09-2015 | RP-69 | RP-151490 | 3107   |  | Removal of square brackets for LTE-CA_B41_B42_B42  | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3112   |  | Corrections on 3DL CA performance requirements   | 13.1.0 |
| 09-2015 | RP-69 | RP-151489 | 3113   |  | CR 36.101 BW combination for CA_8A_41A   | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3114   |  | UL DL pairing for CA of B39+B41+B41 and B39+B39+B41  | 13.1.0 |
| 09-2015 | RP-69 | RP-151498 | 3116   |  | Introduction of additional band combinations for 2DL inter-band CA                               | 13.1.0 |
| 09-2015 | RP-69 | RP-151499 | 3117   |  | Introduction of additional band combinations for 3DL inter-band CA                               | 13.1.0 |
| 09-2015 | RP-69 | RP-151475 | 3118   |  | Minor corrections in 36.101  | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3121   |  | CR adding clarification for Band 28 restrictions in 36.101                                       | 13.1.0 |
| 09-2015 | RP-69 | RP-151494 | 3123r1 |  | Introduction of propagation conditions to handle 4 receivers in the UE                           | 13.1.0 |
| 09-2015 | RP-69 | RP-151504 | 3125r1 |  | Addition on interband CA 2UL/3DL pairs without MSD   | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3127   |  | CR for UE performance tests for intra-band contiguous CA with minimum channel spacing on Band 41 | 13.1.0 |
| 09-2015 | RP-69 | RP-151496 | 3130r2 |  | TM9 performance with CRS assistance information  | 13.1.0 |
| 09-2015 | RP-69 | RP-151495 | 3133r1 |  | Introduction of UL 64QAM to TS 36.101  | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3135r1 |  | Modification of test parameters for TM9 demodulation with 256QAM (Rel-13)                        | 13.1.0 |
| 09-2015 | RP-69 | RP-151485 | 3137   |  | CR to add demodulation tests for new release 13 2CC combinations in 36.101                       | 13.1.0 |
| 09-2015 | RP-69 | RP-151501 | 3139r1 |  | Introduction of 4CC demodulation requirements for FDD and FDD-TDD CA                             | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3141   |  | Correction to FDD-TDD closed loop spatial multiplexing 3CC requirement table                     | 13.1.0 |
| 09-2015 | RP-69 | RP-151473 | 3143r1 |  | Correction to DC supported testable bandwidth list   | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3145   |  | Clarification of UL configuration for CA demodulation requirements                               | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3146r1 |  | Spreading of harmonic for 2UL interband and 2 ULnon-contiguous intraband CA                      | 13.1.0 |
| 09-2015 | RP-69 | RP-151502 | 3147   |  | Correction to dRib and REFSENS   | 13.1.0 |
| 09-2015 | RP-69 | RP-151479 | 3153   |  | Corrections to CSI RMCs used for PUSCH 3-2 testing (Rel-13)                                      | 13.1.0 |
| 09-2015 | RP-69 | RP-151483 | 3155   |  | Corrections to applicability of CSI requirements for low UE categories (Rel-13)                  | 13.1.0 |
| 09-2015 | RP-69 | RP-151482 | 3164   |  | CR for Rel-12 NAICS - Demodulation Test  | 13.1.0 |
| 09-2015 | RP-69 | RP-151482 | 3165   |  | CR for Rel-12 NAICS - Fixed Reference Channels   | 13.1.0 |
| 09-2015 | RP-69 | RP-151482 | 3166   |  | CR for Rel-12 NAICS - Interference Models  | 13.1.0 |

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| 09-2015 | RP-69 | RP-151482 | 3167       |  | CR for Rel-12 NAICS - CQI Tests   | 13.1.0 |
| 09-2015 | RP-69 | RP-151205 | 3168       |  | Introduction of CA_7A-40A and CA_7A-40C to TS 36.101  | 13.1.0 |
| 09-2015 | RP-69 | RP-151593 | 3170       |  | CR for Rel-13 NAICS – TM10 Demodulation and CSI Test  | 13.1.0 |
| 12-2015 | RP-70 | RP-152158 | 3172r<br>1 |  | Introduction of UE RF requirements for CA_42E   | 13.2.0 |
| 12-2015 | RP-70 | RP-152137 | 3173       |  | Correction on UL 64QAM measurement channels   | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3175       |  | Release 13 CAT A CR to align NS_04 values to meet FCC OOB requirements                                  | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3178       |  | Maintenance of eIMTA PDSCH demodulation test  | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3180r<br>1 |  | Correction for eIMTA CQI tests  | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3186       |  | Simplified CA fading Test method becomes optional   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3191       |  | Correction of the applicable UE categories for 256QAM UE demodulation performance requirements (Rel-13) | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3193r<br>1 |  | Correction of TDD-FDD CA performance requirements (Rel-13)  | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3195r<br>1 |  | Correction on FDD CA and TDD CA performance requirements (Rel-13)                                       | 13.2.0 |
| 12-2015 | RP-70 | RP-152163 | 3196       |  | CR on introduction of 5CC FDD/TDD CA demodulation performance requirements                              | 13.2.0 |
| 12-2015 | RP-70 | RP-152163 | 3197       |  | CR on introduction of 5CC TDD FDD CA demodulation performance requirements                              | 13.2.0 |
| 12-2015 | RP-70 | RP-152132 | 3205       |  | Correction of the AMPR table for NS_14 in TS 36.101 R13   | 13.2.0 |
| 12-2015 | RP-70 | RP-152134 | 3206       |  | Correction of the 2UL CA co-existence table for CA_18A-28A  | 13.2.0 |
| 12-2015 | RP-70 | RP-152152 | 3209       |  | Introduction of 3DL/2UL DC  | 13.2.0 |
| 12-2015 | RP-70 | RP-152139 | 3210r<br>1 |  | Correction of uplink configuration for CA_42D   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3212       |  | Introduction of dual uplink CA into 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3214       |  | Corrections to the CSI minimum requirement for PUSCH 3-2 (Rel-13)                                       | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3216       |  | Corrections to MIMO Correlation Matrices using cross polarized antennas (Rel-12)                        | 13.2.0 |
| 12-2015 | RP-70 | RP-152157 | 3221r<br>1 |  | Introducing B20 + B67 CA into TS 36.101   | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3225       |  | CR for UE performance tests for intra-band contiguous CA with minimum channel spacing on Band 41        | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3227r<br>1 |  | Correction in SNR definition for CSI test   | 13.2.0 |
| 12-2015 | RP-70 | RP-152130 | 3232       |  | Correction to reference channel for CQI requirements  | 13.2.0 |
| 12-2015 | RP-70 | RP-152168 | 3233r<br>1 |  | CR 36.101 BW combination for CA_8B  | 13.2.0 |
| 12-2015 | RP-70 | RP-152164 | 3241       |  | Correction to mandatory 2UL support for 3DL interband CA  | 13.2.0 |
| 12-2015 | RP-70 | RP-152164 | 3242       |  | Introduction of 2 UL and 3 DL interband cases with MSD  | 13.2.0 |
| 12-2015 | RP-70 | RP-152132 | 3246       |  | CR on FRC for CDM-multiplexed DM RS   | 13.2.0 |
| 12-2015 | RP-70 | RP-152132 | 3249       |  | Correction to physical channel for CQI reporting in type A test case                                    | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3255       |  | CR for Rel-12 NAICS - Demodulation Test   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3263       |  | Correction on CA_4A-4A-5A table reference   | 13.2.0 |
| 12-2015 | RP-70 | RP-152134 | 3269r<br>1 |  | Clarification of Pcell support in 36.101 in CA scenarios  | 13.2.0 |
| 12-2015 | RP-70 | RP-152132 | 3273       |  | A-MPR correction for CA_NS_06 CA-7C non-contiguous RB allocation  | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3276       |  | Clarification on relative power tolerance for CA  | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3278       |  | Correction of uplink configuration for CA_18-28   | 13.2.0 |
| 12-2015 | RP-70 | RP-152135 | 3280       |  | CR on corrections for ProSe Direct Discovery demodulation requirements                                  | 13.2.0 |
| 12-2015 | RP-70 | RP-152135 | 3281       |  | CR to finalize demodulation performance requirements for D2D Communication                              | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3285       |  | Missing RB allocation and OCNG Pattern for Cat 1 UEs in Multiple PMI CSI Reference Symbol tests         | 13.2.0 |
| 12-2015 | RP-70 | RP-152167 | 3286r<br>1 |  | Introduction of CA_5B to TS 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152169 | 3287       |  | Introduction of CA_5A-5A to TS 36.101   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3288       |  | Introduction of dual uplink CA into 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152150 | 3291r<br>1 |  | CR on eD2D RF core requirements   | 13.2.0 |
| 12-2015 | RP-70 | RP-152171 | 3292r<br>3 |  | Introduction of B65 in Region 1   | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3294       |  | Correction of supported sub-block frequency arrangement for CA_41-41                                    | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3296       |  | Correction of test configuration for combinations of inter-band and intra-band CA                       | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3299r<br>2 |  | RF receiver requirements for UE(s) supporting four antenna ports  | 13.2.0 |

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| 12-2015 | RP-70 | RP-152148 | 3300r<br>2 |   |   | Introduction of RF requirements for LAA operation   | 13.2.0 |
| 12-2015 | RP-70 | RP-152172 | 3309r<br>2 |   |   | Introduction of Band 66   | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3311       |   |   | Correction on CQI test 1A for TDD eIMTA   | 13.2.0 |
| 12-2015 | RP-70 | RP-152166 | 3312r<br>1 |   |   | Introduction of 3DL/3UL Inter-band CA of CA_39A-41C and CA_39C-41A  | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3314       |   |   | Correction of the resource allocation in FRC for CAT0 UE demodulation tests   | 13.2.0 |
| 12-2015 | RP-70 | RP-152151 | 3318       |   |   | Introduce TM4 performance requirements when CRS assistance information is provided                                      | 13.2.0 |
| 12-2015 | RP-70 | RP-152151 | 3319r<br>1 |   |   | Introduce TM10 performance requirements when CRS assistance information is provided for multiple-CSI-process capable UE | 13.2.0 |
| 12-2015 | RP-70 | RP-152151 | 3320r<br>1 |   |   | Introduce TM10 performance requirements when CRS assistance information is provided for one-CSI-process capable UE      | 13.2.0 |
| 12-2015 | RP-70 | RP-152163 | 3325       |   |   | Introduction of 5DL/1UL CA combinations into TS 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152175 | 3326r<br>1 |   |   | Introduction of Region 3 requirement in Band 65   | 13.2.0 |
| 12-2015 | RP-70 | RP-152138 | 3327       |   |   | Correction of CA_8A-41C bandwidth combination set   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3329       |   |   | Removal of DC channel bandwidth combination set table   | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3331       |   |   | CR on demodulation requirements of Dual Connectivity  | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3332r<br>1 |   |   | Modification and correction of CA_3A-3A BCS1 in Rel.13 36.101   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3334       |   |   | Correction of MSD levels for 2UL inter-band CA in TS 36.101 Rel-13  | 13.2.0 |
| 12-2015 | RP-70 | RP-152162 | 3338       |   |   | Introduction of finished 4DL inter-band CAs to TS 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152170 | 3339       |   |   | Introduction of CA_7A-7A BCS1 to TS 36.101  | 13.2.0 |
| 12-2015 | RP-70 | RP-152164 | 3340r<br>1 |   |   | Introduction of additional 2 UL and 3 DL interband cases with MSD   | 13.2.0 |
| 12-2015 | RP-70 | RP-152158 | 3341r<br>1 |   |   | Addition of Class E into CA BW Class table.   | 13.2.0 |
| 12-2015 | RP-70 | RP-152131 | 3343       |   |   | Table 6.2.4A-1 note 1 correction  | 13.2.0 |
| 12-2015 | RP-70 | RP-152164 | 3345       |   |   | Removal of (NOTE 4) from Table 5.6A.1-2a  | 13.2.0 |
| 12-2015 | RP-70 | RP-152160 | 3347       |   |   | Introduction of 4DL NC CA in band42 in 36.101   | 13.2.0 |
| 12-2015 | RP-70 | RP-152173 | 3348       |   |   | Introduction of 1447-1467MHz Band into 36.101   | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3352       |   |   | CR: PDSCH ETU600 performance requirements   | 13.2.0 |
| 12-2015 | RP-70 | RP-152156 | 3357       |   |   | Introduction of additional band combinations for 2DL inter-band CA  | 13.2.0 |
| 12-2015 | RP-70 | RP-151972 | 3358r<br>2 |   |   | Revision of the RAN4 approved R4-158446 (big CR 3DL 36.101)   | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3359r<br>1 |   |   | Introduction of the Medium Correlation A model  | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3360r<br>1 |   |   | Requirements for ePDCCH with 4Rx  | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3361r<br>1 |   |   | Requirements for PDCCH with 4Rx   | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3362r<br>1 |   |   | Requirements for PDSCH with 4Rx   | 13.2.0 |
| 12-2015 | RP-70 | RP-152147 | 3363r<br>1 |   |   | Requirements for PHICH with 4Rx   | 13.2.0 |
| 12-2015 | RP-70 | RP-152159 | 3367r<br>1 |   |   | Introduction of intra-band non-contiguous CA in Band 41 for 4DL   | 13.2.0 |
| 12-2015 | RP-70 | RP-152165 | 3368       |   |   | Addition of 2 UL and 3 DL mixed intra/inter band carrier aggregation combinations without MSD.                          | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3372r<br>1 |   |   | Revision to CR 3256   | 13.2.0 |
| 12-2015 | RP-70 | RP-152133 | 3375       |   |   | Correction to P <sub>cm</sub> for CA to include delta_T_ProSe   | 13.2.0 |
| 12-2015 | RP-70 | RP-152162 | 3376       |   |   | Delta TIB,c and Delta RIB,c for 1UL/4DL   | 13.2.0 |
| 12-2015 | RP-70 | RP-152136 | 3378       |   |   | NS_05 modification for PHS protection in Japan  | 13.2.0 |
| 01-2016 | RP-70 |           |            |   |   | Editorial correction: Correction of reference to section 6.6.3.3.19 for NS_04 in Table 6.2.4-1                          | 13.2.1 |
| 03/2016 | RP-71 | RP-160472 | 3467       | 1 | B | UE receiver requirements for Rel-13 MTC   | 13.3.0 |
| 03/2016 | RP-71 | RP-160472 | 3443       | 1 | B | CR on TX requirements for Rel-13 eMTC   | 13.3.0 |
| 03/2016 | RP-71 | RP-160474 | 3419       |   | B | Introduce Robustness test for CRS-IM capable UE   | 13.3.0 |
| 03/2016 | RP-71 | RP-160474 | 3422       | 1 | B | FRC for non-TM10 with CRS assistance information  | 13.3.0 |
| 03/2016 | RP-71 | RP-160474 | 3420       | 1 | B | Introduce non-TM10 performance with CRS assistance information  | 13.3.0 |

