

# ETSI TS 136 101 V8.10.0 (2010-07)

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*Technical Specification*

**LTE;  
Evolved Universal Terrestrial Radio Access (E-UTRA);  
User Equipment (UE) radio transmission and reception  
(3GPP TS 36.101 version 8.10.0 Release 8)**

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Reference

RTS/TSGR-0436101v8a0

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Keywords

LTE

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## Foreword

This Technical Specification (TS) has been produced by the 3<sup>rd</sup> 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.

---

# 1 Scope

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

---

# 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 ".

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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. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**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.

**Maximum Output Power:** The mean power level per carrier of UE measured at the antenna connector in a specified reference condition.

**Mean power:** When applied to E-UTRA transmission this is the power measured in the operating system bandwidth of the carrier. The period of measurement shall be at least one subframe (1ms) unless otherwise stated.

**Occupied bandwidth:** The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage  $\beta/2$  of the total mean power of a given emission.

**Output power:** The mean power of one carrier of the UE, delivered to a load with resistance equal to the nominal load impedance of the transmitter.

**Reference bandwidth:** The bandwidth in which an emission level is specified.

**Transmission bandwidth:** Bandwidth of an instantaneous transmission from a UE or BS, measured in Resource Block units.

**Transmission bandwidth configuration:** The highest transmission bandwidth allowed for uplink or downlink in a given channel bandwidth, measured in Resource Block units.

## 3.2 Symbols

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

|                                  |  |
|----------------------------------|--|
| $BW_{\text{Channel}}$            | Channel bandwidth  |
| $E_{RS}$                         | 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 received energy per RE of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, averaged across the allocated RB(s) (average power within the allocated RB(s), divided by the number of RE within this allocation, and normalized to the subcarrier spacing) at the UE antenna connector |
| F                                | Frequency  |
| $F_{\text{Interferer (offset)}}$ | Frequency offset of the interferer   |
| $F_{\text{Interferer}}$          | Frequency of the interferer  |
| $F_C$                            | Frequency of the carrier centre frequency  |
| $F_{\text{DL\_low}}$             | The lowest frequency of the downlink operating band  |
| $F_{\text{DL\_high}}$            | The highest frequency of the downlink operating band   |
| $F_{\text{UL\_low}}$             | The lowest frequency of the uplink operating band  |
| $F_{\text{UL\_high}}$            | The highest frequency of the uplink operating band   |
| $I_o$                            | 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   |
| $N_{cp}$                         | Cyclic prefix length   |
| $N_{DL}$                         | 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 $N_{\text{Offs-DL}}$ Offset used for calculating downlink EARFCN                            |

|                         |   |
|-------------------------|---|
| $N_{\text{Offis-UL}}$   | Offset used for calculating uplink EARFCN   |
| $N_{\text{otx}}$        | 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 |
| $N_{\text{RB}}$         | Transmission bandwidth configuration, expressed in units of resource blocks   |
| $N_{\text{UL}}$         | Uplink EARFCN   |
| $R_{\text{av}}$         | Minimum average throughput per RB   |
| $P_{\text{CMAX}}$       | The configured maximum UE output power.   |
| $P_{\text{EMAX}}$       | Maximum allowed UE output power signalled by higher layers. Same as IE <i>P-Max</i> , defined in [7].   |
| $P_{\text{Interferer}}$ | Modulated mean power of the interferer  |
| $P_{\text{PowerClass}}$ | $P_{\text{PowerClass}}$ is the nominal UE power (i.e., no tolerance)r   |
| $P_{\text{UMAX}}$       | The measured configured maximum UE output power.  |
| $\Delta F_{\text{OOB}}$ | $\Delta$ Frequency of Out Of Band emission  |

### 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].

|         |  |
|---------|--|
| ACLR    | Adjacent Channel Leakage Ratio   |
| ACS     | Adjacent Channel Selectivity   |
| A-MPR   | Additional Maximum Power Reduction   |
| AWGN    | Additive White Gaussian Noise  |
| BS      | Base Station   |
| CW      | Continuous Wave  |
| DL      | Downlink   |
| EARFCN  | E-UTRA Absolute Radio Frequency Channel Number   |
| 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  |
| HD-FDD  | Half- Duplex FDD   |
| MCS     | Modulation and Coding Scheme   |
| 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  |
| PSS     | Primary Synchronization Signal   |
| PSS_RA  | PSS-to-RS EPRE ratio for the channel PSS   |
| RE      | Resource Element   |
| REFSENS | Reference Sensitivity power level  |
| r.m.s   | Root Mean Square   |
| SNR     | Signal-to-Noise Ratio  |
| SSS     | Secondary Synchronization Signal   |
| SSS_RA  | SSS-to-RS EPRE ratio for the channel SSS   |
| TDD     | Time Division Duplex   |
| UE      | User Equipment   |
| UL      | Uplink   |
| UMTS    | Universal Mobile Telecommunications System   |
| UTRA    | UMTS Terrestrial Radio Access  |
| UTRAN   | UMTS Terrestrial Radio Access Network  |
| xCH_RA  | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols not containing RS |
| xCH_RB  | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols containing RS     |

---

## 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.xxx section y 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

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

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.

The reference sensitivity power levels defined in subclause 7.3 are valid for the specified reference measurement channels.

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.

### 4.3 Uplink 64-QAM modulation format

Transmit signal quality requirements and maximum transmit power requirements for uplink 64-QAM modulation are not defined in this release of the specification

### 4.4 RF requirements in later releases

The standardisation of new frequency bands 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 that is specified in a later release, it is necessary to specify some extra requirements. TS 36.307 [9] specifies requirements on UEs supporting a frequency band that is independent of release.

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

## 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 band<br>BS transmit<br>UE receive | Duplex<br>Mode |
|-----------------------------|---|---|----------------|
|                             | $F_{UL\_low}$ – $F_{UL\_high}$                          | $F_{DL\_low}$ – $F_{DL\_high}$                            |                |
| 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                           | 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                          | 698 MHz – 716 MHz                                       | 728 MHz – 746 MHz   | FDD            |
| 13                          | 777 MHz – 787 MHz                                       | 746 MHz – 756 MHz   | FDD            |
| 14                          | 788 MHz – 798 MHz                                       | 758 MHz – 768 MHz   | FDD            |
| 17                          | 704 MHz – 716 MHz                                       | 734 MHz – 746 MHz   | FDD            |
| ...                         |   |   |                |
| 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            |

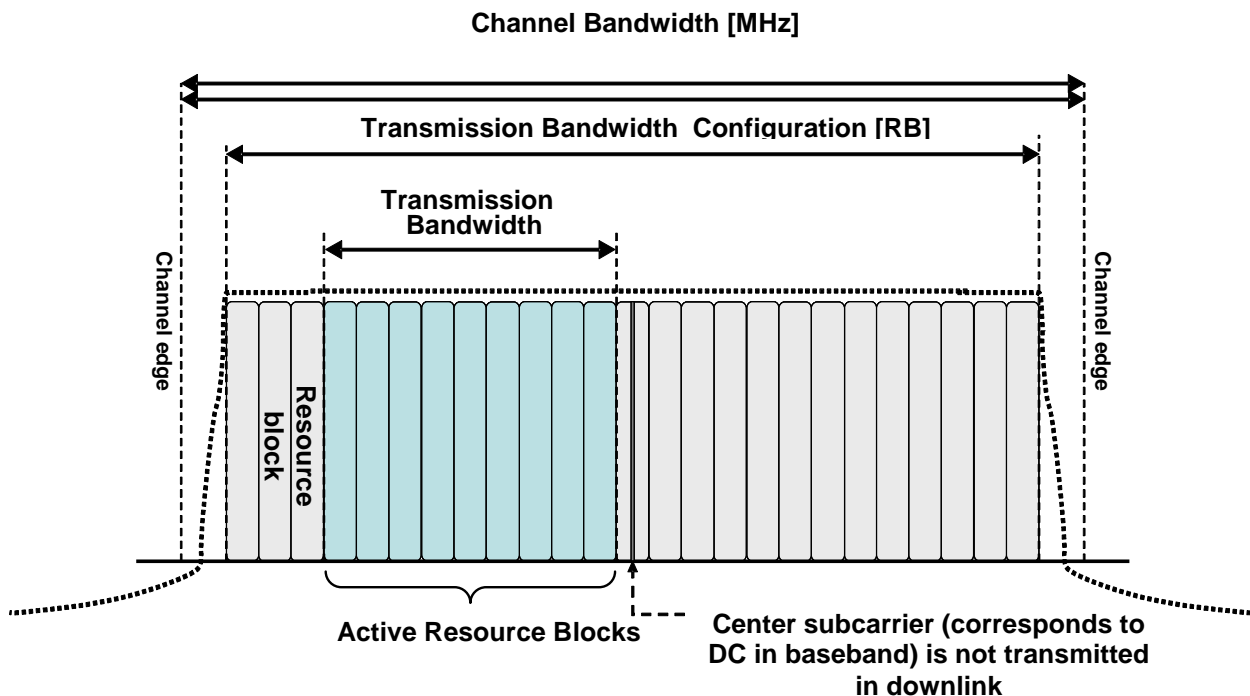
### 5.6 Channel bandwidth

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<br>$BW_{Channel}$ [MHz]        | 1.4 | 3  | 5  | 10 | 15 | 20  |
|--|-----|----|----|----|----|-----|
| Transmission bandwidth<br>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                | Yes <sup>[1]</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> |                    |                    |
| ...  |         |       |                    |                    |                    |                    |
| 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                | Yes                |
| 39   |         |       | Yes                | Yes                | Yes                | Yes                |
| 40   |         |       | Yes                | Yes                | Yes                | Yes                |
| NOTE 1: bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (Clause 7.3) is allowed. |         |       |                    |                    |                    |                    |

- 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.

## 5.7 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:

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

where  $\text{BW}_{\text{Channel}(1)}$  and  $\text{BW}_{\text{Channel}(2)}$  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.

### 5.7.2 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.

### 5.7.3 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 - 65535. 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                    | 728                 | 5000          | 5000 - 5179       | 698                 | 23000         | 23000 - 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     |
| ...                   |                     |               |                   |                     |               |                   |
| 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       |

NOTE: 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.

### 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**

| Frequency Band | TX - RX<br>carrier centre frequency<br>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  |

- 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.

## 6 Transmitter characteristics

### 6.1 General

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

### 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. The period of measurement shall be at least one sub frame (1 ms).