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| 03/2016 | RP-71 | RP-160474 | 3421 | 1 | B | Introduce TM10 performance with CRS assistance information                            | 13.3.0 |
| 03/2016 | RP-71 | RP-160474 | 3423 | 1 | B | FRC for TM10 with CRS assistance information  | 13.3.0 |
| 03/2016 | RP-71 | RP-160475 | 3460 | 1 | B | CR: Correction of FRC for SDR test (Rel-13)   | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3459 |   | F | Correction of 4Rx demodulation performance requirements                               | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3462 |   | B | Correction of Correlation Model for Medium Correlation A                              | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3466 |   | B | UE Demodulation Requirements for DL Control channels for 4Rx                          | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3463 | 1 | B | UE Demodulation Requirements for DL PDSCH rank 1 and 2 performance                    | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3464 | 1 | B | UE Demodulation Requirements for DL PDSCH rank 3 and 4 requirements                   | 13.3.0 |
| 03/2016 | RP-71 | RP-160479 | 3412 | 2 | F | Corrections to UE RF receiver requirements for 4RX AP and support of CA               | 13.3.0 |
| 03/2016 | RP-71 | RP-160480 | 3431 |   | B | Introduction of additional band combinations for 3DL inter-band CA                    | 13.3.0 |
| 03/2016 | RP-71 | RP-160481 | 3396 |   | B | Introduction of completed R13 4DL inter-band CA's to TS 36.101                        | 13.3.0 |
| 03/2016 | RP-71 | RP-160482 | 3424 |   | B | Introduction of 5DL/1UL CA combinations   | 13.3.0 |
| 03/2016 | RP-71 | RP-160483 | 3415 | 2 | B | Introduction of Band 68 for Arab region into 36.101                                   | 13.3.0 |
| 03/2016 | RP-71 | RP-160487 | 3429 |   | A | [Rel-13] Correction on Intra-band non-contiguous CA                                   | 13.3.0 |
| 03/2016 | RP-71 | RP-160488 | 3381 |   | A | Correction to Type A CQI test parameters in TS 36.101                                 | 13.3.0 |
| 03/2016 | RP-71 | RP-160488 | 3405 |   | A | CQI reports in CoMP fading test   | 13.3.0 |
| 03/2016 | RP-71 | RP-160488 | 3453 |   | F | Maintenance CR for CA (Rel-13)  | 13.3.0 |
| 03/2016 | RP-71 | RP-160488 | 3461 |   | A | Correction to TDD CQI Reporting for feICIC  | 13.3.0 |
| 03/2016 | RP-71 | RP-160488 | 3481 |   | A | Beamforming model correction on TM10 DPS UE tests                                     | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3384 |   | A | Correction in beam steering rate for 4 Tx antenna in Rel-13                           | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3386 |   | A | CR for correction to syncOffsetIndicator parameter in D2D resource pool configuration | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3390 |   | A | Correction of eIMTA CSI test  | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3402 |   | A | [Rel-13] NS_05 modification for PHS protection in Japan                               | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3411 |   | A | Correction of Pcmx for Dual Connectivity  | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3436 |   | A | Correction on UE category in Annex of TS 36.101                                       | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3438 |   | A | Removal of brackets for Maximum input level for 256QAM in TS 36.101                   | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3440 |   | A | Removal of brackets for Measurement channels for MTC in TS 36.101                     | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3456 |   | A | Maintenance CR for D2D (Rel-13)   | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3458 |   | A | CR: Correction of FRC for SDR test (Rel-13)   | 13.3.0 |
| 03/2016 | RP-71 | RP-160489 | 3482 |   | A | Maintenance CR for DC (Rel-13)  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3382 |   | F | Correction in UL CA support table   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3397 |   | F | Removing the brackets for 3+40 REFSSENS   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3416 |   | F | Corrections on BCS and EARFCN tables  | 13.3.0 |

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| 03/2016 | RP-71 | RP-160490 | 3425 |   | F | Removal of channel bandwidth sets for three bands DC  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3427 |   | F | Corrections to Notes in 2UL spurious emission table   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3442 |   | F | Revision of channel bandwidths for CA_B3_B41_B42 in 36.101  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3447 |   | F | Removing DC_5-17 from 36.101 Rel 13   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3473 |   | D | CR of editorial change on PHICH group and Ng in Rel-13  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3477 |   | F | Supported bandwidths for Band 66  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3478 |   | F | Corrections to CA_66C   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3441 | 1 | F | Correction on Annex D for LAA in TS 36.101  | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3406 | 3 | F | Correction to UL 64 QAM measurement channels in TS 36.101   | 13.3.0 |
| 03/2016 | RP-71 | RP-160490 | 3430 | 3 | F | Corrections and bracket removals to B46 specifications  | 13.3.0 |
| 06/2016 | RP-72 | RP-161141 | 3489 |   | A | Correction on B39 coexistence spurious emission requirements  | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3491 |   | A | Square brackets on B39 single carrier spurious emission requirements for protecting B3  | 13.4.0 |
| 06/2016 | RP-72 | RP-161135 | 3492 |   | F | Introduction of EB/FD-MIMO channel model using 2D XP antennas at eNB  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3493 |   | F | CR to Correct Notes for CA REFSSENS Tables  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3494 |   | D | Editorial modification on uplink inter-band CA  | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3496 |   | A | CSI requirements for 2DL FDD-TDD for UE Cat 3 (Rel 13)  | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3498 |   | A | Wrong RMC description in overview table (Rel-13)  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3499 | 1 | F | Correction of Pcmx for Prose  | 13.4.0 |
| 06/2016 | RP-72 | RP-161128 | 3504 | 3 | B | Introduction of PDSCH demodulation requirement for Cat-M1 UE  | 13.4.0 |
| 06/2016 | RP-72 | RP-161128 | 3505 | 3 | B | Introduction of CQI test for Cat-M1 UE  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3507 | 1 | C | Correcting fallback inconsistencies in CA of B41 and B42 in REL-13  | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3510 | 1 | F | CR: Addition of performance requirement for TDD-FDD DC(Rel-13)  | 13.4.0 |
| 06/2016 | RP-72 | RP-161133 | 3514 |   | F | Correction on 4Rx demodulation tests  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3517 |   | F | Introduction of 4Rx requirement for Band 1  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3522 |   | F | CR on reference measurement channel for Rel-13 eMTC   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3526 |   | F | Introduction of 4Rx REFSSENS for Band 41  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3528 |   | F | Rx requirement for the non-contiguous CA with more than two component carriers  | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3530 |   | F | Correction on UE category for MTC and eMTC in TS 36.101   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3531 | 1 | F | Correction on eMTC in TS 36.101   | 13.4.0 |
| 06/2016 | RP-72 | RP-161140 | 3535 |   | A | ACS for CA Bandwidth Class D: Case 2 wanted signal power  | 13.4.0 |
| 06/2016 | RP-72 | RP-161140 | 3538 |   | A | Maintenance CR for demodulation performance requirements (Rel-13)   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3545 | 1 | F | Maintenance CR for CRS-IM   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3548 |   | F | Correction to UE Categories for 64 QAM Reference channels   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3549 |   | F | Clean up for CRS-IM related requirements  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3551 | 2 | F | Correction on eMTC In-band emissions in TS 36.101   | 13.4.0 |
| 06/2016 | RP-72 | RP-161136 | 3554 | 1 | B | CR on the introduction of the LTE DL Control Channels Interference Mitigation: PDCCH/PCFICH demodulation performance requirements | 13.4.0 |
| 06/2016 | RP-72 | RP-161136 | 3555 | 1 | B | CR on the introduction of the LTE DL Control Channels Interference Mitigation: Interference models                                | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3559 |   | F | Corrections to 9.6.1.3 and 9.6.1.4 TDD FDD CQI Reporting test   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3560 |   | F | Corrections for CA_28A-42A and CA_28A-42C requirements  | 13.4.0 |
| 06/2016 | RP-72 | RP-161128 | 3568 | 1 | B | CR for eMTC PBCH demodulation requirement for enhanced coverage   | 13.4.0 |
| 06/2016 | RP-72 | RP-161128 | 3569 | 1 | B | CR for eMTC M-PDCCH demodulation requirement for CE Mode A and CE Mode B  | 13.4.0 |
| 06/2016 | RP-72 | RP-161135 | 3573 |   | B | Introduction of EB/FD-MIMO Class A PMI test   | 13.4.0 |
| 06/2016 | RP-72 | RP-161135 | 3574 |   | B | Introduction of EB/FD-MIMO Class B K=1 PMI test   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3576 |   | F | RMC for verification of RF receiver requirements for LAA  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3578 |   | F | Corrections of CA 8A-42A/C in REL-13  | 13.4.0 |
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| 06/2016 | RP-72 | RP-161142 | 3587   |   | F | CR for dTib,c and dRib,c for CA combinations including Band 21 and 42                          | 13.4.0 |
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| 06/2016 | RP-72 | RP-161136 | 3593   | 1 | B | CR on PHICH performance requirements for DL control channel IM                                 | 13.4.0 |
| 06/2016 | RP-72 | RP-161136 | 3594r1 |   | B | CR on ePDCCH performance requirements for DL control channel IM                                | 13.4.0 |
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| 06/2016 | RP-72 | RP-161133 | 3597   | 1 | B | Finalization of 4Rx UE Demodulation Requirements   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3602   | 1 | F | Clarification on eMTC RX requirements in TS 36.101   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3610   |   | F | Uplink configuration for reference sensitivity for B45   | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3614   |   | F | CR: Maintenance CR for demodulation performance requirements (Rel-13)                          | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3619   |   | F | CR 36.101 on 7+38 blocking requirement   | 13.4.0 |
| 06/2016 | RP-72 | RP-161141 | 3623   |   | A | Editorial correction for TM4 MMSE-IRC PDSCH demodulation test                                  | 13.4.0 |
| 06/2016 | RP-72 | RP-161142 | 3632   | 1 | F | CR for TM9 tests with MBSFN subframes configured for PDSCH in Rel-13                           | 13.4.0 |
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| 06/2016 | RP-72 | RP-161136 | 3634   | 1 | B | CR of introducing enhanced control channels requirements under asynchronous network in Rel-13  | 13.4.0 |
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| 06/2016 | RP-72 | RP-161136 | 3640   | 1 | B | CR for applicability rule for control channel enhancement requirements in Rel-13               | 13.4.0 |
| 2016/06 | RP-72 | RP-161164 | 3552   | 1 | F | 36.101 Section 5 operating bands (clean-up)  | 14.0.0 |
| 2016/06 | RP-72 | RP-161125 | 3553   | - | B | Introduction of B70 to TS36.101  | 14.0.0 |
| 2016/06 | RP-72 | RP-161124 | 3577   | 1 | B | Introduction of 2.6GHz SDL and CA B3_2.6SDL  | 14.0.0 |
| 2016/06 | RP-72 | RP-161123 | 3581   | - | B | Introduction of additional 3DL/2UL CA band combinations in Rel-14                              | 14.0.0 |
| 2016/06 | RP-72 | RP-161123 | 3582   | - | B | Introduction of new 4DL/2UL CA band combination in Rel-14                                      | 14.0.0 |
| 2016/06 | RP-72 | RP-161119 | 3583   | - | B | Introduction of additional band combinations for 4DL inter-band CA                             | 14.0.0 |
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| 2016/06 | RP-72 | RP-161121 | 3588   | - | B | Introduction of Rel-14 5DL inter-band combinations in 36.101                                   | 14.0.0 |
| 2016/06 | RP-72 | RP-161122 | 3603   | - | B | Introduction of completed R14 2DL2UL band combinations to TS 36.101                            | 14.0.0 |
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| 09/2016 | RP-73 | RP-161785 | 3645   |   | A | Correct UE DL category for 256QAM demodulation   | 14.1.0 |
| 09/2016 | RP-73 | RP-161786 | 3647   |   | A | CR on finalization of enhanced PDCCH/PCFICH performance requirements for DL control channel IM | 14.1.0 |
| 09/2016 | RP-73 | RP-161611 | 3649   |   | A | CR on introduction of OOC D2D Discovery demodulation requirements                              | 14.1.0 |
| 09/2016 | RP-73 | RP-161632 | 3656   |   | A | Improving the single antenna port description in UL-MIMO clauses                               | 14.1.0 |
| 09/2016 | RP-73 | RP-161623 | 3657   |   | B | Introduction of completed R14 3DL band combination to TS 36.101                                | 14.1.0 |
| 09/2016 | RP-73 | RP-161635 | 3659   |   | A | Correction of CA_42-42 sub-block CA configuration  | 14.1.0 |
| 09/2016 | RP-73 | RP-161784 | 3663   |   | A | Correction of CA REFSENS harmonic formula  | 14.1.0 |
| 09/2016 | RP-73 | RP-161635 | 3665   |   | A | Adding UL configuration for CA_28A-42A and CA_28A-42C  | 14.1.0 |
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| 03/2017 | RP-75 | RP-170588 | 4163 |   | A | Correction to UL/DL configuration & Special subframe configuration for CA CQI tests    | 14.3.0 |
| 03/2017 | RP-75 | RP-170597 | 4165 |   | A | Remove [ ] from UE Cat M1 MPDCCH demodulation SNR values                               | 14.3.0 |
| 03/2017 | RP-75 | RP-170576 | 4168 | 4 | B | 36.101 CR: Addition of Band 25 and Band 40 to M1 bands                                 | 14.3.0 |
| 03/2017 | RP-75 | RP-170575 | 4169 |   | B | Release 14 CR to 36.101 to add Bands 25 and 26 to Category 0                           | 14.3.0 |
| 03/2017 | RP-75 | RP-170563 | 4170 | 1 | B | Introduction of Category 1bis requirements to 36.101                                   | 14.3.0 |
| 03/2017 | RP-75 | RP-170589 | 4172 |   | A | Missing harmonic reference sensitivity exception for CA_20A-42A and CA_20A-42A-42A     | 14.3.0 |
| 03/2017 | RP-75 | RP-170589 | 4175 |   | A | Correction to MPR table for intra-band 2UL CA  | 14.3.0 |
| 03/2017 | RP-75 | RP-170566 | 4176 |   | F | Correction of notes on harmonic exception in 2DL CA 11A-28A                            | 14.3.0 |
| 03/2017 | RP-75 | RP-170566 | 4177 |   | F | Correction on uplink limitation of 2DL CA 8A-28A                                       | 14.3.0 |
| 03/2017 | RP-75 | RP-170570 | 4178 |   | F | Correction of TIB and RIB on 2UL CA 41A-42A  | 14.3.0 |
| 03/2017 | RP-75 | RP-170568 | 4179 |   | B | Introduction of additional band combinations for 4DL inter-band CA                     | 14.3.0 |
| 03/2017 | RP-75 | RP-170565 | 4180 |   | B | Introduction of additional band combinations for Intra-band CA                         | 14.3.0 |
| 03/2017 | RP-75 | RP-170569 | 4181 |   | B | Introduction of Rel-14 5DL inter-band combinations in 36.101                           | 14.3.0 |
| 03/2017 | RP-75 | RP-170566 | 4182 |   | F | Correction of Rel-14 CA configurations and relaxation values                           | 14.3.0 |
| 03/2017 | RP-75 | RP-170566 | 4183 | 1 | F | Correction of Rel-14 CA REFSENS exceptions   | 14.3.0 |
| 03/2017 | RP-75 | RP-170603 | 4185 |   | A | Correction of Rel-13 CA REFSENS exceptions   | 14.3.0 |
| 03/2017 | RP-75 | RP-170553 | 4190 | 2 | B | Introduction of UE requirements for LAA Scell uplink operation in Band 46              | 14.3.0 |
| 03/2017 | RP-75 | RP-170597 | 4192 |   | A | Finalize eMTC PDSCH demodulation requirements  | 14.3.0 |
| 03/2017 | RP-75 | RP-170597 | 4194 |   | A | Finalize eMTC CQI test requirements  | 14.3.0 |
| 03/2017 | RP-75 | RP-170594 | 4198 |   | A | Correction of FRC table for eMTC RF test   | 14.3.0 |
| 03/2017 | RP-75 | RP-170590 | 4201 |   | F | CR on correction of enhanced ePDCCH performance requirements for DL control channel IM | 14.3.0 |
| 03/2017 | RP-75 | RP-170592 | 4204 |   | A | Clean up and correction for LAA PDCCH demodulation requirements                        | 14.3.0 |
| 03/2017 | RP-75 | RP-170599 | 4208 | 1 | A | PCMAX tolerance for UE Cat NB1 power class 5   | 14.3.0 |
| 03/2017 | RP-75 | RP-170558 | 4209 | 1 | B | Addition of uplink 256 QAM feature to TS 36.101  | 14.3.0 |
| 03/2017 | RP-75 | RP-170580 | 4213 |   | A | Addition of missing note for bands 7 and 39 UE to UE co-ex                             | 14.3.0 |
| 03/2017 | RP-75 | RP-170580 | 4217 |   | A | Correction of CA_NS_06 non-contiguous resource allocation MPR formula                  | 14.3.0 |
| 03/2017 | RP-75 | RP-170598 | 4218 | 1 | A | Corrections in TS 36.101 for NB-IoT UE   | 14.3.0 |
| 03/2017 | RP-75 | RP-170592 | 4221 | 1 | F | CR for LAA SDR applicability   | 14.3.0 |
| 03/2017 | RP-75 | RP-170592 | 4223 | 1 | F | CR: Updates to LAA PDSCH demodulation performance requirements and LBT(R14)            | 14.3.0 |
| 03/2017 | RP-75 | RP-170598 | 4225 |   | A | CR: Scheduling pattern for NPUSCH format 1 and NPDSCH in NB-IoT RF test(R14)           | 14.3.0 |
| 03/2017 | RP-75 | RP-170601 | 4227 |   | A | CR:Updates to the overview of RMC for NB-IoT(R14)                                      | 14.3.0 |
| 03/2017 | RP-75 | RP-170601 | 4229 |   | A | CR:Cleanup for NB-IoT UE demod performance requirements(R14)                           | 14.3.0 |
| 03/2017 | RP-75 | RP-170585 | 4232 |   | A | Corrections for D2D resource configuration (Rel-14)                                    | 14.3.0 |
| 03/2017 | RP-75 | RP-170555 | 4233 | 1 | F | CR for UE enhancement in SFN scenario  | 14.3.0 |
| 03/2017 | RP-75 | RP-170595 | 4235 |   | A | clean up the CR for eMTC PBCH requirements(Rel-14)                                     | 14.3.0 |
| 03/2017 | RP-75 | RP-170585 | 4243 |   | A | CR for fixing requirement for soft buffer test for TDD-FDD CA in Rel-14                | 14.3.0 |
| 03/2017 | RP-75 | RP-170587 | 4245 |   | A | CR for fixing power ratio errors in 4Rx tests in Rel-14                                | 14.3.0 |
| 03/2017 | RP-75 | RP-170562 | 4246 | 1 | B | CR for defining requirements for normal demodulation tests for 4Rx CA in Rel-14        | 14.3.0 |
| 03/2017 | RP-75 | RP-170562 | 4247 | 1 | B | CR for introducing normal demodulation tests for 4Rx TDD-FDD CA in Rel-14              | 14.3.0 |
| 03/2017 | RP-75 | RP-170562 | 4249 | 1 | B | CR for introducing applicability rule for normal demodulation tests                    | 14.3.0 |
| 03/2017 | RP-75 | RP-170562 | 4251 | 1 | B | CR for introducing new demodulation tests for 4Rx DC in Rel-14                         | 14.3.0 |
| 03/2017 | RP-75 | RP-170587 | 4254 |   | A | CR for correcting applicability rules for 4Rx tests in Rel-14                          | 14.3.0 |
| 03/2017 | RP-75 | RP-170571 | 4256 |   | B | Introduction of additional 3DL/2UL CA band combinations in Rel-14                      | 14.3.0 |
| 03/2017 | RP-75 | RP-170571 | 4257 |   | B | Introduction of new 4DL/2UL CA band combination in Rel-14                              | 14.3.0 |
| 03/2017 | RP-75 | RP-170571 | 4258 |   | B | Introduction of new 5DL/2UL CA band combination in Rel-14                              | 14.3.0 |
| 03/2017 | RP-75 | RP-170559 | 4262 | 2 | B | CR on intra-band contiguous MCC for V2X for TS 36.101                                  | 14.3.0 |
| 03/2017 | RP-75 | RP-170561 | 4263 | 2 | B | Introduction of a new power class for NB-IoT   | 14.3.0 |
| 03/2017 | RP-75 | RP-170570 | 4264 |   | B | Introduction of completed R14 2DL2UL band combinations to TS 36.101                    | 14.3.0 |

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| 03/2017 | RP-75 | RP-170567 | 4266 |   | B | Introduction of completed R14 3DL band combinations to TS 36.101  | 14.3.0 |
| 03/2017 | RP-75 | RP-170574 | 4267 | 1 | B | Introduction of bands to support 4Rx APs to TS 36.101   | 14.3.0 |
| 03/2017 | RP-75 | RP-170578 | 4268 | 1 | F | CR for remaining issues for V2V UE RF requirements  | 14.3.0 |
| 03/2017 | RP-75 | RP-170559 | 4269 |   | B | Introduction of inter-band con-current V2X UE RF requirements   | 14.3.0 |
| 03/2017 | RP-75 | RP-170559 | 4271 | 1 | B | CR for Tx RF requirements for high power V2X  | 14.3.0 |
| 03/2017 | RP-75 | RP-170577 | 4274 |   | F | Correction to Band 70 use on 20 MHz channel bandwidth   | 14.3.0 |
| 03/2017 | RP-75 | RP-170598 | 4279 |   | A | CR for clarification on SEM of category NB1 [Rel-14]  | 14.3.0 |
| 03/2017 | RP-75 | RP-170594 | 4280 |   | A | CR of TX-RX frequency separation for category M1 [Rel-14]   | 14.3.0 |
| 03/2017 | RP-75 | RP-170587 | 4282 |   | A | CR for fixing antenna configuration for TDD CQI rank 3 test for 4Rx in Rel-13                                   | 14.3.0 |
| 03/2017 | RP-75 | RP-170594 | 4285 |   | A | Reference Channels for partial RB allocation for UE UL category M1  | 14.3.0 |
| 03/2017 | RP-75 | RP-170566 | 4290 |   | B | Introduction of completed R14 2DL band combinations to TS 36.101  | 14.3.0 |
| 03/2017 | RP-75 | RP-170559 | 4293 |   | B | CR for single carrier V2X UE RF requirements  | 14.3.0 |
| 06/2017 | RP-76 | RP-171304 | 4299 |   | A | Correction to 4Tx/4Rx Cell-specific reference signals in Table 8.10.1.1.7-1                                     | 14.4.0 |
| 06/2017 | RP-76 | RP-171269 | 4302 | 1 | F | Introduction of Band 18 UE category 1bis into TS36.101  | 14.4.0 |
| 06/2017 | RP-76 | RP-171257 | 4304 | 1 | F | eHST RF: Practical and consistent model definition for HST-SFN scenario (Rel-14)                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171308 | 4306 |   | A | Correction to UL and DL Reference Channels for Cat M1 UE  | 14.4.0 |
| 06/2017 | RP-76 | RP-171296 | 4309 |   | A | Corrections for D2D FRCs  | 14.4.0 |
| 06/2017 | RP-76 | RP-171279 | 4313 | 3 | B | Intorduction of new bands for NB-IoT in 36.101  | 14.4.0 |
| 06/2017 | RP-76 | RP-171269 | 4314 | 1 | F | CR for correction for CQI test for Cat.1 UE with single Rx antenna  | 14.4.0 |
| 06/2017 | RP-76 | RP-171395 | 4318 |   | A | Correction to SEM table for intra-band 2UL CA   | 14.4.0 |
| 06/2017 | RP-76 | RP-171310 | 4320 |   | A | Cleanup of eMTC UE demodulation requirements (Rel-14)   | 14.4.0 |
| 06/2017 | RP-76 | RP-171311 | 4322 | 1 | A | Correction for FD-MIMO demodulation test (R14)  | 14.4.0 |
| 06/2017 | RP-76 | RP-171278 | 4327 | 1 | F | CR on correction for multiple MSD requirements for dual uplink CA UE  | 14.4.0 |
| 06/2017 | RP-76 | RP-171282 | 4329 | 1 | F | CR on correction for V2X con-current operation  | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4332 | 1 | B | CR for introducing requirements for normal demodulation tests for 4Rx CA in Rel-14                              | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4333 |   | B | CR for introducing for TDD-FDD DC normal demodulation tests for 4Rx CA in Rel-14                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4334 | 1 | B | CR for introducing new IRC tests for 4Rx CA in Rel-14   | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4336 | 1 | F | CR for fixing errors of 4Rx CA in Rel-14  | 14.4.0 |
| 06/2017 | RP-76 | RP-171285 | 4339 |   | F | CR for correction of eLAA UE RF requirements  | 14.4.0 |
| 06/2017 | RP-76 | RP-171307 | 4356 | 1 | F | CR for LAA extension for PDSCH performance with multiple CCs in unlicensed bands                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171301 | 4358 |   | A | Correction of NPDSCH and NPDCCH   | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4360 |   | A | Maintenance CR for 4Rx WI (Rel-14)  | 14.4.0 |
| 06/2017 | RP-76 | RP-171310 | 4367 |   | F | CR for PDSCH fixed reference channel (Rel-14)   | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4373 |   | A | CR on 4-RX TM9 MU-MIMO performance requirements (Rel-14)  | 14.4.0 |
| 06/2017 | RP-76 | RP-171298 | 4375 |   | A | CR on PDCCH/PCFICH DL Control Channel IM Type A TDD test case correction (Rel-14)                               | 14.4.0 |
| 06/2017 | RP-76 | RP-171048 | 4379 | 1 | B | Addition of Band 28 UE category 1bis into TS 36.101   | 14.4.0 |
| 06/2017 | RP-76 | RP-171282 | 4380 | 1 | F | CR on applicability of V2X contiguous intraband multi-carrier operation requirements.                           | 14.4.0 |
| 06/2017 | RP-76 | RP-171309 | 4383 |   | A | Correction to Table A.4-1 and A.4-16 for CatM1.   | 14.4.0 |
| 06/2017 | RP-76 | RP-171310 | 4385 |   | A | Correction to minimum requirement for CatM1 Single-Layer Spatial Multiplexing                                   | 14.4.0 |
| 06/2017 | RP-76 | RP-171300 | 4389 |   | A | CR for demodulation of NB-IoT correction (Rel.14)   | 14.4.0 |
| 06/2017 | RP-76 | RP-171307 | 4391 |   | A | CR for LAA TDD test case correction (Rel.14)  | 14.4.0 |
| 06/2017 | RP-76 | RP-171395 | 4397 |   | F | Correction to the table of intra-band non-contiguous CA with one uplink configuration for reference sensitivity | 14.4.0 |
| 06/2017 | RP-76 | RP-171263 | 4398 | 1 | B | CR on performance requirements for MUST Case 1 and Case 2   | 14.4.0 |
| 06/2017 | RP-76 | RP-171263 | 4399 | 1 | B | CR on performance requirements for MUST Case 3  | 14.4.0 |
| 06/2017 | RP-76 | RP-171263 | 4400 |   | B | CR on Fixed Reference Channels for MUST   | 14.4.0 |
| 06/2017 | RP-76 | RP-171263 | 4401 | 1 | B | CR on applicability rule for MUST Case 3  | 14.4.0 |
| 06/2017 | RP-76 | RP-171297 | 4405 |   | A | Correction of N_RB_agg for CA_41C and CA_7C in Table 7.3.1A-1   | 14.4.0 |
| 06/2017 | RP-76 | RP-171296 | 4412 |   | A | Correction to Mapping of CQI Index to Modulation coding scheme for 256QAM                                       | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4414 |   | A | CR for correction of 4RX demodulation requirements (Rel-14)   | 14.4.0 |
| 06/2017 | RP-76 | RP-171278 | 4417 |   | B | Introduction of new 3DL/2UL CA band combinations in rel-14  | 14.4.0 |
| 06/2017 | RP-76 | RP-171278 | 4418 |   | B | Introduction of new 4DL/2UL CA band combination in Rel-14   | 14.4.0 |
| 06/2017 | RP-76 | RP-171290 | 4419 | 1 | F | Correction on the additional SE for Band 41 UE in rel-14  | 14.4.0 |