**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          |   |                |               |                | 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         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 17         |   |                |               |                | 23            | $\pm 2$        |               |                |
| ...        |   |                |               |                |               |                |               |                |
| 33         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 34         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 35         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 36         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 37         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 38         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 39         |   |                |               |                | 23            | $\pm 2$        |               |                |
| 40         |   |                |               |                | 23            | $\pm 2$        |               |                |
| Note 1:    | The above tolerances are applicable for UE(s) that support up to 4 E-UTRA operating bands. For UE(s) that support 5 or more E-UTRA bands the maximum output power is expected to decrease with each additional band and is FFS                    |                |               |                |               |                |               |                |
| Note 2:    | 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 |                |               |                |               |                |               |                |
| Note 3:    | $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance  |                |               |                |               |                |               |                |

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

For UE Power Class 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 3**

| Modulation | Channel bandwidth / Transmission bandwidth configuration (RB) |         |       |        |        |        | 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      |

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

### 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 3 the specific requirements and identified sub-clauses 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 and 6.2.4-2 are in addition to the allowed MPR requirements specified in clause 6.2.3.

**Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR) / Spectrum Emission requirements**

| Network Signalling value | Requirements (sub-clause) | E-UTRA Band     | Channel bandwidth (MHz) | Resources Blocks | A-MPR (dB)    |
|--------------------------|---------------------------|-----------------|-------------------------|------------------|---------------|
| NS_01                    | NA                        | NA              | NA                      | NA               | NA            |
| NS_03                    | 6.6.2.2.1                 | 2, 4,10, 35, 36 | 3                       | >5               | ≤ 1           |
|                          | 6.6.2.2.1                 | 2, 4,10, 35,36  | 5                       | >6               | ≤ 1           |
|                          | 6.6.2.2.1                 | 2, 4,10, 35,36  | 10                      | >6               | ≤ 1           |
|                          | 6.6.2.2.1                 | 2, 4,10,35,36   | 15                      | >8               | ≤ 1           |
|                          | 6.6.2.2.1                 | 2, 4,10,35, 36  | 20                      | >10              | ≤ 1           |
| NS_04                    | 6.6.2.2.2                 | TBD             | TBD                     | TBD              |               |
| NS_05                    | 6.6.3.3.1                 | 1               | 10,15,20                | ≥ 50             | ≤ 1           |
| NS_06                    | 6.6.2.2.3                 | 12, 13, 14, 17  | 1.4, 3, 5, 10           | n/a              | n/a           |
| NS_07                    | 6.6.2.2.3                 | 13              | 10                      | Table 6.2.4-2    | Table 6.2.4-2 |
|                          | 6.6.3.3.2                 |                 |                         |                  |               |
| ..                       |                           |                 |                         |                  |               |
| NS_32                    | -                         | -               | -                       | -                | -             |

**Table 6.2.4-2: A-MPR for 'NS0\_7'**

|  | Region A |                    | Region B |         | Region C |
|--|----------|--------------------|----------|---------|----------|
| RB_start <sup>1</sup>  | 0 - 12   |                    | 13 - 18  | 19 - 42 | 43 - 49  |
| L_CRB <sup>2</sup> [RBs]   | 6-8      | 1 to 5 and<br>9-50 | ≥8       | ≥18     | ≤2       |
| A-MPR [dB]   | ≤ 8      | ≤ 12               | ≤ 12     | ≤ 6     | ≤ 3      |
| Note<br>1 RB_start indicates the lowest RB index of transmitted resource blocks<br>2 L_CRB is the length of a contiguous resource block allocation<br>3 For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.<br>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 the UE maximum output power modified by A-MPR, the power limits specified in subclause 6.2.5 apply.

## 6.2.5 Configured transmitted Power

The UE is allowed to set its configured maximum output power  $P_{\text{CMAX}}$ . The configured maximum output power  $P_{\text{CMAX}}$  is set within the following bounds:

$$P_{\text{CMAX}_L} \leq P_{\text{CMAX}} \leq P_{\text{CMAX}_H}$$

Where

- $P_{\text{CMAX}_L} = \text{MIN} \{ P_{\text{EMAX}} - \Delta T_C, P_{\text{PowerClass}} - \text{MPR} - \text{A-MPR} - \Delta T_C \}$
- $P_{\text{CMAX}_H} = \text{MIN} \{ P_{\text{EMAX}}, P_{\text{PowerClass}} \}$
- $P_{\text{EMAX}}$  is the value given to IE *P-Max*, 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
- MRP and A-MPR are specified in Section 6.2.3 and Section 6.2.4, respectively
- $\Delta T_C = 1.5$  dB when Note 2 in Table 6.2.2-1 applies
- $\Delta T_C = 0$  dB when Note 2 in Table 6.2.2-1 does not apply

The measured maximum output power  $P_{\text{UMAX}}$  shall be within the following bounds:

$$P_{\text{CMAX}_L} - T(P_{\text{CMAX}_L}) \leq P_{\text{UMAX}} \leq P_{\text{CMAX}_H} + T(P_{\text{CMAX}_H})$$

Where  $T(P_{\text{CMAX}})$  is defined by the tolerance table below and applies to  $P_{\text{CMAX}_L}$  and  $P_{\text{CMAX}_H}$  separately.

**Table 6.2.5-1:  $P_{\text{CMAX}}$  tolerance**

| $P_{\text{CMAX}}$<br>(dBm)        | Tolerance $T(P_{\text{CMAX}})$<br>(dB) |
|-----------------------------------|--|
| $21 \leq P_{\text{CMAX}} \leq 23$ | 2.0                                    |
| $20 \leq P_{\text{CMAX}} < 21$    | 2.5                                    |
| $19 \leq P_{\text{CMAX}} < 20$    | 3.5                                    |
| $18 \leq P_{\text{CMAX}} < 19$    | 4.0                                    |
| $13 \leq P_{\text{CMAX}} < 18$    | 5.0                                    |
| $8 \leq P_{\text{CMAX}} < 13$     | 6.0                                    |
| $-40 \leq P_{\text{CMAX}} < 8$    | 7.0                                    |

## 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 |

### 6.3.3 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 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 / Minimum output 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 |

### 6.3.4 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 sub-frame excluding any transient periods. The ON power measurement period is defined as the mean power over one sub-frame excluding any transient period.

There are no additional requirements on UE transmit power beyond that which is required in clause 6.2.2 and clause 6.6.2.3

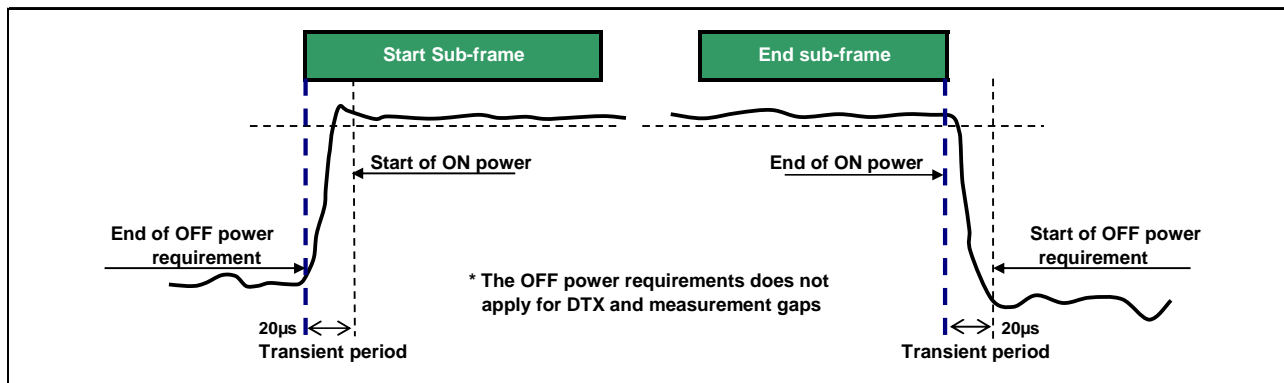


Figure 6.3.4.1-1: General ON/OFF time mask

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 clause 6.2.2 and clause 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                  |

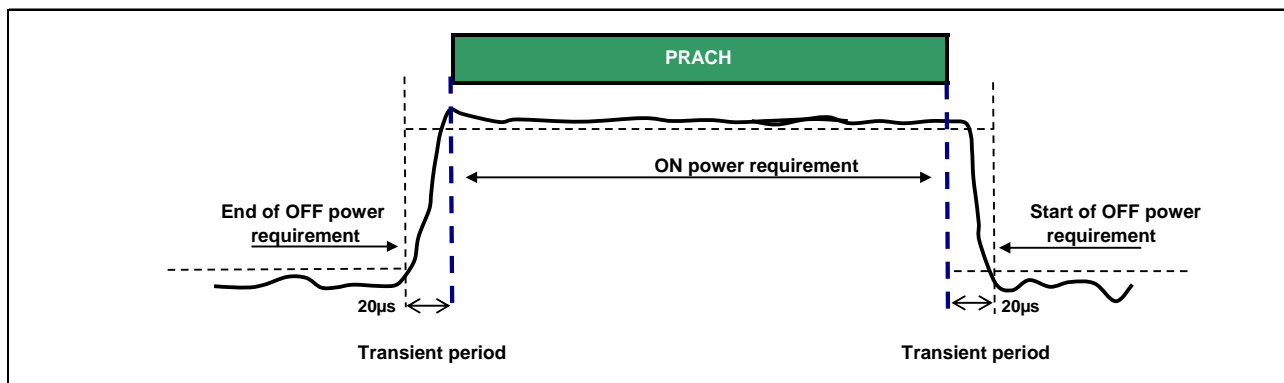


Figure 6.3.4.2-1: PRACH ON/OFF time mask



6.3.4.2.2 SRS time mask

In the case a single SRS transmission, the ON measurement period is defined as the mean power over the symbol duration excluding any transient period. Figure 6.3.4.2.2-1

In the case a dual SRS transmission, the ON measurement period 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 clause 6.2.2 and clause 6.6.2.3

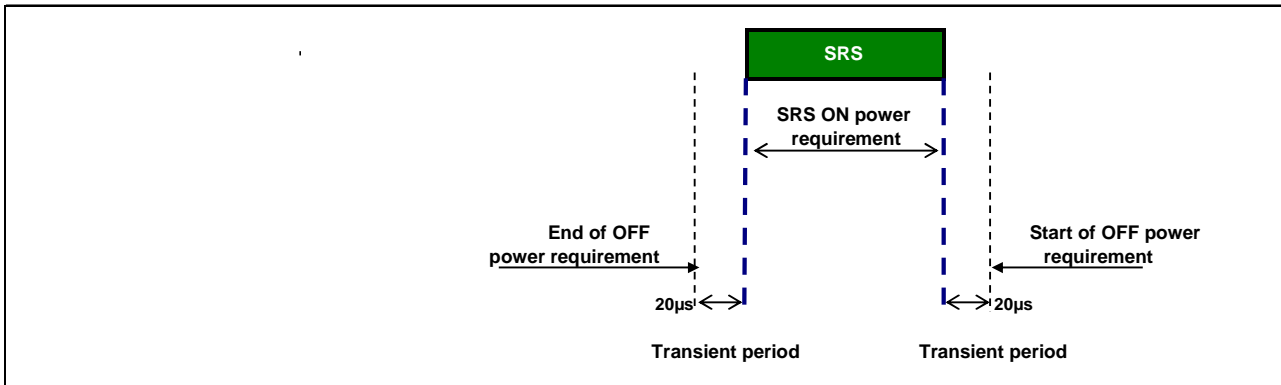


Figure 6.3.4.2.2-1: Single SRS time mask

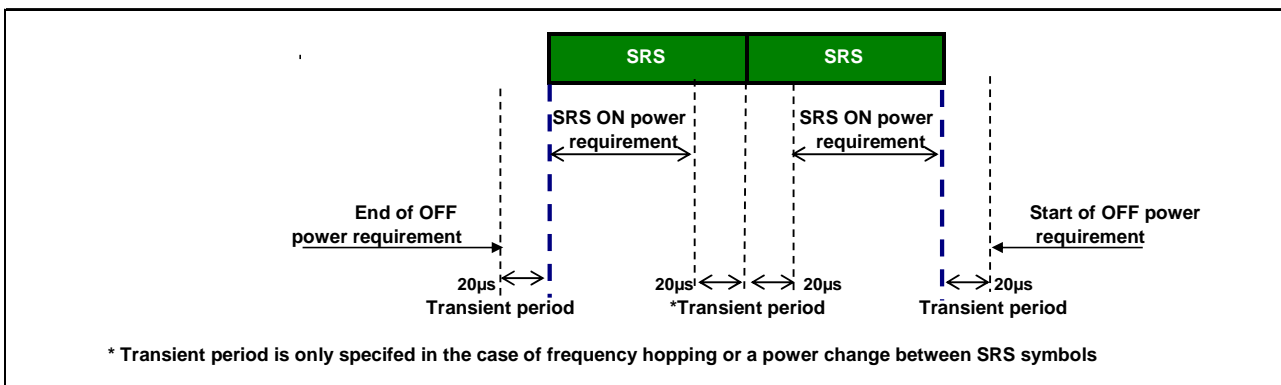


Figure 6.3.4.3-1: Dual SRS time mask for the case of UpPTS transmissions

6.3.4.3 Slot / Sub frame boundary time mask

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 clause 6.2.2 and clause 6.6.2.3

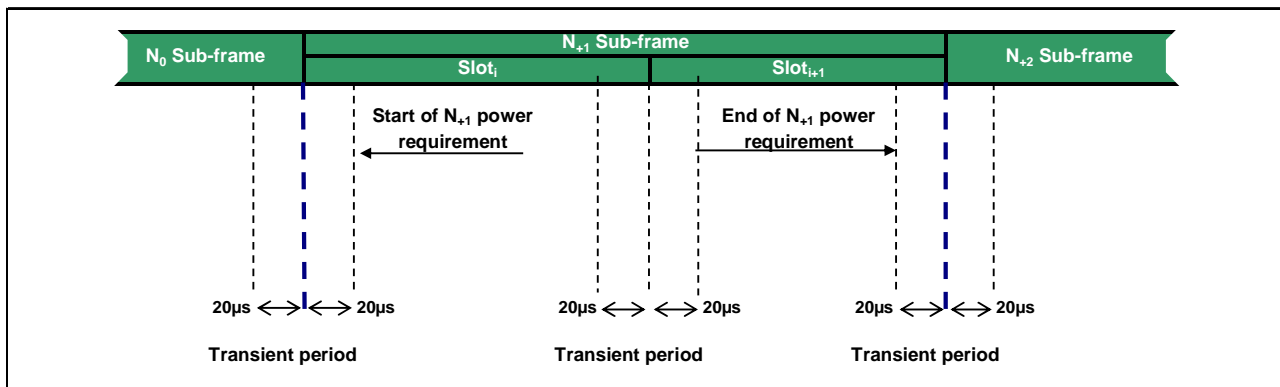


Figure 6.3.4.3-1: Transmission power template

6.3.4.4 PUCCH / PUSCH / SRS time mask

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.

There are no additional requirements on UE transmit power beyond that which is required in clause 6.2.2 and clause 6.6.2.3

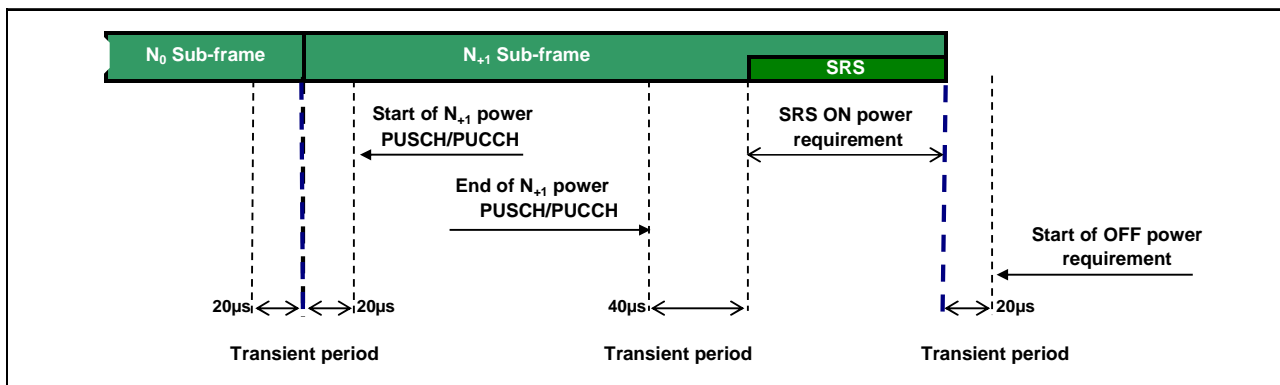


Figure 6.3.4.4-1: PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after

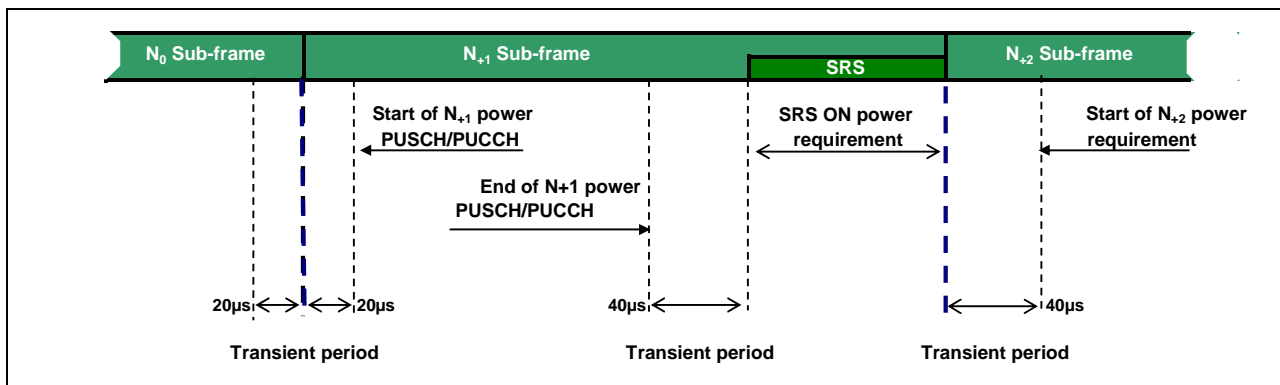


Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS

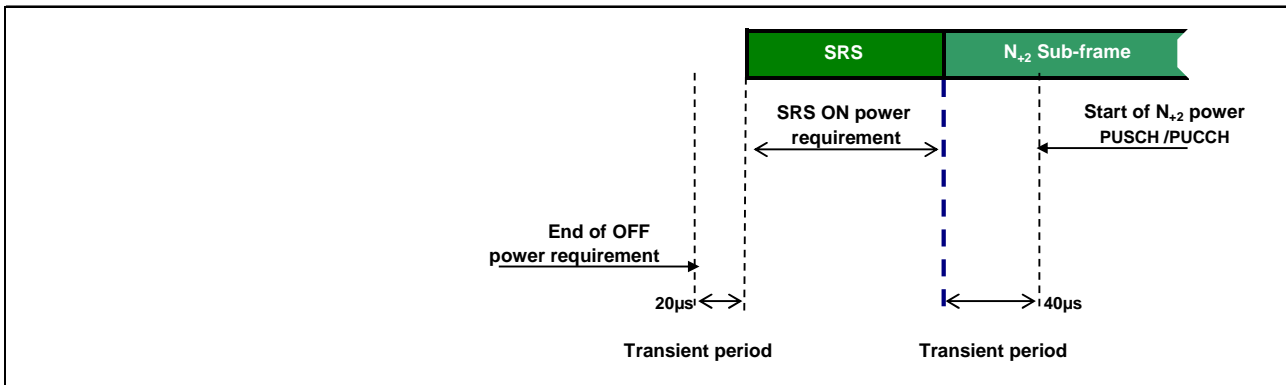


Figure 6.3.4.4-3: PUSCH/PUCCH/SRS time mask when there is a transmission after SRS but not before