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| 06/2017 | RP-76 | RP-171282 | 4420 | 1 | F | CR on V2X Pmax for non-concurrent operation   | 14.4.0 |
| 06/2017 | RP-76 | RP-171311 | 4424 |   | A | Correction of test points for Single-antenna port performance TDD FDD CA                        | 14.4.0 |
| 06/2017 | RP-76 | RP-171272 | 4425 | 1 | B | Introduction of additional band combinations for Intra-band CA                                  | 14.4.0 |
| 06/2017 | RP-76 | RP-171275 | 4426 | 2 | B | Introduction of Rel-14 4DL/1UL combinations in 36.101   | 14.4.0 |
| 06/2017 | RP-76 | RP-171282 | 4428 |   | F | Clean ups of TS36.101 for V2X requirements  | 14.4.0 |
| 06/2017 | RP-76 | RP-171256 | 4432 | 1 | B | CR for V2V Performance Requirements   | 14.4.0 |
| 06/2017 | RP-76 | RP-171261 | 4433 |   | B | CR to 36.101: Introduction of FeMBMS numerologies   | 14.4.0 |
| 06/2017 | RP-76 | RP-171285 | 4435 | 1 | F | Correction to A-MPR tables and in-band emissions for eLAA                                       | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4437 |   | A | CR for FRC overview table for 4 layer SDR tests (R14)   | 14.4.0 |
| 06/2017 | RP-76 | RP-171269 | 4438 |   | D | Maintenance CR for demodulation and CQI tests for Cat.1bis UE                                   | 14.4.0 |
| 06/2017 | RP-76 | RP-171307 | 4440 | 1 | A | Maintenance CR for LAA demodulation tests   | 14.4.0 |
| 06/2017 | RP-76 | RP-171274 | 4441 |   | F | Correction on uplink limitation of 3DL CA 8A-11A-28A  | 14.4.0 |
| 06/2017 | RP-76 | RP-171282 | 4442 |   | F | Some corrections on V2X in TS 36.101  | 14.4.0 |
| 06/2017 | RP-76 | RP-171273 | 4443 |   | B | Introduction of completed R14 2DL band combinations to TS 36.101                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171274 | 4444 |   | B | Introduction of completed R14 3DL band combinations to TS 36.101                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4446 | 1 | F | 4Rx REFSSENS requirements spec improvement for 36.101   | 14.4.0 |
| 06/2017 | RP-76 | RP-171311 | 4448 |   | A | CR for adding TDD 4 DL CA bandwidth combination for CQI CA tests in Rel-14                      | 14.4.0 |
| 06/2017 | RP-76 | RP-171304 | 4450 |   | A | CR for adding applicability rule for MU TM9 4Rx tests in Rel-14                                 | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4451 | 1 | F | CR for updating applicability rule for SDR CA tests for 4Rx CA in Rel-14                        | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4452 | 1 | B | CR for further updating IRC tests for 4Rx CA in Rel-14  | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4453 | 1 | B | CR for introducing applicability rule for 256QAM and higher layer tests for 4Rx CA              | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4454 | 1 | B | CR for introducing 256QAM tests for 4Rx CA in Rel-14  | 14.4.0 |
| 06/2017 | RP-76 | RP-171268 | 4455 | 1 | B | CR for introducing high layers tests for 4Rx CA in Rel-14                                       | 14.4.0 |
| 06/2017 | RP-76 | RP-171277 | 4457 |   | F | Correction CR on 2UL CA for CA_2A-66A   | 14.4.0 |
| 06/2017 | RP-76 | RP-171277 | 4458 |   | B | Introduction of completed R14 2DL2UL band combinations to TS 36.101                             | 14.4.0 |
| 06/2017 | RP-76 | RP-171299 | 4460 |   | F | Channel Raster For Multiple Standalone NB-IoT Carriers (TS 36.101)                              | 14.4.0 |
| 06/2017 | RP-76 | RP-171276 | 4461 |   | B | 5DL UE CR   | 14.4.0 |
| 06/2017 | RP-76 | RP-171287 | 4462 |   | B | CA bandwidth class Class B 256-QAM non-contiguous resource allocation MPR                       | 14.4.0 |
| 06/2017 | RP-76 | RP-171280 | 4463 |   | F | Corrections to CA configurations and bandwidth combination sets                                 | 14.4.0 |
| 06/2017 | RP-76 | RP-171300 | 4464 |   | F | NB1/NB2 OOB note 3 correction   | 14.4.0 |
| 06/2017 | RP-76 | RP-171285 | 4465 | 1 | F | Removing notes in two tables in UE spec wrt applicability of UL and DL requirements for band 46 | 14.4.0 |
| 06/2017 | RP-76 | RP-171311 | 4467 |   | A | Correction on TDD-FDD CSI test cases (R14)  | 14.4.0 |
| 06/2017 | RP-76 | RP-171257 | 4468 | 1 | F | Clean up the requirements for UE enhancement in SFN scenario                                    | 14.4.0 |
| 06/2017 | RP-76 | RP-171256 | 4469 | 1 | B | CR for V2V FRCs   | 14.4.0 |
| 06/2017 | RP-76 | RP-171256 | 4470 | 1 | B | CR for V2V resource pool configuration  | 14.4.0 |
| 06/2017 | RP-76 | RP-171297 | 4473 |   | A | Corrections for inCoverage configuration in ProSe direct communication (Rel-14)                 | 14.4.0 |
| 06/2017 | RP-76 | RP-171299 | 4475 |   | A | CR for NB-IoT Absolute power tolerance  | 14.4.0 |
| 06/2017 | RP-76 | RP-171307 | 4477 | 1 | B | Introduce LBT model for multile LAA Scell(s) in LAA demodulation                                | 14.4.0 |
| 06/2017 | RP-76 | RP-171395 | 4482 |   | F | Missing entries in list of intra-band CA bands  | 14.4.0 |
| 06/2017 | RP-76 | RP-171289 | 4483 |   | F | Correction to NS_27 A-MPR table   | 14.4.0 |
| 06/2017 | RP-76 | RP-171307 | 4484 | 1 | F | Update of LAA REFSSENS exclusion region   | 14.4.0 |
| 06/2017 | RP-76 | RP-171266 | 4485 | 2 | B | CR for CAT-M2 REFSSENS, MPR and adding note for protection band 5                               | 14.4.0 |
| 09/2017 | RP-77 | RP-171940 | 4487 | 1 | F | Corrections on Rel-14 CA requirements   | 14.5.0 |
| 09/2017 | RP-77 | RP-171708 | 4490 | 1 | F | CR for adding missing table for TDD 4 DL CQI CA tests in Rel-14                                 | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4495 | 1 | F | CR for correcting TDD-FDD CA TM9 IRC tests for 4Rx CA in Rel-14                                 | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4497 |   | F | CR for updating applicability rule of 4Rx CA in Rel-14  | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4498 | 2 | F | CR for further updating IRC TM9 SINR requirements for 4Rx CA in Rel-14                          | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4499 | 1 | B | CR for introducing 256QAM SNR requirements for 4Rx CA in Rel-14                                 | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4500 | 1 | B | CR for introducing 3 and 4 layers SNR requirements for 4Rx CA in Rel-14                         | 14.5.0 |
| 09/2017 | RP-77 | RP-171932 | 4501 | 1 | B | CR for introduction of PMCH and PDSCH demodulation tests for FeMBMS                             | 14.5.0 |

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| 09/2017 | RP-77 | RP-171941 | 4502 |   | F | Corrections of Notes on REFSSENS exception in 3DL/1UL of 1A-11A-28A and 3A-11-28A   | 14.5.0 |
| 09/2017 | RP-77 | RP-171941 | 4503 |   | F | Modification of REFSSENS exception in 4DL/1UL of 1A-3A-8A-11A   | 14.5.0 |
| 09/2017 | RP-77 | RP-171973 | 4505 | 1 | F | Addition of OCNB Pattern for LAA Rx tests   | 14.5.0 |
| 09/2017 | RP-77 | RP-171940 | 4508 | 1 | F | CR to 36.101 with corrections of newly introduced CA combinations   | 14.5.0 |
| 09/2017 | RP-77 | RP-171971 | 4510 |   | A | PDSCH Demodulation downlink power allocation parameters for UEs supporting coverage enhancement. This CR was NOT implemented as it didn't use revision marks and the cover sheet information was wrong. | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4514 |   | A | Correction to Test Parameters for MPDCCH in Table 8.11.2.1-1  | 14.5.0 |
| 09/2017 | RP-77 | RP-171965 | 4515 | 2 | A | Correction of band 43 spurious emissions limit (Rel-14)   | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4520 |   | F | eHST RF: Further clarifications to HST-SFN scenario model (Rel-14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171941 | 4522 | 2 | F | Correction to B26 Cat 0 REFSSENS  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4523 | 1 | B | CR on Enhanced CRS-IM PDSCH performance requirements  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4524 |   | B | CR on Enhanced CRS-IM PDSCH FRCs  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4525 | 2 | B | CR on Enhanced CRS-IM PDCCH/PCFICH performance requirements   | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4526 | 1 | B | CR on Enhanced CRS-IM PDSCH requirements applicability rules  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4527 | 1 | B | CR on Enhanced CRS-IM DL control channels requirements applicability rules  | 14.5.0 |
| 09/2017 | RP-77 | RP-171943 | 4532 | 1 | F | Correction on the resource pool configuration for V2V demodulation tests  | 14.5.0 |
| 09/2017 | RP-77 | RP-171935 | 4533 | 1 | B | CR for V2X resource pool configuration  | 14.5.0 |
| 09/2017 | RP-77 | RP-171941 | 4537 | 1 | F | Minor corrections to B70 specifications   | 14.5.0 |
| 09/2017 | RP-77 | RP-171947 | 4539 |   | A | Band 68 modification to enable operation in Europe  | 14.5.0 |
| 09/2017 | RP-77 | RP-171967 | 4544 | 1 | A | Band 31 modification to add DTV protection Rel-14   | 14.5.0 |
| 09/2017 | RP-77 | RP-171940 | 4547 | 1 | F | Corrections to Rel-14 CA configurations   | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4549 |   | A | Correction to demodulation requirements for coverage enhancement UEs  | 14.5.0 |
| 09/2017 | RP-77 | RP-171972 | 4551 | 1 | A | Correction to ON/OFF time mask for NB-IoT   | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4553 |   | A | Correction of UE-selected subband CQI test for eMTC   | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4555 |   | A | Correction of RMC for Cat-M1 TDD PDSCH demodulation requirements  | 14.5.0 |
| 09/2017 | RP-77 | RP-171969 | 4557 | 1 | A | Addition of scheduling pattern with repetition for Cat-M1 UL FRC  | 14.5.0 |
| 09/2017 | RP-77 | RP-171969 | 4559 |   | A | Correction of missing reference to Cat-M1 DL FRC tables   | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4560 |   | B | CR for test applicability rule for 4 Rx CA tests  | 14.5.0 |
| 09/2017 | RP-77 | RP-171940 | 4561 |   | F | CR for correcting FRC for Cat.1 bis demodulation test   | 14.5.0 |
| 09/2017 | RP-77 | RP-171940 | 4564 |   | F | Correction CR on 5DL CA for CA_1A-3A-7A-7A-26A  | 14.5.0 |
| 09/2017 | RP-77 | RP-171941 | 4566 |   | F | 4Rx spec correction CR for 36.101   | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4568 |   | F | Maintenance of performance requirements for MUST  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4569 |   | B | CR for test applicability rule for enhanced SU-MIMO   | 14.5.0 |
| 09/2017 | RP-77 | RP-171935 | 4570 | 1 | B | CR for V2X sidelink FRC   | 14.5.0 |
| 09/2017 | RP-77 | RP-171943 | 4572 | 1 | F | Some corrections on V2X in TS 36.101  | 14.5.0 |
| 09/2017 | RP-77 | RP-171943 | 4578 | 1 | F | CR on V2X duplexer mode in rel-14   | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4582 | 1 | B | CR for CAT-M2 FRC   | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4583 | 1 | F | CR for CAT-M2 REFSSENS for FDD/TDD  | 14.5.0 |
| 09/2017 | RP-77 | RP-171943 | 4586 | 1 | F | CR for V2V performance requirements (maintenance)   | 14.5.0 |
| 09/2017 | RP-77 | RP-171935 | 4587 | 1 | B | CR for V2X test cases   | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4588 | 1 | B | CR for enhanced SU-MIMO performance requirements  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4589 | 1 | B | CR for enhanced SU-MIMO FRCs  | 14.5.0 |
| 09/2017 | RP-77 | RP-171939 | 4590 |   | B | CR for MIMO correlation matrices  | 14.5.0 |
| 09/2017 | RP-77 | RP-171964 | 4597 |   | A | Correction for EPA delay profiles of r.m.s delay spread (Rel-14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4599 |   | F | Maintenance CR for channel model for HST-SFN scenario   | 14.5.0 |
| 09/2017 | RP-77 | RP-171942 | 4600 |   | F | Maintenance CR for FRC for HST-SFN scenario   | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4602 |   | A | CR for requirements of Cat-1bis and Cat-0(R14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4604 |   | A | CR for requirements of MPDCCH with 2Rx and 4Rx(R14)   | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4606 |   | A | CR for requirements of TM2 with 2Rx and 4Rx(R14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4610 |   | A | CR for requirements of TM9 with 2Rx and 4Rx(R14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171970 | 4612 |   | A | Correction to FRC Table A.3.4.2.1-7 for eMTC (R14)  | 14.5.0 |
| 09/2017 | RP-77 | RP-171937 | 4613 | 1 | B | CR for NB-IoT enhancements  | 14.5.0 |
| 09/2017 | RP-77 | RP-171972 | 4615 |   | A | CR for R13 NB-IoT performance requirements maintenances (R14)   | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4620 |   | F | Addition of new Rel-14 CA 3DL CC test cases for 4Rx CA  | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4625 |   | F | Addition of new Rel-14 CA 4DL CC test cases for 4Rx CA  | 14.5.0 |
| 09/2017 | RP-77 | RP-171938 | 4630 |   | F | Addition of new Rel-14 CA 5DL CC test cases for 4Rx CA  | 14.5.0 |

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| 09/2017 | RP-77 | RP-171965 | 4634 |   | A | Apply CA demodulation performance requirements with 30us timing difference between two CCs to intra-band non-contiguous CA case | 14.5.0 |
| 09/2017 | RP-77 | RP-171966 | 4639 |   | A | Update to CA_NS_04 SEM and additional spurious emissions  | 14.5.0 |
| 09/2017 | RP-77 | RP-171969 | 4648 |   | A | CR for Remove bracket for NS_07 in A-MPR requirement for CAT-M1   | 14.5.0 |
| 09/2017 | RP-77 | RP-171943 | 4649 |   | F | CR on band definition for sidelink operation in band 47   | 14.5.0 |
| 09/2017 | RP-77 | RP-171955 | 4506 | 1 | B | Introduction of Rel-15 LTE Intra-band combinations in 36.101  | 15.0.0 |
| 09/2017 | RP-77 | RP-171958 | 4507 |   | B | Introduction of additional band combinations for 4DL CA   | 15.0.0 |
| 09/2017 | RP-77 | RP-171948 | 4536 |   | B | Introduction of the FDD L-band (Band 74) into TS 36.101   | 15.0.0 |
| 09/2017 | RP-77 | RP-171946 | 4541 | 1 | B | Introduction of Band 72 into TS 36.101  | 15.0.0 |
| 09/2017 | RP-77 | RP-171959 | 4545 |   | B | 5DL/1UL CR to TS 36.101   | 15.0.0 |
| 09/2017 | RP-77 | RP-171962 | 4565 |   | B | Big CR for introduction new band support for 4Rx antenna ports R15 for LTE  | 15.0.0 |
| 09/2017 | RP-77 | RP-171957 | 4567 |   | B | Introduction of completed R15 3DL band combinations to TS 36.101  | 15.0.0 |
| 09/2017 | RP-77 | RP-171956 | 4571 | 3 | B | Introduction of completed combination to 36.101   | 15.0.0 |
| 09/2017 | RP-77 | RP-171960 | 4573 | 1 | B | Introduction of completed R15 2DL/2UL band combinations to TS 36.101  | 15.0.0 |
| 09/2017 | RP-77 | RP-171951 | 4574 |   | B | Introduction of power class 1 HPUE in Band 3, 20 and 28   | 15.0.0 |
| 09/2017 | RP-77 | RP-171961 | 4576 |   | B | Introduction of additional 3DL/2UL CA band combinations w/o self-interference issues in Rel-15                                  | 15.0.0 |
| 09/2017 | RP-77 | RP-171961 | 4577 | 1 | B | Introduction of additional 4DL/2UL CA band combinations w/o self-interference issues in Rel-15                                  | 15.0.0 |
| 09/2017 | RP-77 | RP-171963 | 4579 |   | B | Addition of band 28 and 40 to LTE MTC Cat.0   | 15.0.0 |
| 09/2017 | RP-77 | RP-171953 | 4581 |   | B | Introduction of V2X new band combinations in Rel-15   | 15.0.0 |
| 09/2017 | RP-77 | RP-171949 | 4598 | 1 | B | Introduction of TDD L-band TS 36.101  | 15.0.0 |
| 09/2017 | RP-77 | RP-171952 | 4635 | 2 | B | Introduction of Band 71 to 36.101   | 15.0.0 |
| 09/2017 | RP-77 | RP-171950 | 4640 | 1 | B | Introduction of Extended 1.5 GHz SDL bands 75 and 76  | 15.0.0 |
| 09/2017 | RP-77 | RP-172047 | 4650 |   | B | Additional LTE bands for UE category M1, NB1, M2, NB2 in Rel-15   | 15.0.0 |
| 12/2017 | RP-78 | RP-172574 | 4654 |   | A | Correction to Test Parameters for Cat M1 PUCCH 1-0 static test  | 15.1.0 |
| 12/2017 | RP-78 | RP-172607 | 4657 |   | A | Correction of the reference channel for the LAA CSI test  | 15.1.0 |
| 12/2017 | RP-78 | RP-172590 | 4658 |   | B | Introduction of completed R15 2DL/2UL band combinations to TS 36.101  | 15.1.0 |
| 12/2017 | RP-78 | RP-172611 | 4661 |   | A | CR for NB-IoT Transmit Intermodulation  | 15.1.0 |
| 12/2017 | RP-78 | RP-172610 | 4667 | 1 | A | Corrections to NPDCCH configuration in NPDSCH test case   | 15.1.0 |
| 12/2017 | RP-78 | RP-172613 | 4676 | 1 | A | Updates to performance requirements in 8.3.1.1 and 8.3.2.1A   | 15.1.0 |
| 12/2017 | RP-78 | RP-172584 | 4678 |   | A | Maintenance CR for V2V (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172585 | 4680 |   | A | Maintenance CR for V2X (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172582 | 4682 |   | A | Maintenances CR for eSU-MIMO (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172608 | 4685 | 1 | A | CR for MPDCCH with 2Rx/4Rx (R15)  | 15.1.0 |
| 12/2017 | RP-78 | RP-172608 | 4688 | 1 | A | CR for TM2/TM9 with 2Rx/4Rx (R15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172608 | 4691 |   | A | CR on redundancy version for BL/CE UEs (R15)  | 15.1.0 |
| 12/2017 | RP-78 | RP-172586 | 4700 |   | A | CR on reflection of FCC regulation for vehicle mounted UE at Band 30 in rel-15  | 15.1.0 |
| 12/2017 | RP-78 | RP-172608 | 4704 |   | A | Applicability of CQI test for coverage enhancement for non-BL CE UE (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78 | RP-172583 | 4706 |   | A | Introduction of DL FRC for FeMTC RF test (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172579 | 4708 | 1 | A | Introduction of UE demodulation and CQI requirements for FeMTC (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78 | RP-172584 | 4714 |   | A | CR on correction of V2V Test requirement for power imbalance test   | 15.1.0 |
| 12/2017 | RP-78 | RP-172581 | 4717 | 1 | A | CR for updating TDD CQI CA tests in Rel-15  | 15.1.0 |
| 12/2017 | RP-78 | RP-172582 | 4720 | 1 | A | CR for updating overview table for 4Rx RMC in Rel-15  | 15.1.0 |
| 12/2017 | RP-78 | RP-172582 | 4722 | 1 | A | CR for removing square bracket for 4Rx CA tests in Rel-15   | 15.1.0 |
| 12/2017 | RP-78 | RP-172593 | 4728 |   | B | Introduction of Band 73 into TS 36.101  | 15.1.0 |
| 12/2017 | RP-78 | RP-172582 | 4732 |   | A | Corrections to CA_29A-66C, CA_29A-70A and CA_29A-66A-66A  | 15.1.0 |
| 12/2017 | RP-78 | RP-172597 | 4733 |   | F | Corrections to B29 CA related specifications  | 15.1.0 |
| 12/2017 | RP-78 | RP-172572 | 4734 |   | B | ProSe support for Band 72   | 15.1.0 |
| 12/2017 | RP-78 | RP-172582 | 4737 |   | A | Correction to supported bandwidths for CA configurations with Band 30   | 15.1.0 |
| 12/2017 | RP-78 | RP-172580 | 4740 |   | A | NPDSCH demodulation test parameter and minimum requirement for CatNB2 UE Rel.15   | 15.1.0 |
| 12/2017 | RP-78 | RP-172581 | 4741 |   | A | Correction of MPR for CA BW Class D   | 15.1.0 |
| 12/2017 | RP-78 | RP-172603 | 4744 | 1 | F | Adding missing UE co-existence requirements for B71   | 15.1.0 |
| 12/2017 | RP-78 | RP-172596 | 4745 |   | B | CR for 36101  | 15.1.0 |
| 12/2017 | RP-78 | RP-172586 | 4747 |   | A | CR for EIRP based requirements in V2X   | 15.1.0 |