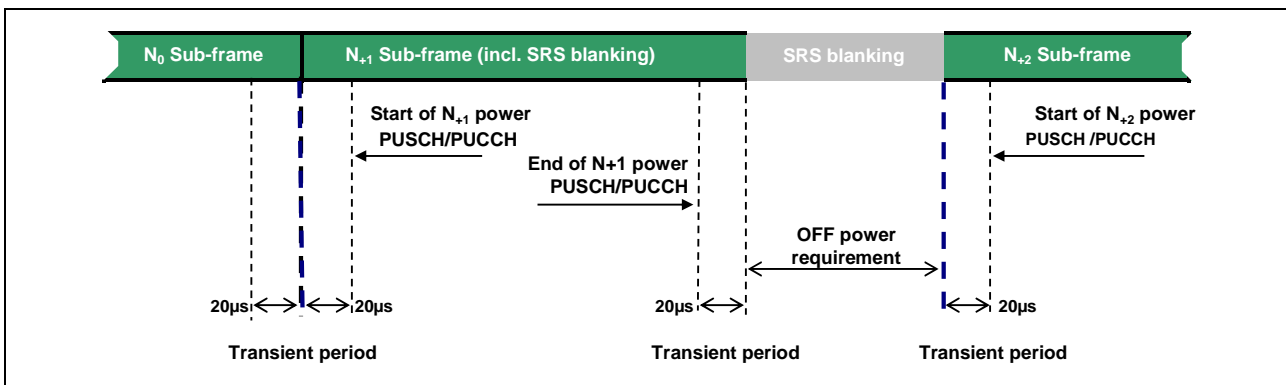


Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking

### 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 clause 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 clause 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 sub-clause 6.2.2 and the Minimum output power as defined in sub-clause 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  $P_{UMAX}$  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 clauses 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   |  |            |
| Note 2:                                       | For operating bands under Note 2 in Table 6.2.2-1, the relative power tolerance is relaxed by reducing the lower limit by 1.5 dB if the transmission bandwidth of either the reference or target sub-frames is confined within $F_{UL\_low}$ and $F_{UL\_low} + 4$ MHz or $F_{UL\_high} - 4$ MHz and $F_{UL\_high}$ . |  |            |
| 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 Clause 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.

#### 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:   |            |  |
| 1. The UE transmission gap is 4 ms. TPC command is transmitted via PDCCH 4 subframes preceding each PUCCH/PUSCH transmission. |            |  |

## 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

### 6.5.2 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 (caused by IQ offset)
- In-band emissions for the non-allocated RB

All the parameters defined in clause 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 IQ origin offset 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 is one slot for the PUCCH and PUSCH in the time domain.. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the EVM measurement interval is reduced by one symbol, accordingly. The PUSCH or PUCCH EVM measurement interval is also reduced when the mean power, modulation or allocation between slots 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.

#### 6.5.2.1.1 Minimum requirement

The RMS average of the basic EVM measurements for 10 sub-frames excluding any transient period for the average EVM case, and 60 sub-frames 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]                     |
| 16QAM        | %    | 12.5              | [12.5]                     |

**Table 6.5.2.1.1-2: Parameters for Error Vector Magnitude**

| Parameter            | Unit | Level             |
|----------------------|------|-------------------|
| UE Output Power      | dBm  | $\geq -40$        |
| Operating conditions |      | Normal conditions |

### 6.5.2.2 Carrier leakage

Carrier leakage (The IQ origin offset) is an additive sinusoid waveform that has the same frequency as the 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) |
|--|------------|----------------------|
|  |            |                      |

|  |                                  |     |
|--|----------------------------------|-----|
|  | Output power >0 dBm              | -25 |
|  | -30 dBm ≤ Output power ≤ 0 dBm   | -20 |
|  | -40 dBm ≤ Output power < -30 dBm | -10 |

### 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.

#### 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   | $\max \left\{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRBs}), \right.$ $20 \cdot \log_{10} EVM - 3 - 5 \cdot ( \Delta_{RB}  - 1) / L_{CRBs},$ $\left. -57 \text{ dBm} / 180 \text{ kHz} - P_{RB} \right\}$ |                                  | Any non-allocated (Note 2)     |
| <b>IQ Image</b>  | dB   | -25  |                                  | Image frequencies (Notes 2, 3) |
| <b>Carrier leakage</b>   | dBc  | -25  | Output power > 0 dBm             | Carrier frequency (Notes 4, 5) |
|  |      | -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.</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.</p> <p>Note 6: <math>L_{CRBs}</math> is the Transmission Bandwidth (see Figure 5.6-1).</p> <p>Note 7: <math>N_{RB}</math> is the Transmission Bandwidth Configuration (see Figure 5.6-1).</p> <p>Note 8: <math>EVM</math> is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.</p> <p>Note 9: <math>\Delta_{RB}</math> is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. <math>\Delta_{RB} = 1</math> or <math>\Delta_{RB} = -1</math> for the first adjacent RB outside of the allocated bandwidth).</p> <p>Note 10: <math>P_{RB}</math> is the transmitted power per 180 kHz in allocated RBs, measured in dBm.</p> |      |  |                                  |                                |

### 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] |
|---|---------------------|
| $F_{UL\_Meas} - F_{UL\_Low} \geq 3 \text{ MHz}$ and $F_{UL\_High} - F_{UL\_Meas} \geq 3 \text{ MHz}$<br>(Range 1) | 4 (p-p)             |
| $F_{UL\_Meas} - F_{UL\_Low} < 3 \text{ MHz}$ or $F_{UL\_High} - F_{UL\_Meas} < 3 \text{ MHz}$<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] |
|---|---------------------|
| $F_{UL\_Meas} - F_{UL\_Low} \geq 5 \text{ MHz}$ and $F_{UL\_High} - F_{UL\_Meas} \geq 5 \text{ MHz}$<br>(Range 1) | 4 (p-p)             |
| $F_{UL\_Meas} - F_{UL\_Low} < 5 \text{ MHz}$ or $F_{UL\_High} - F_{UL\_Meas} < 5 \text{ MHz}$<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             |                     |



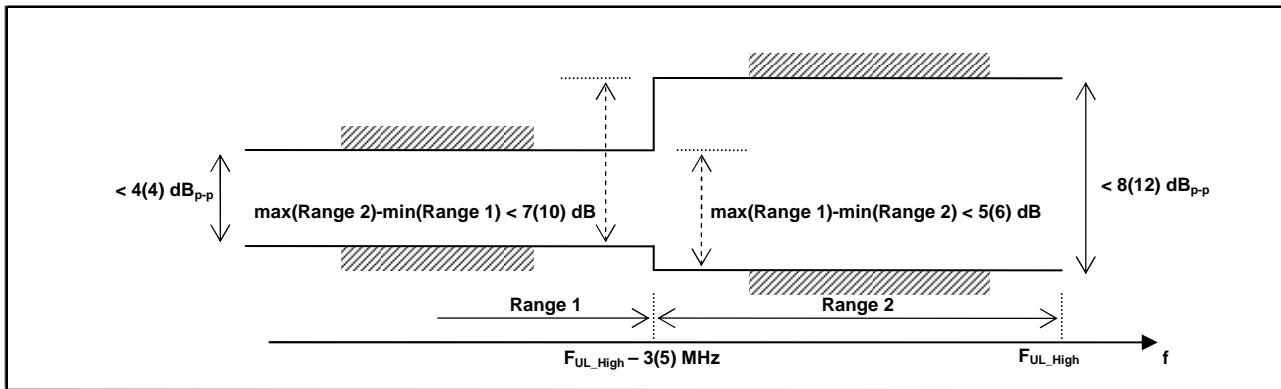


Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).

## 6.6 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.

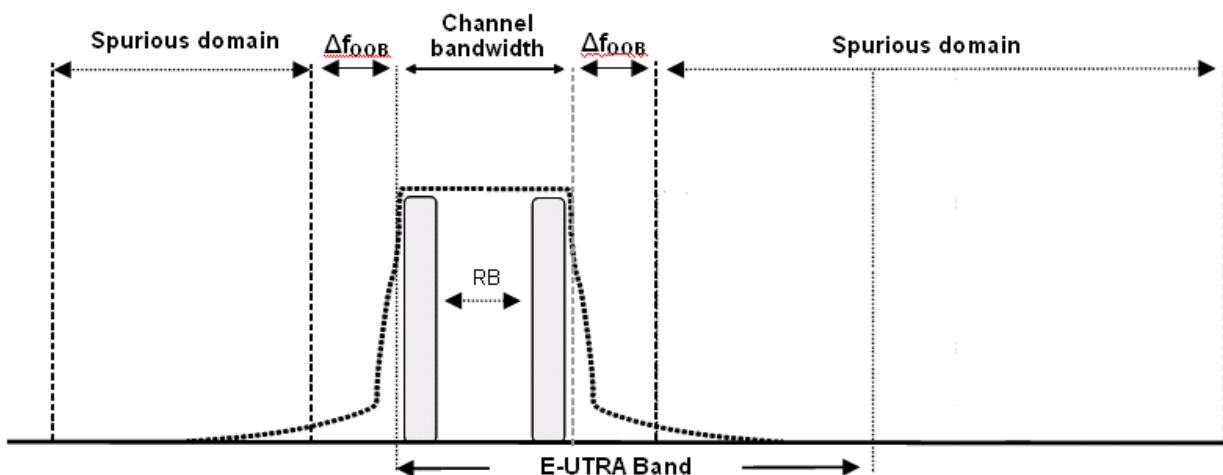


Figure 6.6-1: Transmitter RF spectrum

### 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

| Channel bandwidth (MHz) | Occupied channel bandwidth / channel bandwidth |         |       |        |        |        |
|-------------------------|--|---------|-------|--------|--------|--------|
|                         | 1.4 MHz  | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 1.4                     | 1.4  | 3       | 5     | 10     | 15     | 20     |

## 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 greater than ( $\Delta f_{\text{OOB}}$ ) as specified in Table 6.6.2.1.1-1 the spurious requirements in clause 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.

### 6.6.2.2 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")

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" 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 |            |          |           |           |           |                          |
|----------------------------------|--|------------|----------|-----------|-----------|-----------|--------------------------|
|                                  | 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                   |
| $\pm 1-2.5$                      | -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 |            |          |           |           |           |                          |
|----------------------------------|--|------------|----------|-----------|-----------|-----------|--------------------------|
|                                  | 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                   |
| $\pm 1-2.5$                      | -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        | -25      | -25       | -25       | -25       | 1 MHz                    |
| $\pm 6-10$                       |  |            | -25      | -25       | -25       | -25       | 1 MHz                    |
| $\pm 10-15$                      |  |            |          | -25       | -25       | -25       | 1 MHz                    |
| $\pm 15-20$                      |  |            |          |           | -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.

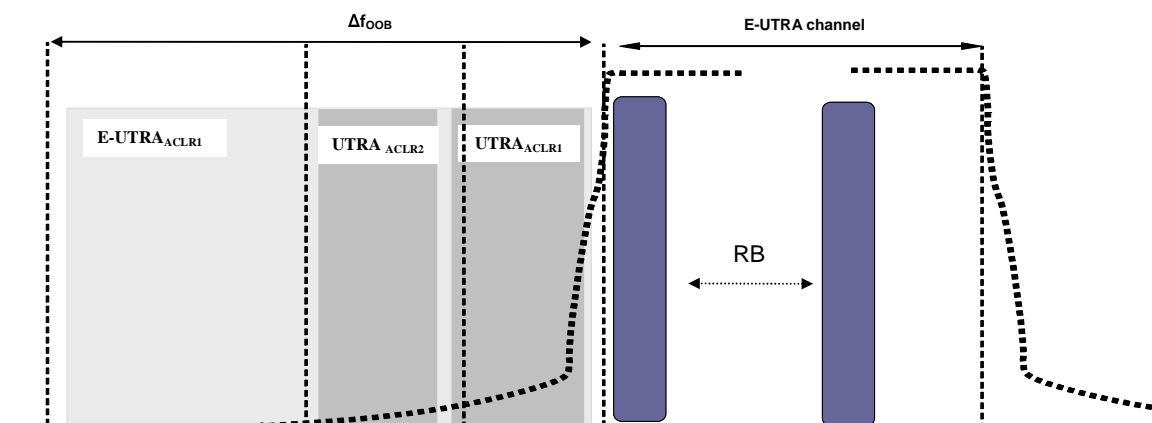
**Table 6.6.2.3-1: Additional requirements**

| $\Delta f_{\text{OOB}}$<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.

### 6.6.2.3 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 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**

#### 6.6.2.3.1 Minimum requirement E-UTRA

E-UTRA Adjacent Channel Leakage power Ratio ( $E\text{-UTRA}_{\text{ACLR}}$ ) 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. If the measured adjacent channel power is greater than  $-50\text{dBm}$  then the  $E\text{-UTRA}_{\text{ACLR}}$  shall be higher than the value specified in Table 6.6.2.3.1-1.

**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     |
| Adjacent channel centre frequency offset (in MHz) | +1.4 / -1.4   | +3.0 / -3.0 | +5 / -5 | +10 / -10 | +15 / -15 | +20 / -20 |

### 6.6.2.3.2 Minimum requirements UTRA

UTRA Adjacent Channel Leakage power Ratio (UTRA<sub>ACLR</sub>) 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<sub>ACLR1</sub>) and the 2<sup>nd</sup> UTRA adjacent channel (UTRA<sub>ACLR2</sub>). 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  $-50$  dBm then the UTRA<sub>ACLR</sub> shall be higher than the value specified in Table 6.6.2.3.2-1.

**Table 6.6.2.3.2-1: Requirements for UTRA<sub>ACLR1/2</sub>**

|   | Channel bandwidth / UTRA <sub>ACLR1/2</sub> / measurement bandwidth |  |   |   |   |   |
|---|---|--|---|---|---|---|
|   | 1.4 MHz   | 3.0 MHz                                | 5 MHz                                       | 10 MHz                                  | 15 MHz                                      | 20 MHz                                    |
| UTRA <sub>ACLR1</sub>                             | 33 dB   | 33 dB                                  | 33 dB                                       | 33 dB                                   | 33 dB                                       | 33 dB                                     |
| Adjacent channel centre frequency offset (in MHz) | $0.7+BW_{UTRA}/2$ / $-0.7-BW_{UTRA}/2$                              | $1.5+BW_{UTRA}/2$ / $-1.5-BW_{UTRA}/2$ | $+2.5+BW_{UTRA}/2$ / $-2.5-BW_{UTRA}/2$     | $+5+BW_{UTRA}/2$ / $-5-BW_{UTRA}/2$     | $+7.5+BW_{UTRA}/2$ / $-7.5-BW_{UTRA}/2$     | $+10+BW_{UTRA}/2$ / $-10-BW_{UTRA}/2$     |
| UTRA <sub>ACLR2</sub>                             | -   | -                                      | 36 dB                                       | 36 dB                                   | 36 dB                                       | 36 dB                                     |
| Adjacent channel centre frequency offset (in MHz) | -   | -                                      | $+2.5+3*BW_{UTRA}/2$ / $-2.5-3*BW_{UTRA}/2$ | $+5+3*BW_{UTRA}/2$ / $-5-3*BW_{UTRA}/2$ | $+7.5+3*BW_{UTRA}/2$ / $-7.5-3*BW_{UTRA}/2$ | $+10+3*BW_{UTRA}/2$ / $-10-3*BW_{UTRA}/2$ |
| 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*          | 3.84 MHz  | 3.84 MHz                               | 3.84 MHz                                    | 3.84 MHz                                | 3.84 MHz                                    | 3.84 MHz                                  |
| UTRA 1.6MHz channel measurement bandwidth**       | 1.28 MHz  | 1.28 MHz                               | 1.28 MHz                                    | 1.28MHz                                 | 1.28MHz                                     | 1.28MHz                                   |

\* Note: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.

\*\* Note: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum.

### 6.6.2.4 Additional ACLR requirements

This requirement is specified in terms of an additional UTRA<sub>ACLR2</sub> requirement.

## 6.6.2.4.1 Void

## 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. 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.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than  $\Delta f_{\text{OOB}}$  (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth. 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

**Table 6.6.3.1-1: Boundary between E-UTRA  $\Delta f_{\text{OOB}}$  and spurious emission domain**

| Channel bandwidth             | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
|-------------------------------|---------|---------|-------|--------|--------|--------|
| $\Delta f_{\text{OOB}}$ (MHz) | 2.8     | 6       | 10    | 15     | 20     | 25     |

The spurious emission limits in Table 6.6.3.1-2 apply for all transmitter band configurations (RB) and channel bandwidths.

NOTE: In order that the measurement of spurious emissions falls within the frequency ranges that are more than  $\Delta f_{\text{OOB}}$  (MHz) from the edge of the channel bandwidth, the minimum offset of the measurement frequency from each edge of the channel should be  $\Delta f_{\text{OOB}} + \text{MBW}/2$ . MBW denotes the measurement bandwidth defined in Table 6.6.3.1-2.

**Table 6.6.3.1-2: Spurious emissions limits**

| Frequency Range                            | Maximum Level | Measurement Bandwidth |
|--|---------------|-----------------------|
| $9 \text{ kHz} \leq f < 150 \text{ kHz}$   | -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                 |

## 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  $\text{MBW}/2$ . 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.

Table 6.6.3.2-1: Requirements

| E-UTRA Band     | Spurious emission                         |                       |        |                                       |           |         |                                       |
|-----------------|---|-----------------------|--------|---------------------------------------|-----------|---------|---------------------------------------|
|                 | Protected band                            | Frequency range (MHz) |        | Maximum Level (dBm)                   | MBW (MHz) | Comment |                                       |
| 1               | E-UTRA Band 1, 3, 7, 8, 9, 11, 34, 38, 40 | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | E-UTRA band 33                            | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>3</sup>                     |
|                 | E-UTRA band 39                            | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>3</sup>                     |
|                 | Frequency range                           | 860                   | -      | 895                                   | -50       | 1       |                                       |
|                 | Frequency range                           | 1475.9                | -      | 1510.9                                | -50       | 1       |                                       |
|                 | Frequency range                           | 1884.5                | -      | 1919.6                                | -41       | 0.3     | Note <sup>6</sup> , Note <sup>7</sup> |
| Frequency range | 1884.5                                    | -                     | 1915.7 | Note <sup>6</sup> , Note <sup>8</sup> |           |         |                                       |
| 2               | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17   | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
| 3               | E-UTRA Band 1, 3, 7, 8, 33, 34, 38        | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
| 4               | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17   | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
| 5               | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17   | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
| 6               | E-UTRA Band 1, 9, 11, 34                  | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | Frequency range                           | 860                   | -      | 875                                   | -37       | 1       |                                       |
|                 | Frequency range                           | 875                   | -      | 895                                   | -50       | 1       |                                       |
|                 | Frequency range                           | 1884.5                | -      | 1919.6                                | -41       | 0.3     | Note <sup>7</sup>                     |
|                 |   | 1884.5                | -      | 1915.7                                |           |         | Note <sup>8</sup>                     |
| 7               | E-UTRA Band 1, 3, 7, 8, 33, 34            | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | E-UTRA Band 38                            | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>3</sup>                     |
| 8               | E-UTRA Band 1, 8, 33, 34, 38, 39, 40      | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | E-UTRA band 3                             | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>2</sup>                     |
|                 | E-UTRA band 7                             | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>2</sup>                     |
| 9               | E-UTRA Band 1, 9, 11, 34                  | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | Frequency range                           | 860                   | -      | 895                                   | -50       | 1       |                                       |
|                 | Frequency range                           | 1475.9                | -      | 1510.9                                | -50       | 1       |                                       |
|                 | Frequency range                           | 1884.5                | -      | 1919.6                                | -41       | 0.3     | Note <sup>7</sup>                     |
|                 |   | 1884.5                | -      | 1915.7                                |           |         | Note <sup>8</sup>                     |
| 10              | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17   | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
| 11              | E-UTRA Band 1, 9, 11, 34                  | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | Frequency range                           | 1457.9                | -      | 1510.9                                | -50       | 1       |                                       |
|                 | Frequency range                           | 860                   | -      | 895                                   | -50       | 1       |                                       |
|                 | Frequency range                           | 1884.5                | -      | 1919.6                                | -41       | 0.3     | Note <sup>7</sup>                     |
|                 |   | 1884.5                | -      | 1915.7                                |           |         | Note <sup>8</sup>                     |
| 12              | E-UTRA Band 2, 5, 12, 13, 14, 17          | FDL_low               | -      | FDL_high                              | -50       | 1       |                                       |
|                 | E-UTRA Band 4, 10                         | FDL_low               | -      | FDL_high                              | -50       | 1       | Note <sup>2</sup>                     |