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| 12/2017 | RP-78  | RP-172586 | 4749 | 1 | A | CR for CEN DSRC and HDR DSRC coex requirement for V2X  | 15.1.0 |
| 12/2017 | RP-78  | RP-172573 | 4751 |   | A | Draft CR for introduction of eFD-MIMO PMI test cases   | 15.1.0 |
| 12/2017 | RP-78  | RP-172573 | 4753 |   | A | CR for introducing eFD-MIMO demodulation performance requirements  | 15.1.0 |
| 12/2017 | RP-78  | RP-172573 | 4755 |   | A | Draft CR for introduction of eFD-MIMO Hybrid CSI test cases  | 15.1.0 |
| 12/2017 | RP-78  | RP-172573 | 4757 |   | A | CR for introducing FRC for eFD-MIMO performance requirements test cases  | 15.1.0 |
| 12/2017 | RP-78  | RP-172612 | 4760 | 1 | A | Correction CR for FD-MIMO performance requirements (R15 CAT A)   | 15.1.0 |
| 12/2017 | RP-78  | RP-172610 | 4763 |   | A | Correction to NPDCCH configuration in demodulation test case   | 15.1.0 |
| 12/2017 | RP-78  | RP-172585 | 4765 |   | A | CR on SNR values modification for V2X demodulation test cases (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78  | RP-172583 | 4767 |   | A | CR for introducing B1 Cat.M2 UE A-MPR in Japan into 36.101   | 15.1.0 |
| 12/2017 | RP-78  | RP-172595 | 4768 |   | B | Introduction of additional band combinations for Intra-band CA   | 15.1.0 |
| 12/2017 | RP-78  | RP-172704 | 4769 |   | B | Introduction of Rel-15 LTE 4DL/1UL combinations in 36.101  | 15.1.0 |
| 12/2017 | RP-78  | RP-172586 | 4772 |   | A | Correction of channel spacing for band 46 intraband CA band combinations with 10 MHz bandwidth   | 15.1.0 |
| 12/2017 | RP-78  | RP-172598 | 4773 |   | B | Introduction of 5DL CA combinations to 36.101  | 15.1.0 |
| 12/2017 | RP-78  | RP-172611 | 4777 | 1 | A | NB-IoT removal of repetition sensitivity requirement Rel-15  | 15.1.0 |
| 12/2017 | RP-78  | RP-172601 | 4778 |   | F | Correction to band 72  | 15.1.0 |
| 12/2017 | RP-78  | RP-172582 | 4780 |   | F | Correction of CR Implementation error to 36.101 (REL-15)   | 15.1.0 |
| 12/2017 | RP-78  | RP-172594 | 4781 | 3 | B | Introduction of Band 49  | 15.1.0 |
| 12/2017 | RP-78  | RP-172602 | 4782 | 2 | F | CR to 36.101: corrections for HPUE requirements  | 15.1.0 |
| 12/2017 | RP-78  | RP-172585 | 4784 | 1 | A | Correction on V2X resource pool configuration  | 15.1.0 |
| 12/2017 | RP-78  | RP-172587 | 4785 | 2 | B | Add sTTI support to 6.3.4 ON/OFF Mask section  | 15.1.0 |
| 12/2017 | RP-78  | RP-172587 | 4786 | 2 | B | Add sTTI support to sub-clauses related to Max output power, MPR, A-MPR and min output power of 36.101   | 15.1.0 |
| 12/2017 | RP-78  | RP-172587 | 4787 | 4 | B | Add sTTI support to remaining sub-clauses of 36.101  | 15.1.0 |
| 12/2017 | RP-78  | RP-172612 | 4793 |   | A | CSI 4RX: Correction to RI tests and used reference channels and MCS schemes (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78  | RP-172607 | 4796 |   | A | Correction of FRC for Cat-M1 UE maximum input level test (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172581 | 4799 |   | A | Corrections to FeMBMS demodulation test FRC rel.15   | 15.1.0 |
| 12/2017 | RP-78  | RP-172590 | 4802 |   | B | Introduction of completed R15 2DL/2UL band combinations to TS 36.101   | 15.1.0 |
| 12/2017 | RP-78  | RP-172610 | 4804 |   | A | CR for NB-IoT Additional Spectrum Emission Mask  | 15.1.0 |
| 12/2017 | RP-78  | RP-172606 | 4808 | 2 | A | Corrections on operating band table for CA (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172591 | 4810 |   | B | Introduction of new xDL/2UL CA band combinations in Rel-15   | 15.1.0 |
| 12/2017 | RP-78  | RP-172581 | 4811 | 2 | A | Corrections on inter-band CA operating bands (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172612 | 4814 | 2 | A | Corrections on the description of requirements for inter-band CA (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172592 | 4815 | 1 | B | Introduction of power class 2 HPUE in Band 38  | 15.1.0 |
| 12/2017 | RP-78  | RP-172582 | 4819 |   | A | CR for further updating SDR 4Rx tests in Rel-15  | 15.1.0 |
| 12/2017 | RP-78  | RP-172597 | 4820 |   | B | Introduction of completed R15 3DL band combinations to TS 36.101   | 15.1.0 |
| 12/2017 | RP-78  | RP-172598 | 4821 |   | F | Correction to Uplink configurations for CA_5DL_1A-1A-3C-7A_1UL_BCS0, CA_5DL_1A-3C-7A-8A_1UL_BCS0 and max aggregation bandwidth for CA_1A-3C-7A-20A | 15.1.0 |
| 12/2017 | RP-78  | RP-172585 | 4823 |   | A | CR for updating overview table for V2X (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172606 | 4827 |   | A | CR for updating overview table for Sidelink (Rel-15)   | 15.1.0 |
| 12/2017 | RP-78  | RP-172584 | 4829 |   | A | Corrections to UL 256QAM RMCs  | 15.1.0 |
| 12/2017 | RP-78  | RP-172612 | 4832 |   | A | Addition of beamforming model to chapter 9 4Rx TM9 requirements  | 15.1.0 |
| 12/2017 | RP-78  | RP-172582 | 4837 | 2 | A | Correction to Rel-15 CA configurations   | 15.1.0 |
| 12/2017 | RP-78  | RP-172581 | 4839 | 1 | A | Correction to section 8.11.1.2.3   | 15.1.0 |
| 12/2017 | RP-78  | RP-172597 | 4840 |   | F | Correction to Rel-15 CA configurations   | 15.1.0 |
| 12/2017 | RP-78  | RP-172587 | 4841 | 2 | B | PCMAC for single carrier in Rel-15 sTTI operation  | 15.1.0 |
| 12/2017 | RP-78  | RP-172587 | 4842 | 2 | B | PCMAC for UL CA in Rel-15 sTTI operation   | 15.1.0 |
| 12/2017 | RP-78  | RP-172581 | 4844 |   | A | Addition of new 3DL CCs related test cases (Rel-15)  | 15.1.0 |
| 12/2017 | RP-78  | RP-172586 | 4851 |   | A | CR on Uplink and sidelink configure for REFSense table   | 15.1.0 |
| 12/2017 | RP-78  | RP-172589 | 4852 |   | B | Introduction of PC2 for CA_41C   | 15.1.0 |
| 12/2017 | RP-78  | RP-172605 | 4857 |   | A | Update to A-MPR for CA_NS_04   | 15.1.0 |
| 12/2017 | RP-78  | RP-172586 | 4859 |   | A | Correction of IMD Exclusion zone BW caused by dual uplink CA with band 46  | 15.1.0 |
| 12/2017 | RP-78  | RP-172549 | 4860 |   | B | Introduction of missing 3DL fallbacks to 4DL combinations  | 15.1.0 |
| 2018-03 | RAN#79 | RP-180265 | 4862 | 1 | B | CR on UE RF requirements for DL 1024QAM in TS 36.101   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180296 | 4864 |   | A | Update EVM requirements for V2X  | 15.2.0 |

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| 2018-03 | RAN#79 | RP-180296 | 4866 |   | A | CR on IBE requirements for intra-band contiguous multiple carriers                              | 15.2.0 |
| 2018-03 | RAN#79 | RP-180266 | 4867 | 1 | F | CR for TS 36.101: Removal UE requirements for shared spectrum channel access                    | 15.2.0 |
| 2018-03 | RAN#79 | RP-180277 | 4868 | 1 | B | Introduction of power class 2 HPUE in Band 40 and 42 to TS 36.101                               | 15.2.0 |
| 2018-03 | RAN#79 | RP-180275 | 4870 |   | B | Introduction of additional xDL/2UL CA band combinations in rel-15                               | 15.2.0 |
| 2018-03 | RAN#79 | RP-180298 | 4872 |   | A | Correction to Test Parameters for Cat M1 PUCCH 1-0 static test                                  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180292 | 4875 |   | A | Correction to UE-selected subband CQI test for eMTC   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180296 | 4877 |   | A | CR for removing square bracket for V2X eNB sync test (Rel-15)                                   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180295 | 4879 |   | A | Correction on FRC for 4Rx CA tests (Rel-15)   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180292 | 4883 |   | A | Maintennace CR for R13 Non-BL/UE requirements (R15)   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180292 | 4885 |   | A | PDSCH Demodulation downlink power allocation parameters for UEs supporting coverage enhancement | 15.2.0 |
| 2018-03 | RAN#79 | RP-180295 | 4888 |   | A | Correction to DL power allocation of CSI reporting for 4Rx UE in 9.9.4.1                        | 15.2.0 |
| 2018-03 | RAN#79 | RP-180291 | 4891 |   | A | Corrections to LAA CQI reporting requirements   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180291 | 4894 |   | A | Addition of two sided OCNG pattern for FS3  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180276 | 4898 |   | B | Introduction of UL CA_41C-42C into TS36.101   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180297 | 4903 |   | A | Correction of A-MPR table for UE Cat.M2 of Band 1   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180294 | 4908 |   | A | Correction on Test Parameters for FRC for CA more than 3DL CA                                   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180272 | 4909 |   | B | Introduction of completed R15 3DL/1UL band combinations to TS 36.101                            | 15.2.0 |
| 2018-03 | RAN#79 | RP-180269 | 4910 | 2 | B | CR on UE RF requirement for 8Rx   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180270 | 4911 |   | B | Introduction of additional band combinations for Intra-band CA                                  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180273 | 4912 |   | B | Introduction of Rel-15 LTE 4DL/1UL combinations in 36.101                                       | 15.2.0 |
| 2018-03 | RAN#79 | RP-180290 | 4921 |   | A | Correction for CA CQI tests (R15)   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180268 | 4922 | 2 | B | CR for enhanced PDCCH demodulation performance for category 1bis UE with CRS-IM                 | 15.2.0 |
| 2018-03 | RAN#79 | RP-180284 | 4923 | 1 | F | Correction of a target band for FDD class 1 HP-UE   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180294 | 4926 | 1 | A | Corrections to Spurious emission band UE co-existence for CA                                    | 15.2.0 |
| 2018-03 | RAN#79 | RP-180295 | 4928 |   | A | Correction CR for Semi-OL rank1 test (CAT A)  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180279 | 4929 | 1 | B | CR to 36.101: Introduction of Band 85 (B12-extended)  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180285 | 4932 |   | A | PC2 for CA_41C REL-15   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180286 | 4933 | 1 | F | Correction of band 72 MOP   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180283 | 4936 | 1 | F | Correction to UL-MIMO MOP Table Rel-15  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180271 | 4937 |   | F | MSD for CA_2A-71A   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180271 | 4938 | 1 | F | Introduction of CA band combination basis Delta TIB,c table                                     | 15.2.0 |
| 2018-03 | RAN#79 | RP-180271 | 4939 | 1 | F | Introduction of CA band combination basis Delta RIB,c table                                     | 15.2.0 |
| 2018-03 | RAN#79 | RP-180298 | 4941 |   | A | Clean up of PDSCH demodulation requirements for FeMTC   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180290 | 4948 |   | A | Adding note about timing difference for TDD CA (2Rx)  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180299 | 4950 |   | A | Adding note about timing difference for TDD CA and TDD FDD CA (4Rx)                             | 15.2.0 |
| 2018-03 | RAN#79 | RP-180292 | 4953 |   | A | CR to 36.101: Introduction of A-MPR table for NS4 and NS12 for CAT-M1                           | 15.2.0 |
| 2018-03 | RAN#79 | RP-180294 | 4956 |   | A | CSI 4RX: Correction to reference channels and MCS schemes used in RI tests (Rel-15)             | 15.2.0 |
| 2018-03 | RAN#79 | RP-180286 | 4957 |   | F | Correction to Band 72 ProSe frequencies   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180271 | 4959 |   | B | CR for 36.101   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180295 | 4961 |   | A | CR on Enhanced CRS-IM test case applicability (Rel-15)  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180299 | 4963 |   | A | CR on definition of 4x1 MIMO correlation matrices (Rel-15)                                      | 15.2.0 |
| 2018-03 | RAN#79 | RP-180299 | 4965 |   | A | CR to TS 36.101: Correction of CA table 7.3.1A-0bD R15  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180299 | 4967 |   | A | CR to TS 36.101: Correction of CA table 7.3.1A-6 R15  | 15.2.0 |
| 2018-03 | RAN#79 | RP-180278 | 4969 | 1 | B | Introduction of TDD 3.3-3.4GHz band (band 52)   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180274 | 4970 |   | B | Introduction of 5DL CA combinations to 36.101   | 15.2.0 |
| 2018-03 | RAN#79 | RP-180292 | 4973 |   | A | Correction of MPDCCH performance requirements   | 15.2.0 |
| 2018-06 | RAN#80 | RP-181086 | 4974 | 1 | B | Enhanced PDCCH demodulation performance for category 1bis UE with CRS-IM TDD                    | 15.3.0 |
| 2018-06 | RAN#80 | RP-181115 | 4980 |   | A | CR on absolute power tolerance for V2X  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181104 | 4982 | 1 | F | CR on UE-to-UE coexistence requirements for LTE band 71   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181092 | 4985 |   | B | Introduction of 5DL CA combinations to 36.101 (This CR was superseded by CR#5096)               | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 4986 | 1 | F | Corrections to B66+B70+B71 related Inter-band CA combinations                                   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181097 | 4987 |   | B | TS 36.101 big CR for introduction new band support for 4Rx antenna ports R15 for LTE            | 15.3.0 |
| 2018-06 | RAN#80 | RP-181108 | 4992 |   | A | CA_NS_08 correction for TS 36.101 R15   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181087 | 4993 | 1 | B | CR for 36.101: 8Rx CA RF requirement  | 15.3.0 |