|     |  |         |   |          |     |         |                   |
|-----|--|---------|---|----------|-----|---------|-------------------|
| 13  | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17      | FDL_low | - | FDL_high | -50 | 1       |                   |
|     | Frequency range                              | 763     | - | 775      | -35 | 0.00625 |                   |
| 14  | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17      | FDL_low | - | FDL_high | -50 | 1       |                   |
|     | Frequency range                              | 763     | - | 775      | -35 | 0.00625 |                   |
| 17  | E-UTRA Band 2, 5, 12, 13, 14, 17             | FDL_low | - | FDL_high | -50 | 1       |                   |
|     | E-UTRA Band 4, 10                            | FDL_low | - | FDL_high | -50 | 1       | Note <sup>2</sup> |
| ... |  |         |   |          |     |         |                   |
| 33  | E-UTRA Band 1, 3, 7, 8, 34, 38, 39, 40       | FDL_low | - | FDL_high | -50 | 1       | Note <sup>5</sup> |
| 34  | E-UTRA Band 1, 3, 7, 8, 9, 11, 33, 38,39, 40 | FDL_low | - | FDL_high | -50 | 1       | Note <sup>5</sup> |
|     | Frequency range                              | 860     | - | 895      | -50 | 1       |                   |
|     | Frequency range                              | 1475.9  | - | 1510.9   | -50 | 1       |                   |
|     | Frequency range                              | 1884.5  | - | 1919.6   |     |         | Note <sup>7</sup> |
|     |  | 1884.5  | - | 1915.7   | -41 | 0.3     | Note <sup>8</sup> |
| 35  |  |         |   |          |     |         |                   |
| 36  |  |         |   |          |     |         |                   |
| 37  |  |         | - |          |     |         |                   |
| 38  | E-UTRA Band 1, 3, 8, 33, 34                  | FDL_low | - | FDL_high | -50 | 1       |                   |
|     | E-UTRA Band 7                                | FDL_low | - | FDL_high | -50 | 1       | Note <sup>3</sup> |
| 39  | E-UTRA Band 34, 40                           | FDL_low | - | FDL_high | -50 | 1       |                   |
| 40  | E-UTRA Band 1, 3, 33, 34, 39                 | FDL_low | - | FDL_high | -50 | 1       |                   |

## Note

- 1 FDL\_low and FDL\_high refer to each E-UTRA frequency band specified in Table 5.5-1
- 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 2nd or 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RE within the transmission bandwidth (see Figure 5.6-1) for which the 2nd or 3rd harmonic, i.e. the frequency equal to two or three times the frequency of that RE, is within the measurement bandwidth (MBW).
- 3 To meet these requirements some restriction will be needed for either the operating band or protected band
- 4 N/A
- 5 For non synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band
- 6 Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.
- 7 Applicable when co-existence with PHS system operating in 1884.5 -1919.6MHz.
- 8 Applicable when co-existence with PHS system operating in 1884.5-1915.7MHz.

### 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.



### 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  $\Delta f_{\text{OoB}}$  (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 |
|----------------------------------|---|--------|--------|--------|-----------------------|
|                                  | 5 MHz   | 10 MHz | 15 MHz | 20 MHz |                       |
| $1884.5 \leq f \leq 1919.6^{*1}$ | -41   | -41    | -41    | -41    | 300 KHz               |
| $1884.5 \leq f \leq 1915.7^{*2}$ | -41   | -41    | -41    | -41    | 300 KHz               |

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 (1919.6 MHz) + 4 MHz + the Channel BW assigned, where Channel BW is as defined in Subclause 5.6. Operations below this point are for further study.
2. 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. Operations below this point are for further study.

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 (300 kHz).

### 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.

**Table 6.6.3.3.2-1: Additional requirements**

| Frequency band (MHz)  | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|-----------------------|---|-----------------------|
|                       | 10 MHz  |                       |
| $763 \leq f \leq 775$ | -57   | 6.25 kHz              |

## 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  |

# 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 Clause 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.

## 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. Requirements for 4 ports are FFS. With the exception of clause 7.9 all requirements shall be verified by using both (all) antenna ports simultaneously.

## 7.3 Reference sensitivity power level

The reference sensitivity power level REFSSENS is the minimum mean power applied to both the UE antenna ports at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

### 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           | -103.2  | -100.2      | -98         | -95          | -93.2        | -92          | FDD         |
| 3           | -102.2  | -99.2       | -97         | -94          | -92.2        | -91          | FDD         |
| 4           | -105.2  | -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          | -102.2  | -99.2       | -97         | -94          |              |              | FDD         |
| 13          |   |             | -97         | -94          |              |              | FDD         |
| 14          |   | -99.2       | -97         | -94          |              |              | FDD         |
| ...         |   |             |             |              |              |              |             |
| 17          |   |             | -97         | -94          |              |              | FDD         |
| ...         |   |             |             |              |              |              |             |
| 33          |   |             | -100        | -97          | -95.2        | -94          | TDD         |
| 34          | -   | -           | -100        | -97          | -95.2        | -94          | 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         |
| Note 1:     | The transmitter shall be set to $P_{\text{UMAX}}$ as defined in clause 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 of Band 3 + 0.5 dB is applicable for band 9  |             |             |              |              |              |             |

Table 7.3.1-2 specifies the minimum number of allocated uplink resource blocks for which the reference receive sensitivity requirement must be met.

**Table 7.3.1-2: 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   |  |       | 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 <sup>1</sup> | 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    | 15 <sup>1</sup> | 15 <sup>1</sup> |                 |                 | FDD         |
| ...   |  |       |                 |                 |                 |                 |             |
| 17  |  |       | 20 <sup>1</sup> | 20 <sup>1</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         |
| Note 1:   | The number of UL resource blocks allocated is less than the total resources blocks supported by the channel bandwidth. 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). |       |                 |                 |                 |                 |             |

Unless given by Table 7.3.1-3, the minimum requirements specified in Tables 7.3.1-1 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                    |
| 35          | NS_03                    |
| 36          | NS_03                    |

## 7.3.2 Requirement for large transmission configurations

For some combinations of bandwidths and operating bands, a certain relaxation of the UE performance is allowed when the transmission configuration is larger than that in Table 7.3.1-2. Table 7.3.2-1 specifies the allowed maximum sensitivity degradation (MSD) when the UL resource block allocation is the maximum supported transmission bandwidth configuration  $N_{RB}$  (Table 5.6-1). Unless given by Table 7.3.1-3, the MSD shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

**Table 7.3.2-1: Maximum Sensitivity Degradation**

| E-UTRA Band  | Channel bandwidth |            |            |             |             |             | Duplex Mode |
|--|-------------------|------------|------------|-------------|-------------|-------------|-------------|
|  | 1.4 MHz (dB)      | 3 MHz (dB) | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) |             |
| 1  |                   |            | n/a        | n/a         | n/a         | n/a         | FDD         |
| 2  | n/a               | n/a        | n/a        | n/a         | TBD         | TBD         | FDD         |
| 3  | n/a               | n/a        | n/a        | n/a         | TBD         | TBD         | FDD         |
| 4  | n/a               | n/a        | n/a        | n/a         | n/a         | n/a         | FDD         |
| 5  | n/a               | n/a        | n/a        | TBD         |             |             | FDD         |
| 6  |                   |            | n/a        | TBD         |             |             | FDD         |
| 7  |                   |            | n/a        | n/a         | TBD         | TBD         | FDD         |
| 8  | n/a               | n/a        | n/a        | TBD         |             |             | FDD         |
| 9  |                   |            | n/a        | n/a         | TBD         | TBD         | FDD         |
| 10   |                   |            | n/a        | n/a         | n/a         | n/a         | FDD         |
| 11   |                   |            | n/a        | TBD         |             |             | FDD         |
| 12   |                   |            | TBD        | TBD         |             |             | FDD         |
| 13   |                   |            | TBD        | TBD         |             |             | FDD         |
| 14   |                   |            |            |             |             |             | FDD         |
| 17   |                   |            | TBD        | TBD         |             |             | FDD         |
| Note:<br>1. The transmitter shall be set to $P_{UMAX}$ as defined in clause 6.2.5 with MPR applied and with the maximum transmission configuration (Table 5.5-1) allocated |                   |            |            |             |             |             |             |

## 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.

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 |
| Wanted signal mean power   | dBm   | -25               |       |       |        |        |        |
| 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 clause 6.2.5. |       |                   |       |       |        |        |        |
| 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.                        |       |                   |       |       |        |        |        |

## 7.5 Adjacent Channel Selectivity (ACS)

### 7.5.1 Minimum requirements

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).

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).

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                     |
| Wanted signal mean power  | dBm   | REFSENS + 14 dB          |                      |                      |                          |                        |                            |
| $P_{\text{Interferer}}$   | dBm   | REFSENS +45.5dB          | REFSENS +45.5dB      | REFSENS +45.5dB*     | REFSENS +45.5dB          | REFSENS +42.5dB        | REFSENS +39.5dB            |
| $BW_{\text{Interferer}}$  | MHz   | 1.4                      | 3                    | 5                    | 5                        | 5                      | 5                          |
| $F_{\text{Interferer}}$ (offset)  | MHz   | 1.4+0.0025 / -1.4-0.0025 | 3+0.0075 / -3-0.0075 | 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 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 clause 6.2.5.                                |       |                          |                      |                      |                          |                        |                            |
| 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 |       |                          |                      |                      |                          |                        |                            |

**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                           |
| Wanted signal mean power  | 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 $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in clause 6.2.5.                                 |       |                                |                            |                            |                                |                              |                                  |
| 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 |       |                                |                            |                            |                                |                              |                                  |

## 7.6 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..

#### 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.

**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      |
| Wanted signal mean power   | 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 |
| Note 1: The transmitter shall be set to 4dB $P_{\text{CMAX\_L}}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{\text{CMAX\_L}}$ as defined in clause 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 |       |  |            |             |             |             |             |

**Table 7.6.1.1-2: In-band blocking**

| E-UTRA band   | Parameter                        | Units                   | Case 1  | Case 2  | Case 3   |
|---|----------------------------------|-------------------------|---|---|--|
|   |                                  | $P_{\text{Interferer}}$ | 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>$\geq +BW/2 + F_{\text{offset, case 2}}$ | $-BW/2 - 9 \text{ MHz}$<br>&<br>$-BW/2 - 15 \text{ MHz}$                 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 33, 34, 35, 36, 37, 38, 39, 40   | $F_{\text{Interferer}}$          | MHz                     | (Note 2)  | $F_{\text{DL\_low}} -15$<br>to<br>$F_{\text{DL\_high}} +15$                               |  |
| 17  | $F_{\text{Interferer}}$          | MHz                     | (Note 2)  | $F_{\text{DL\_low}} -9.0$<br>to<br>$F_{\text{DL\_high}} +15$                              | $F_{\text{DL\_low}} -15$<br>and<br>$F_{\text{DL\_low}} -9.0$<br>(Note 3) |
| <p>Note</p> <p>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>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>3 <math>F_{\text{interferer}}</math> range values for unwanted modulated interfering signal are interferer center frequencies.</p> <p>4 Case 3 only applies to assigned UE channel bandwidth of 5 MHz.</p> |                                  |                         |   |   |  |

## 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 sub-clause 7.5.1 and sub-clause 7.6.1 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 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 5.4.2-1). For these exceptions the requirements of clause 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 5.4.2-1) 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 |
| Wanted signal mean power | 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 clause 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.