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| 2018-06 | RAN#80 | RP-181086 | 4994 | 1 | B | CR on 1RX CRS-IM PDSCH Cat1bis performance requirements                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181086 | 4995 | 1 | B | CR on 1RX CRS-IM PDSCH CatM2 performance requirements   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181086 | 4996 | 1 | B | CR on 1RX CRS-IM MPDCCH CatM2 performance requirements  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181086 | 4997 |   | B | CR on 1RX CRS-IM test case applicability  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181078 | 4998 | 1 | B | CR on FeCoMP UE PDSCH demodulation requirements   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181114 | 5000 |   | A | CR on Enhanced 4RX SU-MIMO test cases correction (Rel-15)                                     | 15.3.0 |
| 2018-06 | RAN#80 | RP-181112 | 5003 |   | A | Clarification on TX-RX frequency separation for stand-alone NB-IoT operation                  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181114 | 5005 | 1 | A | Addition of UL RMC for eLAA R15   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181108 | 5009 |   | A | Clarification of Transmission Modes for REFSEN test R15                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181108 | 5013 |   | A | Correction for CA CQI tests (R15)   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181105 | 5021 |   | F | Cat.F CR for UE-to-UE co-existence for Band 3 in Japan (Rel-15)                               | 15.3.0 |
| 2018-06 | RAN#80 | RP-181077 | 5025 | 1 | F | Clarification on sTTI applicability and wording fixes   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181098 | 5026 |   | F | CR to 36.101: Removed note for B42 PC2 from UE power class Table                              | 15.3.0 |
| 2018-06 | RAN#80 | RP-181115 | 5028 |   | A | Correction to RMC for UL 256QAM   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181111 | 5031 |   | A | Update to eMTC demod requirements   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181091 | 5035 |   | B | Introduction of Rel-15 LTE 4DL/1UL combinations in 36.101 (This CR was superseded by CR#5098) | 15.3.0 |
| 2018-06 | RAN#80 | RP-181103 | 5036 |   | F | Correction of UE co-existence from bands 12/17 into band 51                                   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181111 | 5039 |   | A | Correction of UE co-existence from band 28 into band 66                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181111 | 5041 |   | A | Correction of UE co-existence from band 28 into band 66 (CA part 1)                           | 15.3.0 |
| 2018-06 | RAN#80 | RP-181111 | 5042 |   | F | Correction of UE co-existence from band 28 into band 66 (CA part 2)                           | 15.3.0 |
| 2018-06 | RAN#80 | RP-181093 | 5043 |   | B | Introduction of more than 5DL CA combinations to 36.101                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181081 | 5044 | 2 | B | CR ON_OFF mask for feLAA  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181083 | 5045 | 1 | B | MPR for PC6 CAT-M1 and CAT-M2   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181106 | 5051 |   | A | CR: Corrections for CSI tests (Rel-15)  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181108 | 5054 |   | A | Correction to uplink configuration for CA_25A-41C   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181089 | 5055 |   | B | CR to add new 2DL1UL CA combos to 36101   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181090 | 5056 |   | B | Introduction of Rel-15 LTE 3DL/1UL combinations in 36.101 (This CR was superseded by CR#5109) | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5057 |   | F | Improvement of REFSENS exceptions due to harmonic issue                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181095 | 5058 |   | B | Introduction of 3UL CA into TS36.101  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5059 |   | F | Improvement of REFSENS exceptions for due to close proximity of UL to DL channel              | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5060 |   | F | Improvement of REFSENS exceptions due to harmonic issues in mixed intra and inter-band CA     | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5061 |   | F | Improvement of REFSENS exceptions due to cross band isolation issues                          | 15.3.0 |
| 2018-06 | RAN#80 | RP-181113 | 5064 |   | A | Correction to DL power allocation of CSI reporting for 4Rx UE in 9.9.4.2                      | 15.3.0 |
| 2018-06 | RAN#80 | RP-181110 | 5067 |   | A | Correction to CQI reporting definition on PUSCH static test                                   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181094 | 5070 |   | F | CR to add note 19 to CA_26A-41A and CA_5A-41A in harmonic table                               | 15.3.0 |
| 2018-06 | RAN#80 | RP-181078 | 5072 | 1 | B | CR on FeCoMP UE CSI reporting requirements  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181089 | 5073 | 1 | F | CR to correct Note 18 in table 7.3.1A-0bE in rel 15   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181089 | 5074 | 1 | B | CR for 36101 to update 2DL1UL CA basket items   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181116 | 5077 |   | A | Correction to Rel-14 CA configurations  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5078 |   | F | Addition of Band 72 and 73 to chapter 8 and 9 general clauses                                 | 15.3.0 |
| 2018-06 | RAN#80 | RP-181110 | 5081 |   | A | Correction to LAA RMC (Rel-14)  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181110 | 5084 |   | A | Update to chapter 8 LAA requirements  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181091 | 5085 |   | F | Corrections to Rel-15 CA configurations   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181094 | 5086 |   | B | Introduction of additional xDL/2UL CA band combinations in rel-15                             | 15.3.0 |
| 2018-06 | RAN#80 | RP-181096 | 5087 |   | B | CR on introduction of new V2X band combinations in rel-15                                     | 15.3.0 |
| 2018-06 | RAN#80 | RP-181084 | 5088 | 2 | B | NB-IoT: Adding TDD support in TS 36.101   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181115 | 5091 |   | A | Removal of square brackets from eNB-IoT UE demodulation requirements                          | 15.3.0 |
| 2018-06 | RAN#80 | RP-181093 | 5092 |   | B | Introduction of more than 5DL CA combinations to 36.101                                       | 15.3.0 |
| 2018-06 | RAN#80 | RP-181111 | 5095 |   | A | Correction to eMTC subband CQI test R15   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181092 | 5096 |   | B | Introduction of 5DL CA combinations to 36.101   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181091 | 5098 |   | B | Introduction of Rel-15 LTE 4DL/1UL combinations in 36.101                                     | 15.3.0 |
| 2018-06 | RAN#80 | RP-181104 | 5099 | 1 | F | Adding missing spurious emission UE co-existence requirement for B70                          | 15.3.0 |

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| 2018-06 | RAN#80 | RP-181079 | 5102 | 1 | B | CR on introduction of Tx Diversity scenario for eV2X in TS 36.101                                 | 15.3.0 |
| 2018-06 | RAN#80 | RP-181079 | 5103 |   | B | CR on introduction of sidelink 64QAM in TS 36.101   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181079 | 5104 |   | B | CR on introduction of new eV2X scenarios in TS 36.101   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181116 | 5107 |   | A | CR to add nominal guard band for CA bandwidth class F   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181083 | 5108 | 1 | B | CR_UE RF requirement on subPRB feature  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181090 | 5109 |   | B | Introduction of completed R15 3DL/1UL band combinations to TS 36.101                              | 15.3.0 |
| 2018-06 | RAN#80 | RP-181107 | 5114 |   | A | Update to CA_NS_04 requirements   | 15.3.0 |
| 2018-06 | RAN#80 | RP-181108 | 5118 |   | A | Update to NS_04 requirements  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181116 | 5120 |   | A | Update to NS_27 requirements  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181092 | 5124 |   | F | Missing channel bandwidths and editorial corrections  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181101 | 5125 | 2 | B | Introduction of power class 1 HPUE in Band 31 and 72  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181100 | 5128 | 2 | F | CR on Correction on Band 74 requirement on protecting EESS  | 15.3.0 |
| 2018-06 | RAN#80 | RP-181088 | 5129 |   | B | Introduction of Rel-15 LTE Intra-band combinations in 36.101                                      | 15.3.0 |
| 2018-06 | RAN#80 | RP-181115 | 5130 |   | A | CR on A-SE, A-SEM and A-MPR for V2X Service in Band 47  | 15.3.0 |
| 2018-09 | RAN#81 | RP-181899 | 5169 | 1 | B | CR_UE RF requirement on low output power  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181899 | 5170 | 1 | B | CR_UE RF requirement on subPRB feature  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181902 | 5164 |   | F | CR on UE category for DL 1024QAM in TS 36.101   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181902 | 5141 | 2 | B | CR: test case for reduced DMRS  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181903 | 5167 |   | F | CR on V2X reference measurement channel for R15   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181908 | 5190 | 1 | A | Correction on Table 7.3.1-3 Network signalling value for reference sensitivity                    | 15.4.0 |
| 2018-09 | RAN#81 | RP-181909 | 5159 |   | A | Mirror CR Rel-15 towards TS 36.101 to remove square brackets for CA_4A-7A_12A                     | 15.4.0 |
| 2018-09 | RAN#81 | RP-181909 | 5150 | 1 | F | Correction on Table 6.6.3.2A-0 Requirements for uplink inter-band carrier aggregation (two bands) | 15.4.0 |
| 2018-09 | RAN#81 | RP-181912 | 5135 |   | A | Correction of cqi-pmi-ConfigurationIndex for PUCCH 1-0 static test on multiple cells              | 15.4.0 |
| 2018-09 | RAN#81 | RP-181913 | 5179 |   | A | Corrections of Rel-15 CA specs  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181913 | 5173 | 1 | A | CR to add CA_1-21-42 in exception table   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181913 | 5163 | 1 | A | CR correction of UL CA configuration CA_40D REFSENS requirement Rel-15                            | 15.4.0 |
| 2018-09 | RAN#81 | RP-181914 | 5138 |   | A | CR on A-SE, A-SEM and A-MPR for V2X Service in Band 47  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181914 | 5193 |   | A | CR on frame structure type for band 47  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181914 | 5168 | 1 | A | CR on V2X reference measurement channel for 64QAM   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181916 | 5132 |   | A | Correction on the typo in subclause 9.11.1  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181916 | 5152 | 1 | A | Correction on Table 7.3.1A-0bE  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181916 | 5154 | 1 | F | Correction on Table 7.3.1A-5  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181916 | 5160 | 1 | A | Rel-15 CR towards TS 36.101 to correct errors in notes  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5139 |   | F | CR on 1RX CRS-IM requirements corrections   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5140 |   | F | CR on FeCoMP requirements corrections   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5177 |   | F | Corrections of REFSENS exceptions   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5181 |   | F | Corrections to Rel-15 CA configurations   | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5176 | 1 | F | Corrections of Rel-15 CA specs  | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5183 | 1 | B | Introduction of missing R15 2DL2UL band combinations to TS 36.101                                 | 15.4.0 |
| 2018-09 | RAN#81 | RP-181917 | 5146 | 1 | F | Correction on Table 6.6.3.2-1 Spurious emission band UE co-existence                              | 15.4.0 |
| 2018-12 | RAN#82 | RP-182383 | 5196 |   | F | UE category M1 and M2 MPR section corrections Rel-15  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5199 |   | F | Simplification of CA UE to UE co-ex table by adopting CA band approach                            | 15.5.0 |
| 2018-12 | RAN#82 | RP-182385 | 5204 |   | A | Correction to PDSCH CA and DC Demodulation (4 Rx Ant ports)                                       | 15.5.0 |
| 2018-12 | RAN#82 | RP-182369 | 5206 | 1 | B | CR for eV2X FRCs and resource pool configuration  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182369 | 5207 |   | F | CR on RMC for sidelink 64QAM  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5210 |   | F | Correction of BCS for CA_3A-3A-7A-20A and CA_2A-46A-48C-66A                                       | 15.5.0 |
| 2018-12 | RAN#82 | RP-182364 | 5214 | 3 | B | Introduction of Slot/Subslot-PDSCH demodulation requirements                                      | 15.5.0 |
| 2018-12 | RAN#82 | RP-182364 | 5215 | 3 | B | Introduction of SPDCCH demodulation requirements  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182364 | 5216 | 3 | B | Introduction of CQI tests for sTTI  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182365 | 5217 | 3 | B | Introduction of UE demodulation requirements for eFeMTC   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182365 | 5218 | 2 | B | Introduction of CQI reporting requirements for eFeMTC   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182381 | 5225 | 1 | A | Correction of spurious emission band UE co-existence for NB-IoT                                   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182374 | 5227 | 2 | B | CR on introduction of 6CCs and 7CCs FDD/TDD CA demodulation performance requirements              | 15.5.0 |
| 2018-12 | RAN#82 | RP-182374 | 5228 | 2 | B | CR on introduction of 6CCs and 7CCs FDD-TDD CA demodulation performance requirements              | 15.5.0 |

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| 2018-12 | RAN#82 | RP-182374 | 5229 | 2 | B | CR on introduction of 6CCs and 7CCs SDR test cases requirements  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182383 | 5232 |   | A | Clarification of applicability for demodulation requirement for CE UE R15                                    | 15.5.0 |
| 2018-12 | RAN#82 | RP-182368 | 5233 |   | F | Clarification of applicability rule and test parameter for OCC4-based TM9 rank4 demodulation requirement R15 | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5234 | 1 | F | Correction to test parameter in 1Rx CRS-IM demodulation requirement  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182382 | 5239 | 1 | F | Correction of LTE UE requirements for inter-band CA - R15  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5244 |   | B | CR: Addition of propagation conditions related with 8Rx  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182368 | 5245 | 3 | B | CR:For 1024QAM DL demodulation requirements under fading propagation conditions                              | 15.5.0 |
| 2018-12 | RAN#82 | RP-182385 | 5252 |   | F | Updating the limit of the Power Spectral Density for LAA in Korea  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182385 | 5257 | 1 | F | Correction on REFSSENS exception of CA_3A-28A-42C for REL-15   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182379 | 5261 | 1 | A | Correction to frequency of CA_4A-7A for MSD with inter-band 2UL  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182362 | 5263 | 1 | B | Introduction of NR band protection in TS36.101   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182369 | 5264 |   | B | CR on eV2X UE soft buffer and SDR requirements   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182386 | 5265 | 1 | B | CR to TS 36.101: Implementation of UL PRB to DL PRB center offset for TDD NB-IoT                             | 15.5.0 |
| 2018-12 | RAN#82 | RP-182369 | 5266 | 1 | B | CR for eV2X single link PSSCH tests and PSCCH decoding capability test cases                                 | 15.5.0 |
| 2018-12 | RAN#82 | RP-182381 | 5273 |   | A | PDSCH traffic pattern in 4Rx PHICH Demodulation test - Rel-15  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182379 | 5275 | 1 | A | MCG/SCG Abbreviations in TS36.101 in rel-15  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182385 | 5280 |   | A | Remove the brackets in Rel-14 V2V AMPR   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182385 | 5285 |   | A | Corrections of REFSSENS exceptions in Rel-15 Cas   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5286 | 1 | F | Misc corrections on Rel-15 CAs   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182366 | 5291 | 1 | A | CR MPR for NB-IoT PC6 Rel-15   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182374 | 5293 |   | B | CR on introduction of 6CCs and 7CCs LAA CA demodulation performance requirements                             | 15.5.0 |
| 2018-12 | RAN#82 | RP-182365 | 5298 | 1 | B | CR_UE RF requirement on subPRB feature_cat_M1  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182365 | 5299 |   | B | CR_UE RF requirement on subPRB feature_cat_M2  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5301 |   | F | Rel-15 CR to remove NS_04 requirements   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5303 | 1 | B | CR on 8Rx CA RF requirement for TS 36.101  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182372 | 5306 | 1 | B | CR for demodulation performance requirements for network-based CRS interference mitigation                   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5307 | 1 | B | CR: applicability and test rules for 8Rx capable UEs   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5308 | 1 | B | CR: Addition of performance requirements for 8Rx   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5309 | 1 | B | CR: Addition of SDR test for 8Rx   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182368 | 5312 | 1 | B | CR: SDR test cases with 1024QAM DL   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182368 | 5313 | 1 | B | CR: For 1024QAM DL CSI requirements  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5314 | 2 | F | CR for 36.101: PC2 UTRA ACLR exemption list update   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5317 | 2 | F | CR for 36.101: Introduction of a PC3 UTRA ACLR exemption list  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5318 | 1 | F | CR to TS 36.101 – revision of OOB for B42  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182388 | 5319 | 2 | F | CR to TS 36.101 – Add RF requirements for CA 66C   | 15.5.0 |
| 2018-12 | RAN#82 | RP-182373 | 5320 |   | B | CR: Addition of CQI tests for 8Rx  | 15.5.0 |
| 2018-12 | RAN#82 | RP-182376 | 5195 | 1 | B | Introduction of band 53 into TS 36.101   | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5202 |   | B | Introducing CR on new xDL/2UL CA band combinations in TS36.101 rel-16  | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5208 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101        | 16.0.0 |
| 2018-12 | RAN#82 | RP-182377 | 5220 |   | B | CR of adding LTE B65 for UE category NB1 and NB2 in R16  | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5292 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101               | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5297 |   | B | Introduction of completed LTE CA for 2 bands DL with 2 band into Rel-16 TS 36.101                            | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5300 |   | B | Introduction of Rel-16 LTE Intra-band combinations in 36.101   | 16.0.0 |
| 2018-12 | RAN#82 | RP-182375 | 5302 |   | B | Introduction of completed LTE CA for 3 bands DL with 1 bands UL into Rel-16 TS 36.101                        | 16.0.0 |
| 2019-03 | RAN#83 | RP-190401 | 5327 | 1 | A | V2X UE protection to NR bands in TS36.101  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190405 | 5374 |   | A | Correction of UE demodulation requirements for SPDCCH  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190405 | 5376 |   | A | Correction of UE demodulation requirements for Slot/Subslot-PDSCH  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190405 | 5378 |   | A | Correction of sTTI CQI reporting test  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190406 | 5362 |   | A | CR: Addition of performance requirements for FeNB-IoT TDD NPBCH(Rel-16)                                      | 16.1.0 |
| 2019-03 | RAN#83 | RP-190406 | 5366 |   | A | CR: Addition of performance requirements for FeNB-IoT TDD NPDSCH(Rel-16)                                     | 16.1.0 |

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| 2019-03 | RAN#83 | RP-190406 | 5364 | 1 | A | CR: Addition of performance requirements for FeNB-IoT TDD NPDCCH(Rel-16)                                 | 16.1.0 |
| 2019-03 | RAN#83 | RP-190408 | 5352 |   | A | CR: Addition of FRC for 8Rx(Rel-16)  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190408 | 5354 |   | A | CR: Updates to the applicability and test rule for 8Rx capable UE(Rel-16)                                | 16.1.0 |
| 2019-03 | RAN#83 | RP-190408 | 5356 |   | A | CR: Updates to 8Rx demodulation performance requirements(Rel-16)   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190408 | 5358 |   | A | CR: Updates to 8Rx SDR tests(Rel-16)   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190408 | 5360 |   | A | CR: Updates to 8Rx CQI tests(Rel-16)   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190409 | 5324 |   | B | Introducing CR on new x bands (x=3,4,5) DL with 2 bands UL inter-band CA in TS36.101 rel-16              | 16.1.0 |
| 2019-03 | RAN#83 | RP-190409 | 5329 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101    | 16.1.0 |
| 2019-03 | RAN#83 | RP-190409 | 5347 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101           | 16.1.0 |
| 2019-03 | RAN#83 | RP-190409 | 5388 |   | B | Introduction of Rel-16 LTE Intra-band combinations in 36.101   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190409 | 5402 |   | B | Introduction of completed LTE CA for 3 bands DL with 1 bands UL into Rel-16 TS 36.101                    | 16.1.0 |
| 2019-03 | RAN#83 | RP-190411 | 5341 |   | A | CR on protection Band 32, 75 and 76 for Band 28 and corresponding band combinations                      | 16.1.0 |
| 2019-03 | RAN#83 | RP-190414 | 5372 |   | A | CR: Correction to 4Rx TDD CQI TC 9.9.1.4.2 (Rel-16)  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190415 | 5336 |   | A | CR on absolut power tolerance for V2X  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190415 | 5401 |   | A | Correction of PCmax requirement for V2X  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190415 | 5344 | 1 | A | Corrections to Rel-16 CA configurations  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190420 | 5349 |   | A | CR to 36.101: frequency offset between anchor and non-anchor carrier for TDD NB-IoT standalone operation | 16.1.0 |
| 2019-03 | RAN#83 | RP-190420 | 5368 |   | A | CR: Updates to test cases for 1024QAM (Rel-16)   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190420 | 5385 |   | A | CR for TDD requirements for network-based CRS interference mitigation (Rel-16)                           | 16.1.0 |
| 2019-03 | RAN#83 | RP-190420 | 5323 | 1 | A | CR to 36.101 on simulation parameters and FRCs for 1024QAM testcases                                     | 16.1.0 |
| 2019-03 | RAN#83 | RP-190421 | 5380 |   | A | Correction of PDSCH demodulation requirements for eFeMTC   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190421 | 5382 |   | A | Correction of CQI reporting test requirements for eFeMTC   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5331 |   | A | Editorial correction R15 CA  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5406 |   | A | Correction on eV2X demodulation requirements   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5405 |   | A | CR TS 36.101 Update of LAA REFSENS exclusion region for B25 and B12                                      | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5403 |   | A | CR TS 36.101 Introduction of a PC3 UTRA ACLR exemption list for CA                                       | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5333 | 1 | A | CA Rx requirement for more than five downlink carriers   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5346 | 1 | A | Corrections to Rel-16 CA configurations  | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5383 | 1 | A | Alignment of Foob related description for 36.101   | 16.1.0 |
| 2019-03 | RAN#83 | RP-190422 | 5408 | 1 | A | CR to 36.101 for CA configuration on CA_3A-41C-42C   | 16.1.0 |
| 2019-06 | RAN#84 | RP-191261 | 5413 | 1 | A | CR to exclude 100kHz for NBIOT for B26 band edge operation   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5415 | 2 | A | CR for 36.101 adding band 46 for Rx spurious emissions(Rel-16)   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5421 |   | A | Finalize UE demodulation requirements for CRS-IM   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5423 |   | A | Finalize UE demodulation requirements for sTTI   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5425 |   | A | Finalize CQI reporting test for sTTI   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191267 | 5427 |   | A | Editorial corrections for 36.101 CA OOB additional spectrum emission requirements                        | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5431 |   | A | Update 4Rx Requirement for Band 30   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191264 | 5435 | 1 | A | CR for correcting A-MPR for subPRB for CAT-M1 and CAT-M2 type A  | 16.2.0 |
| 2019-06 | RAN#84 | RP-191264 | 5437 |   | A | CR: Updates to V2X test applicability(Rel-16)  | 16.2.0 |
| 2019-06 | RAN#84 | RP-191265 | 5441 |   | A | CR on antenna configurations for NB-IoT demodulation performance requirements (Rel-16)                   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5444 |   | B | Introduction of completed LTE CA for 2 bands DL with 2 bands UL into Rel-16 TS 36.101                    | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5446 | 1 | A | Shadow CR for TS 36.101: CA_NS_04 A-MPR Corrections (Rel-16)   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191258 | 5447 | 1 | F | CR for TS 36.101: Add B25 MSD for CA_25-41   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191256 | 5449 | 1 | B | Introduction of bands 87 and 88 into TS 36.101   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191259 | 5453 |   | A | Correction to demodulation of PDCCH for LAA  | 16.2.0 |
| 2019-06 | RAN#84 | RP-191266 | 5455 |   | A | CR: cleanup for LTE 8Rx DL (Rel-16)  | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5458 |   | B | Introduction of completed LTE CA for 2 bands DL with 2 bands UL into Rel-16 TS 36.101                    | 16.2.0 |
| 2019-06 | RAN#84 | RP-191261 | 5461 | 1 | A | CR to Rel-16 TS 36.101 CA_NS_08 A-MPR  | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5465 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101    | 16.2.0 |

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| 2019-06 | RAN#84 | RP-191267 | 5470 |   | A | CR to TS 36.101 - NB-IoT REFSENS requirement being band agnostic                                      | 16.2.0 |
| 2019-06 | RAN#84 | RP-191259 | 5474 |   | A | Correction to demodulation of PDSCH LAA   | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5475 |   | B | Introducing CR on new x bands (x=3,4,5) DL with 2 bands UL inter-band CA in TS36.101 rel-16           | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5476 |   | B | Introducing CR on new x bands (x=3,4,5) DL with 2 bands UL inter-band CA in TS36.101 rel-16           | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5478 |   | B | Introduction of completed R16 3DL band combinations to TS 36.101                                      | 16.2.0 |
| 2019-06 | RAN#84 | RP-191255 | 5480 | 1 | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101        | 16.2.0 |
| 2019-09 | RAN#85 | RP-192056 | 5484 |   | A | Correction to reference sensitivity for Band 74   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192056 | 5490 |   | A | CR to 36.101 rel. 16 to fix Out-of-band Blocking issue for bands 51, 76                               | 16.3.0 |
| 2019-09 | RAN#85 | RP-192051 | 5494 |   | A | Correction to RMC for Cat M1 CSI tests  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192041 | 5495 | 3 | B | CR: Demod test definition for HST in 500km/h speed  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192056 | 5497 |   | A | CR to 36.101 NS_40, NS_41, NS_42 spurious emission requirement  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192045 | 5498 |   | B | Introduction of PC2 for Category HD-FDD M1 and M2 UE operating on bands 31 and 72                     | 16.3.0 |
| 2019-09 | RAN#85 | RP-192051 | 5502 |   | A | CR for Narrowband blocking for LTE CatM1/M2   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5503 | 1 | B | Introduction of LTE-A inter-band CA Rel-16 for new x bands (x=3,4,5) DL with 2 bands UL to TS36.101   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192052 | 5506 |   | A | Correction to B70 UE Co-existence   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5511 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101 | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5512 |   | B | Introduction of completed R16 3DL band combinations to TS 36.101                                      | 16.3.0 |
| 2019-09 | RAN#85 | RP-192052 | 5513 | 1 | A | CR for 36.101 Pcmx for V2X_v16  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192043 | 5519 | 1 | B | CR of adding LTE B42/B43 for UE category NB1/NB2 and CAT_M1/M2 in R16                                 | 16.3.0 |
| 2019-09 | RAN#85 | RP-192043 | 5520 | 1 | B | CR of adding LTE B7 for UE category NB1/NB2 in R16  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5521 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101        | 16.3.0 |
| 2019-09 | RAN#85 | RP-192056 | 5522 |   | A | CR for 36.101: adding spurious emission band UE co-existence for CA_1-41                              | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5524 | 1 | F | Rel-16 CR to 36.101 to correct typos  | 16.3.0 |
| 2019-09 | RAN#85 | RP-192056 | 5526 | 1 | A | Update NS_40 into TS 36.101   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192056 | 5527 | 1 | A | Update NS_42 into TS 36.101   | 16.3.0 |
| 2019-09 | RAN#85 | RP-192042 | 5529 |   | B | Introduction of completed LTE CA for 2 bands DL with 2 bands UL into Rel-16 TS 36.101                 | 16.3.0 |
| 2019-12 | RAN#86 | RP-193046 | 5537 |   | A | CR: Updates to HST-SFN channel model (Rel-16)   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193044 | 5552 | 1 | F | CR to 36.101 to revise LTE CA_NS_04 AMPR for BW class D   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193043 | 5555 |   | A | CR to 36.101 to revise CA_NS_04 AMPR for BW Class C   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193043 | 5558 |   | A | CR to 36.101 rel. 15 to fix Out-of-band Blocking issue for bands 38, 41                               | 16.4.0 |
| 2019-12 | RAN#86 | RP-193043 | 5560 |   | A | CR to 36.101 rel. 15 to fix Out-of-band Blocking issue for bands 32                                   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193027 | 5561 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101 | 16.4.0 |
| 2019-12 | RAN#86 | RP-193027 | 5562 |   | D | Remove double entry of CA_41F   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193049 | 5564 |   | A | Correction of Note number in Table 5.6.1-1  | 16.4.0 |
| 2019-12 | RAN#86 | RP-193046 | 5567 |   | A | DeltaTib for CA_1-7-46  | 16.4.0 |
| 2019-12 | RAN#86 | RP-193046 | 5570 |   | A | CR for correction on Rel-14 eFDMIMO PMI test cases with advanced codebook for TS 36.101 (Rel-16)      | 16.4.0 |
| 2019-12 | RAN#86 | RP-193044 | 5571 | 3 | B | Adding Band40 for UE category 1bis into Rel-16 TS 36.101  | 16.4.0 |
| 2019-12 | RAN#86 | RP-193027 | 5573 |   | B | Introduction of LTE-A inter-band CA for x bands (x=3,4,5) DL with 2 bands UL into TS36.101            | 16.4.0 |
| 2019-12 | RAN#86 | RP-193043 | 5578 |   | A | Correction to intraband contiguous CA in-band and out-of-band blocking tables REL-16                  | 16.4.0 |
| 2019-12 | RAN#86 | RP-193026 | 5579 | 1 | B | CR on introducing UE demodulation tests for 500km/h velocity  | 16.4.0 |
| 2019-12 | RAN#86 | RP-193026 | 5580 | 1 | B | Introduction of CA PDSCH demodulation requirements with HST-SFN                                       | 16.4.0 |
| 2019-12 | RAN#86 | RP-193023 | 5581 | 1 | B | CR to TS 36.101 - NB-IoT in NR in-band support clarifications   | 16.4.0 |
| 2019-12 | RAN#86 | RP-193027 | 5583 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101        | 16.4.0 |
| 2019-12 | RAN#86 | RP-193026 | 5584 | 1 | B | CR for Addition of test applicability rule for LTE HST CA test(Re-16)                                 | 16.4.0 |
| 2019-12 | RAN#86 | RP-193027 | 5587 |   | B | Introduction of completed R16 3DL band combinations to TS 36.101                                      | 16.4.0 |
| 2019-12 | RAN#86 | RP-193046 | 5588 |   | A | CR for 36.101 UE-to-UE coexistence for V2X_v16  | 16.4.0 |