**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<br>6, 7, 8, 9,<br>10,11,12, 13,<br>17, 33,34, 35,<br>36, 37, 38, 39,<br>40 | $F_{Interferer}$<br>(CW) | MHz   | $F_{DL\_low}$ -15 to<br>$F_{DL\_low}$ -60    | $F_{DL\_low}$ -60 to<br>$F_{DL\_low}$ -85   | $F_{DL\_low}$ -85 to<br>1 MHz       | -                            |
|  |                          |       | $F_{DL\_high}$ +15 to<br>$F_{DL\_high}$ + 60 | $F_{DL\_high}$ +60 to<br>$F_{DL\_high}$ +85 | $F_{DL\_high}$ +85 to<br>+12750 MHz | -                            |
| 2, 5, 12, 17   | $F_{Interferer}$         | MHz   | -  | -   | -                                   | $F_{UL\_low} - F_{UL\_high}$ |
| Note:  |                          |       |  |   |                                     |                              |

### 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  $\geq 95\%$  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 7.6.3.1-1

**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  |
| $P_w$  | dBm  | $P_{REFSENS}$ + channel-bandwidth specific value below |        |        |        |        |         |
|  |      | 22   | 18     | 16     | 13     | 14     | 16      |
| $P_{uw}$ (CW)  | dBm  | -55  | -55    | -55    | -55    | -55    | -55     |
| $F_{uw}$ (offset for $\Delta f = 15$ kHz)  | MHz  | 0.9075   | 1.7025 | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| $F_{uw}$ (offset for $\Delta f = 7.5$ kHz)   | MHz  |  |        |        |        |        |         |
| Note 1: The transmitter shall be set a 4 dB below $P_{CMAX,L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX,L}$ as defined in clause 6.2.5.<br>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. |      |  |        |        |        |        |         |

## 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 sub-clause 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 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 7.7.1-1 and 7.7.1-2.

**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 |
| Wanted signal mean power   | 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 with $P_{\text{CMAX}_L}$ as defined in clause 6.2.5. |       |  |       |       |        |        |        |
| 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 7.7.1-2: Spurious Response**

| Parameter                       | Unit | Level                         |
|---------------------------------|------|-------------------------------|
| $P_{\text{Interferer}}$<br>(CW) | dBm  | -44                           |
| $F_{\text{Interferer}}$         | MHz  | Spurious response frequencies |

## 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

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 |
| Wanted signal mean power              | dBm   | REFSENS + channel bandwidth specific value below |                                |                                 |        |        |        |
|                                       |   | 12   | 8                              | 6                               | 6      | 7      | 9      |
| $P_{\text{Interferer 1 (CW)}}$        | dBm   | -46  |                                |                                 |        |        |        |
| $P_{\text{Interferer 2 (Modulated)}}$ |   | -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 |        |        |        |
| $F_{\text{Interferer 2 (Offset)}}$    |   | $2 * F_{\text{Interferer 1}}$                    |                                |                                 |        |        |        |
| <b>Note:</b>                          |   |  |                                |                                 |        |        |        |
| 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 clause 6.2.5.   |  |                                |                                 |        |        |        |
| 2                                     | Reference measurement channel is specified in Annex 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.   |  |                                |                                 |        |        |        |
| 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 The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth $\geq 5\text{MHz}$ |  |                                |                                 |        |        |        |

## 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 |
|---|-----------------------|---------------|------|
| $30\text{MHz} \leq f < 1\text{GHz}$       | 100 kHz               | -57 dBm       |      |
| $1\text{GHz} \leq f \leq 12.75\text{GHz}$ | 1 MHz                 | -47 dBm       |      |

## 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.

### 8.1 General

#### 8.1.1 Dual-antenna receiver capability

The performance requirements are based on UE(s) that utilize a dual-antenna receiver.

For all test cases, the SNR is defined as

$$SNR = \frac{\hat{E}_s^{(1)} + \hat{E}_s^{(2)}}{N_{oc}^{(1)} + N_{oc}^{(2)}}$$

where the superscript indicates the receiver antenna connector. The SNR requirement applies for the UE categories given for each test.

##### 8.1.1.1 Simultaneous unicast and MBMS operations

##### 8.1.1.2 Dual-antenna receiver capability in idle mode

### 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            | 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    | 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  |
| Note:                               |              |  |

##### 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

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.

**Table 8.2.1.1.1-1: Test Parameters**

| Parameter   |          | Unit      | Test 1- 5     | Test 6- 8     | Test 9- 15    | Test 16- 18   |
|---|----------|-----------|---------------|---------------|---------------|---------------|
| 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)    |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98           | -98           | -98           | 98            |
| Symbols for unused PRBs   |          |           | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Modulation  |          |           | QPSK          | 16QAM         | 64QAM         | 16QAM         |
| 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 8.2.1.1.1-2: 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 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | -1.0     | 1-5         |
| 2           | 10 MHz    | R.2 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 70                                 | -0.4     | 1-5         |
| 3           | 10 MHz    | R.2 FDD           | OP.1 FDD     | ETU300                | 1x2 Low                                      | 70                                 | 0.0      | 1-5         |
| 4           | 10 MHz    | R.2 FDD           | OP.1 FDD     | HST                   | 1x2 Low                                      | 70                                 | -2.4     | 1-5         |
| 5           | 1.4 MHz   | R.4 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 0.0      | 1-5         |
| 6           | 10 MHz    | R.3 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 6.7      | 2-5         |
| 7           | 10 MHz    | R.3 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.4      | 2-5         |
| 8           | 10 MHz    | R.3 FDD           | OP.1 FDD     | ETU300                | 1x2 High                                     | 70                                 | 9.4      | 2-5         |
| 9           | 3 MHz     | R.5 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 1-5         |
| 10          | 5 MHz     | R.6 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.4     | 2-5         |
| 11          | 10 MHz    | R.7 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | 2-5         |
| 12          | 10 MHz    | R.7 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 70                                 | 19.0     | 2-5         |
| 13          | 10 MHz    | R.7 FDD           | OP.1 FDD     | EVA5                  | 1x2 High                                     | 70                                 | 19.1     | 2-5         |
| 14          | 15 MHz    | R.8 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | 2-5         |
| 15          | 20 MHz    | R.9 FDD           | OP.1 FDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 3-5         |
| 16          | 3 MHz     | R.0 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.9      | 1-5         |
| 17          | 10 MHz    | R.1 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.9      | 1-5         |
| 18          | 20 MHz    | R.1 FDD           | OP.1 FDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.9      | 1-5         |

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        | 0             |
|  | $\rho_B$ | dB        | 0 (Note 1)    |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98           |
| Symbols for MBSFN portion of MBSFN subframes (Note 2)  |          |           | OCNG (Note 3) |
| 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      | 1-5         |

## 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) |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| Note 1: $P_B = 1$         |          |           |             |

**Table 8.2.1.2.1-2: 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 FDD          | OP.1 FDD     | EVA5                  | 2x2 Medium                                   | 70                                 | 6.8      | 2-5         |
| 2           | 10 MHz    | R.10 FDD          | OP.1 FDD     | HST                   | 2x2 Low                                      | 70                                 | -2.3     | 1-5         |

### 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 to 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      |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| 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      | 1-5         |

### 8.2.1.3 Open-loop spatial multiplexing performance

#### 8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port

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. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

**Table 8.2.1.3.1-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 |          | Unit      | Test 1      |
|---------------------------|----------|-----------|-------------|
| Downlink power allocation | $\rho_A$ | dB        | -3          |
|                           | $\rho_B$ | dB        | -3 (Note 1) |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| Note 1: $P_B = 1$         |          |           |             |

**Table 8.2.1.3.1-2: Minimum performance Large Delay CDD (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     | EVA70                 | 2x2 Low                                      | 70                                 | 13.0     | 2-5         |

#### 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        | -6          |
|                           | $\rho_B$ | dB        | -6 (Note 1) |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98         |
| Note 1: $P_B = 1$         |          |           |             |

**Table 8.2.1.3.2-2: Minimum performance Large Delay CDD (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.14 FDD          | OP.1 FDD     | EVA70                 | 4x2 Low                                      | 70                                 | 14.3     | 2-5         |

#### 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 2      |
|--|----------|-----------|-------------|-------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3          | -3          |
|  | $\rho_B$ | dB        | -3 (Note 1) | -3 (Note 1) |
| $N_{oc}$ 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   |
| 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 | 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.10 FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | -2.5     | 1-5         |
| 2           | 10 MHz     | R.10 FDD          | OP.1 FDD     | EPA5                  | 2x2 High                                     | 70                                 | -2.3     | 1-5         |

##### 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      |
|--|----------|-----------|-------------|
| Downlink power allocation  | $\rho_A$ | dB        | -6          |
|  | $\rho_B$ | dB        | -6 (Note 1) |
| $N_{oc}$ 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   |
| 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 | 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.13 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | -3.2     | 1-5         |

#### 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      | Test 2      |
|--|----------|-----------|-------------|-------------|
| Downlink power allocation  | $\rho_A$ | dB        | -3          | -3          |
|  | $\rho_B$ | dB        | -3 (Note 1) | -3 (Note 1) |
| $N_{oc}$ at antenna port   |          | dBm/15kHz | -98         | -98         |
| Precoding granularity  |          | PRB       | 50          | 50          |
| PMI delay (Note 2)   |          | ms        | 8           | 8           |
| Reporting interval   |          | ms        | 1           | 1           |
| Reporting mode   |          |           | PUSCH 3-1   | PUSCH 3-1   |
| 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 8.2.1.4.2-2: 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.11 FDD          | OP.1 FDD     | EVA5                  | 2x2 Low                                      | 70                                 | 12.9     | 2-5         |
| 2           | 10 MHz     | R.11 FDD          | OP.1 FDD     | ETU70                 | 2x2 Low                                      | 70                                 | 14.3     | 2-5         |

### 8.2.1.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

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. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.1.4.3-1: 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) |
| $N_{oc}$ 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   |
| 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 8.2.1.4.3-2: 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 |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.14 FDD          | OP.1 FDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.5     | 2-5         |

### 8.2.1.5 MU-MIMO

### 8.2.1.6 [Control channel performance: D-BCH and PCH]

## 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                             | 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                     | 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 |
| 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

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.