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| 2020-03 | RAN#87-e | RP-200414 | 5591 |   | B | Introduction of LTE inter-band Carrier Aggregation for x bands DL (x=4, 5) with 1 band UL to TS36.101                | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200414 | 5593 |   | A | Mirror CR for 36.101: Missing P <sub>max</sub> tolerance for 23-33 dBm in Table 6.2.5A-2 and Table 6.2.5B-1          | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200412 | 5596 |   | F | CR to TS 36.101: Finalization on PDSCH demodulation with 500km/h velocity  | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200414 | 5599 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101                       | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200500 | 5601 |   | B | Introduction of completed R16 3DL band combinations to TS 36.101   | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200416 | 5602 | 1 | B | CR for TS 36.101-1 Introduction of new SRS requirements for LTE eMIMO  | 16.5.0 |
| 2020-03 | RAN#87-e | RP-200384 | 5595 | 1 | B | Introducing new channel bandwidth for band n28   | 16.5.0 |
| 2020-06 | RAN#88   | RP-201060 | 5608 |   | A | CR Coexistence cleanup for 36101 Rel16   | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5613 |   | A | CR for TS 36.101: CR for spec corrections for MSD table  | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5615 |   | A | Corrections of CA band combo table   | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5618 |   | A | Mirror CR for 36.101: fix modifiedMPRbehavior for NS_31  | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5619 |   | B | Introduction of LTE-A inter-band CA for x bands (x=3,4,5) DL with 2 bands UL to TS36.101                             | 16.6.0 |
| 2020-06 | RAN#88   | RP-200961 | 5620 |   | B | Adding Band34 for UE category 1bis into Rel-16 TS 36.101   | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5622 |   | A | CR: Updates to FeNB-IoT UE performance requirements in 36.101 (Rel-16)   | 16.6.0 |
| 2020-06 | RAN#88   | RP-200991 | 5627 |   | A | CR: Updates to LTE CQI test cases 9.2.1.7 and 9.2.1.8 (Rel-16)   | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5629 |   | A | CR: Introduction for intra-band contiguous CA performance requirements for FDD with minimum channel spacing (Rel-16) | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5633 |   | B | Introduction of Rel-16 LTE inter-band CA for 2 bands DL with 1 band UL combinations in TS36101                       | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5636 |   | A | CR to remove TBD and bracket on CAT-M2 Type A for Rel-16   | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5638 |   | F | CR Rel-16 for editorial corrections TS 36.101  | 16.6.0 |
| 2020-06 | RAN#88   | RP-200967 | 5639 |   | F | CR for Band 53 NS_45 requirement and OOB blocking  | 16.6.0 |
| 2020-06 | RAN#88   | RP-201045 | 5640 | 1 | B | Addition of UE coexistence between US bands and NR Band n77  | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5641 |   | B | Introduction of completed R16 3DL band combinations to TS 36.101   | 16.6.0 |
| 2020-06 | RAN#88   | RP-201060 | 5646 |   | B | Introduction of completed LTE CA for 2 bands DL with 2 bands UL into Rel-16 TS 36.101                                | 16.6.0 |
| 2020-06 | RAN#88   | RP-200989 | 5649 |   | A | CR to remove TBD for A-MPR for NS_33 in 36.101 Rel-16  | 16.6.0 |
| 2020-06 | RAN#88   | RP-200988 | 5651 |   | A | CR to remove TBD in in clause 6.6.3 in 36.101 Rel-16   | 16.6.0 |
| 2020-09 | RAN#89   | RP-201512 | 5653 |   | A | Correction to band 85 spurious emission limits UE co-existence   | 16.7.0 |
| 2020-09 | RAN#89   | RP-201535 | 5654 | 1 | F | Coexistence cleanup for 36101 Rel16  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201512 | 5656 | 2 | F | A-MPR definition for CA_48B  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201512 | 5659 |   | A | Correction of OCNG configuration for LAA SDR requirements  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201512 | 5661 |   | A | Addition of applicability for MTC UE capable of 64QAM DL   | 16.7.0 |
| 2020-09 | RAN#89   | RP-201508 | 5662 | 1 | B | Introduction of enhanced MPDCCCH demodulation requirements   | 16.7.0 |
| 2020-09 | RAN#89   | RP-201508 | 5663 | 1 | B | Introduction of CSI-RS based PMI reporting test for non-BL UEs   | 16.7.0 |
| 2020-09 | RAN#89   | RP-201512 | 5667 |   | F | Correction of band combinations table in Rel-16  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201510 | 5669 | 1 | B | CR to 36.101: Introduction of LTE based 5G terrestrial broadcast numerologies  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201512 | 5670 |   | A | Update to NB-IOT aggregate power control tolerance for TDD   | 16.7.0 |
| 2020-09 | RAN#89   | RP-201510 | 5671 | 1 | B | CR addition on LTE-based 5G terrestrial broadcast  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201509 | 5672 | 1 | B | CR: Introduce NPDSCH performance requirements for multi-TB interleaved transmission.                                 | 16.7.0 |
| 2020-09 | RAN#89   | RP-201535 | 5673 |   | F | CR to 36.101 Removal band 10 protection  | 16.7.0 |
| 2020-09 | RAN#89   | RP-201535 | 5675 |   | F | CR to 36.101 Correction to CA_NS_10  | 16.7.0 |
| 2020-12 | RAN#90   | RP-202484 | 5676 |   | F | Correction of B88 UL EARFCN  | 16.8.0 |
| 2020-12 | RAN#90   | RP-202493 | 5682 | 1 | A | Clarifications and corrections on UE co-ex requirements(R16)   | 16.8.0 |
| 2020-12 | RAN#90   | RP-202484 | 5683 |   | F | LTE CA corrections   | 16.8.0 |
| 2020-12 | RAN#90   | RP-202482 | 5684 |   | F | Band 88 and 87 bracket removal   | 16.8.0 |
| 2020-12 | RAN#90   | RP-202484 | 5686 |   | F | Coexistence cleanup for 36101 Rel16  | 16.8.0 |
| 2020-12 | RAN#90   | RP-202498 | 5690 |   | A | CR for 36.101 to clarify the SCS supports for LTE MBMS (Rel-16)  | 16.8.0 |
| 2020-12 | RAN#90   | RP-202512 | 5693 | 1 | A | CR on cleanup for LTE FeMBMS(Rel-16)   | 16.8.0 |
| 2020-12 | RAN#90   | RP-202481 | 5694 | 1 | F | CR on cleanup for LTE-based 5G terrestrial broadcast   | 16.8.0 |
| 2020-12 | RAN#90   | RP-202474 | 5696 | 1 | F | CR: Cleanup for NPDSCH performance requirements for multi-TB interleaved transmission in TS 36.101                   | 16.8.0 |



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| 2020-12 | RAN#90  | RP-202492 | 5698 | 2 | A | CR for 36.101: Cleanup for performance requirements of sTTI (Rel-16)                                  | 16.8.0  |
| 2020-12 | RAN#90  | RP-202473 | 5700 |   | F | Clean up of enhanced MPDCCH demodulation requirements   | 16.8.0  |
| 2020-12 | RAN#90  | RP-202473 | 5701 | 1 | F | Clean up of CSI-RS based PMI reporting test for non-BL UEs  | 16.8.0  |
| 2020-12 | RAN#90  | RP-202510 | 5703 | 1 | A | CR Correction to B72 coex - CA_NS_08 - Band 10 protection 36.101 Rel16                                | 16.8.0  |
| 2020-12 | RAN#90  | RP-202477 | 5707 | 1 | F | CR for editorial corrections 36.101   | 16.8.0  |
| 2020-12 | RAN#90  | RP-202477 | 5708 |   | F | CR for 36.101: Corrections for UL CA_41D  | 16.8.0  |
| 2020-12 | RAN#90  | RP-202476 | 5709 |   | B | Introduction of completed R17 3DL band combinations to TS 36.101                                      | 16.8.0  |
| 2021-03 | RAN#91  | RP-210119 | 5718 |   | A | CR for missing B48 references in a table and note   | 16.9.0  |
| 2021-03 | RAN#91  | RP-210109 | 5721 |   | F | CR for 36.101 to add missing spurious emissions for band 38 UE co-existence (Rel-16)                  | 16.9.0  |
| 2021-03 | RAN#91  | RP-210109 | 5725 | 1 | F | CR for TS 36.101: Cleanup for spurious emissions for UE co-existence table                            | 16.9.0  |
| 2021-03 | RAN#91  | RP-210111 | 5733 | 1 | A | CR for 36.101: Corrections related to Band 24 regulatory updates                                      | 16.9.0  |
| 2021-06 | RAN#92  | RP-211076 | 5738 |   | A | Correction of LTE 5DL CA demodulation requirements  | 16.10.0 |
| 2021-06 | RAN#92  | RP-211076 | 5741 |   | A | Correction to NB-IoT TDD RMCs   | 16.10.0 |
| 2021-06 | RAN#92  | RP-211076 | 5746 |   | A | Correction to NB-IoT HD-FDD RMCs  | 16.10.0 |
| 2021-06 | RAN#92  | RP-211077 | 5748 |   | F | CR LTE CA corrections R16 CAT F   | 16.10.0 |
| 2021-06 | RAN#92  | RP-211092 | 5757 |   | A | CR for updates related to LTE band 24 in 36.101 (Rel-16)  | 16.10.0 |
| 2021-06 | RAN#92  | RP-211092 | 5768 |   | A | CR to TS 36.101[R16]: Addition of UE co-existence requirements for band 40                            | 16.10.0 |
| 2021-06 | RAN#92  | RP-211077 | 5773 | 1 | F | Cleanup for UE co-existence 36.101 Rel-16   | 16.10.0 |
| 2021-06 | RAN#92  | RP-211105 | 5777 |   | F | CR on MSD test configurations for dual uplink LTE-A CA  | 16.10.0 |
| 2021-06 | RAN#92  | RP-211076 | 5782 |   | A | CR: Updates to LTE V2V PSSCH/PSCCH requirements and cleanup for square brackets in TS 36.101 (Rel-16) | 16.10.0 |
| 2021-06 | RAN#92  | RP-211093 | 5790 |   | A | CR of updating the subPRB UE aspect   | 16.10.0 |
| 2021-06 | RAN#92  | RP-211092 | 5792 | 2 | F | CR MPR and AMPR for LTE CA 256QAM PC2   | 16.10.0 |
| 2021-06 | RAN#92  | RP-211110 | 5798 |   | A | Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA                             | 16.10.0 |
| 2021-09 | RAN#93  | RP-211920 | 5807 |   | A | CR for updates related to LTE band 24 in 36.101 (Rel-16)  | 16.11.0 |
| 2021-09 | RAN#93  | RP-211914 | 5820 |   | A | Big CR for TS 36.101 Maintenance(Rel-16)  | 16.11.0 |
| 2021-12 | RAN#94  | RP-212844 | 5829 |   | A | CR to clarify default Tx-Rx spacing for LTE band 24   | 16.12.0 |
| 2021-12 | RAN#94  | RP-212853 | 5842 |   | F | Big CR for TS 36.101 Maintenance (Rel-16)   | 16.12.0 |
| 2022-03 | RAN#95  | RP-220330 | 5856 |   | F | Big CR for TS 36.101 Maintenance (Rel-16)   | 16.13.0 |
| 2022-06 | RAN#96  | RP-221667 | 5873 |   | F | Big CR for TS 36.101 Maintenance (Rel-16)   | 16.14.0 |
| 2022-09 | RAN#97  | RP-222024 | 5887 |   | F | Big CR for 36.101 maintenance (Rel-16)  | 16.15.0 |
| 2023-03 | RAN#99  | RP-230499 | 5905 |   | F | CR for TS 36.101 Rel-16 CAT-F: Corrections on CA_NS_10  | 16.16.0 |
| 2023-03 | RAN#99  | RP-230508 | 5909 |   | A | CR for TS 36.101: P-Max definition correction for Band 14   | 16.16.0 |
| 2023-03 | RAN#99  | RP-230499 | 5912 | 1 | F | LTE interband 2UL CA co-ex simplification R16   | 16.16.0 |
| 2023-03 | RAN#99  | RP-230499 | 5922 |   | F | CR: Updates to applicability rules for LTE 8Rx requirements in TS 36.101 (Rel-16)                     | 16.16.0 |
| 2023-03 | RAN#99  | RP-230499 | 5925 | 1 | A | CR: Corrections on FRC for LTE SDR test for cases with 6DL_7DL CCs in TS 36.101 (Rel-16)              | 16.16.0 |
| 2023-03 | RAN#99  | RP-230499 | 5930 |   | A | CR for TS 36.101 Rel-16: Adding note 44 to B65 for spurious emission requirement                      | 16.16.0 |
| 2023-03 | RAN#99  | RP-230499 | 5934 |   | A | Output power for NS_38, NS_40, and NS_41  | 16.16.0 |
| 2023-06 | RAN#100 | RP-231340 | 5949 |   | A | CR TS 36.101: Correction for REFSENS requirements for LTE-A CA in Rel-16                              | 16.17.0 |
| 2023-06 | RAN#100 | RP-231340 | 5953 | 2 | F | Correction of UE co-existence requirement in 36.101 Rel-16  | 16.17.0 |
| 2023-06 | RAN#100 | RP-231341 | 5964 |   | F | CR to TS 36.101 on relative humidity condition for normal temperature (R16_CAT_A)                     | 16.17.0 |
| 2023-06 | RAN#100 | RP-231341 | 5977 |   | A | Correction of RMCs for power imbalance TC   | 16.17.0 |
| 2023-09 | RAN#101 | RP-232500 | 5985 |   | A | CR to TS 36.101 Rel-18 Removal of Cat-M2 REFSENS in B71   | 16.18.0 |
| 2023-09 | RAN#101 | RP-232486 | 5996 |   | F | CR 36.101: uplink inter-band carrier aggregation UEtoUE co-ex table cell border correction R16        | 16.18.0 |
| 2023-09 | RAN#101 | RP-232485 | 5999 |   | A | [LTE_CA_R14_intra-Core] CR for adding Band46 downlink RMC definition                                  | 16.18.0 |
| 2023-09 | RAN#101 | RP-232500 | 6006 |   | A | [TE15] CR TS 36.101: Band 28 3 MHz operation for Japan [Japan_3MHz_n28]                               | 16.18.0 |
| 2023-09 | RAN#101 | RP-232486 | 6009 | 1 | F | CR for TS 36.101 [LTE_CA_R16_2BDL_2BUL] Addition of missing CA operating bands                        | 16.18.0 |
| 2023-12 | RAN#102 | RP-233336 | 6019 | 1 | F | CR on TS36.101 for simplification of LTE V2X UE co-existence in Rel-16                                | 16.19.0 |
| 2023-12 | RAN#102 | RP-233337 | 6022 |   | F | CR for 36.101 UE to UE coex R16   | 16.19.0 |

# History

| <b>Document history</b> |                |             |
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| V16.6.0                 | August 2020    | Publication |
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