**Table 8.2.2.1.1-1: Test Parameters**

| Parameter   |          | Unit      | Test 1- 5     | Test 6- 8     | Test 9- 15    | Test 16- 18   |
|---|----------|-----------|---------------|---------------|---------------|---------------|
| 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)    |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98           | -98           | -98           | -98           |
| Symbols for unused PRBs   |          |           | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Modulation  |          |           | QPSK          | 16QAM         | 64QAM         | 16QAM         |
| ACK/NACK feedback mode  |          |           | Multiplexing  | Multiplexing  | Multiplexing  | Multiplexing  |
| 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 8.2.2.1.1-2: 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     | 1-5         |
| 2           | 10 MHz    | R.2 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 70                                 | -0.6     | 1-5         |
| 3           | 10 MHz    | R.2 TDD           | OP.1 TDD     | ETU300                | 1x2 Low                                      | 70                                 | -0.2     | 1-5         |
| 4           | 10 MHz    | R.2 TDD           | OP.1 TDD     | HST                   | 1x2 Low                                      | 70                                 | -2.6     | 1-5         |
| 5           | 1.4 MHz   | R.4 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 0.0      | 1-5         |
| 6           | 10 MHz    | R.3 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 6.7      | 2-5         |
| 7           | 10 MHz    | R.3 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 1.4      | 2-5         |
| 8           | 10 MHz    | R.3 TDD           | OP.1 TDD     | ETU300                | 1x2 High                                     | 70                                 | 9.3      | 2-5         |
| 9           | 3 MHz     | R.5 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 1-5         |
| 10          | 5 MHz     | R.6 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 2-5         |
| 11          | 10 MHz    | R.7 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.6     | 2-5         |
| 12          | 10 MHz    | R.7 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 70                                 | 19.1     | 2-5         |
| 13          | 10 MHz    | R.7 TDD           | OP.1 TDD     | EVA5                  | 1x2 High                                     | 70                                 | 19.1     | 2-5         |
| 14          | 15 MHz    | R.8 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.8     | 2-5         |
| 15          | 20 MHz    | R.9 TDD           | OP.1 TDD     | EVA5                  | 1x2 Low                                      | 70                                 | 17.7     | 3-5         |
| 16          | 3 MHz     | R.0 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 2.1      | 1-5         |
| 17          | 10 MHz    | R.1 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 2.0      | 1-5         |
| 18          | 20 MHz    | R.1 TDD           | OP.1 TDD     | ETU70                 | 1x2 Low                                      | 30                                 | 2.1      | 1-5         |

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 8.2.2.1.1.4-1 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            |
|  | $\rho_B$  | dB            |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98           |
| Symbols for MBSFN portion of MBSFN subframes (Note 2)  |           | OCNG (Note 3) |
| ACK/NACK feedback mode   |           | Multiplexing  |
| 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      | 1-5         |

## 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        | -3           |
|                           | $\rho_B$ | dB        | -3 (Note 1)  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode    |          |           | Multiplexing |
| 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      | 2-5         |
| 2           | 10 MHz    | R.10 TDD          | OP.1 TDD     | HST                   | 2x2 Low                                      | 70                                 | -2.3     | 1-5         |

### 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       |
|---------------------------|----------|-----------|--------------|
| Downlink power allocation | $\rho_A$ | dB        | -3           |
|                           | $\rho_B$ | dB        | -3 (Note 1)  |
| $N_{oc}$ at antenna port  |          | dBm/15kHz | -98          |
| ACK/NACK feedback mode    |          |           | Multiplexing |
| Note 1: $P_B = 1$         |          |           |              |

**Table 8.2.2.2-2: 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      | 1-5         |

### 8.2.2.3 Open-loop spatial multiplexing performance

#### 8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port

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. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

**Table 8.2.2.3.1-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter                 | Unit      | Test 1      |
|---------------------------|-----------|-------------|
| Downlink power allocation | $\rho_A$  | -3          |
|                           | $\rho_B$  | -3 (Note 1) |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98         |
| ACK/NACK feedback mode    |           | Bundling    |
| Note 1: $P_B = 1$         |           |             |

**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           | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | EVA70                 | 2x2 Low                                      | 70                                 | 13.1     | 2-5         |

#### 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) |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98         |
| ACK/NACK feedback mode    |           | Bundling    |
| 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     | 2-5         |

## 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  | $\rho_A$  | -3              | -3              |
|  | $\rho_B$  | -3 (Note 1)     | -3 (Note 1)     |
| $N_{oc}$ 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       |
| ACK/NACK feedback mode   |           | Multiplexing    | Multiplexing    |
| 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     | 1-5         |
| 2           | 10 MHz    | R.10 TDD          | OP.1 TDD     | EPA5                  | 2x2 High                                     | 70                                 | -2.8     | 1-5         |

### 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          |
|--|-----------|-----------------|
| Downlink power allocation  | $\rho_A$  | -6              |
|  | $\rho_B$  | -6 (Note 1)     |
| $N_{oc}$ 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   |           | Multiplexing    |
| 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 |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.13 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | -3.5     | 1-5         |

#### 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          | Test 2          |
|--|-----------|-----------------|-----------------|
| Downlink power allocation  | $\rho_A$  | -3              | -3              |
|  | $\rho_B$  | -3 (Note 1)     | -3 (Note 1)     |
| $N_{oc}$ at antenna port   | dBm/15kHz | -98             | -98             |
| Precoding granularity  | PRB       | 50              | 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 3-1       | PUSCH 3-1       |
| ACK/NACK feedback mode   |           | Bundling        | Bundling        |
| 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 |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | EVA5                  | 2x2 Low                                      | 70                                 | 12.8     | 2-5         |
| 2           | 10 MHz    | R.11-1 TDD        | OP.1 TDD     | ETU70                 | 2x2 Low                                      | 70                                 | 13.9     | 2-5         |

### 8.2.2.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port

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. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.2.4.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter  | Unit      | Test 1          |
|--|-----------|-----------------|
| Downlink power allocation  | $\rho_A$  | dB              |
|  | $\rho_B$  | dB              |
| $N_{oc}$ 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        |
| 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 8.2.2.4.3-2: 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 |
|-------------|-----------|-------------------|--------------|-----------------------|--|------------------------------------|----------|-------------|
|             |           |                   |              |                       |  | Fraction of Maximum Throughput (%) | SNR (dB) |             |
| 1           | 10 MHz    | R.14 TDD          | OP.1 TDD     | EVA5                  | 4x2 Low                                      | 70                                 | 10.7     | 2-5         |

### 8.2.2.5 MU-MIMO

### 8.2.2.6 [Control channel performance: D-BCH and PCH]

## 8.3 Demodulation of PDSCH (User-Specific Reference Symbols)

### 8.3.1 FDD

[TBD]

## 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 DRS**

| 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 |
| Number of OFDM symbols for PDCCH                     | OFDM symbols | 2   |
| Beamforming Model                                    |              | As specified in Section B.4                         |
| Precoder update granularity                          |              | Frequency domain: 1 PRB<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] |              |   |

The requirements are specified in Table 8.3.2-3, with the addition of the parameters in Table 8.3.2-2 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 8.3.2-2: Test Parameters for Testing DRS**

| parameter   | Unit      | Test 1         | Test 2        | Test 3        | Test 4        |
|---|-----------|----------------|---------------|---------------|---------------|
| Downlink power allocation   | $\rho_A$  | 0              | 0             | 0             | 0             |
|   | $\rho_B$  | 0 (Note 1)     | 0 (Note 1)    | 0 (Note 1)    | 0 (Note 1)    |
| Cell-specific reference signals   |           | Antenna port 0 |               |               |               |
| $N_{oc}$ at antenna port  | dBm/15kHz | -98            | -98           | -98           | -98           |
| Symbols for unused PRBs   |           | OCNG (Note 2)  | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Number of allocated resource blocks   | PRB       | 50             | 50            | 50            | 1 (Note 2)    |
| 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 8.3.2-3: 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     | 1-5         |
| 2           | 10 MHz 16QAM 1/2  | R.26 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 7.0      | 2-5         |
| 3           | 10 MHz 64QAM 3/4  | R.27 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 70                                 | 17.0     | 2-5         |
| 4           | 10 MHz 16QAM 1/2  | R.28 TDD          | OP.1 TDD     | EPA5                  | 2x2 Low                                      | 30                                 | 1.7      | 1-5         |

## 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

Table 8.4.1-1: Test Parameters for PDCCH/PCFICH

| Parameter                        |                                   | Unit      | Single antenna port | Transmit diversity |
|----------------------------------|-----------------------------------|-----------|---------------------|--------------------|
| Number of PDCCH symbols          |                                   | symbols   | 2                   | 2                  |
| Number of PHICH groups ( $N_g$ ) |                                   |           | 1                   | 1                  |
| PHICH duration                   |                                   |           | Normal              | Normal             |
| Cell ID                          |                                   |           | 0                   | 0                  |
| Downlink power allocation        | PCFICH_RA<br>PDCCH_RA<br>PHICH_RA | dB        | 0                   | -3                 |
|                                  | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB | dB        | 0                   | -3                 |
| $N_{oc}$ at antenna port         |                                   | dBm/15kHz | -98                 | -98                |
| Cyclic prefix                    |                                   |           | Normal              | Normal             |

#### 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 1.4 MHz   | 2 CCE             | R.16 FDD          | EPA5                  | 2 x 2 Low                                    | 1               | 4.3      |

### 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.17 FDD          | EVA5                  | 4 x 2 Medium                                 | 1               | 0.9      |

## 8.4.2 TDD

**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                  |     |
| Number of PHICH groups ( $N_g$ )                     |                                   | 1                   | 1                  |     |
| PHICH duration                                       |                                   | Normal              | Normal             |     |
| Cell ID  |                                   | 0                   | 0                  |     |
| Downlink power allocation                            | PCFICH_RA<br>PDCCH_RA<br>PHICH_RA | dB                  | 0                  | -3  |
|  | PDFICH_RB<br>PDCCH_RB<br>PDCCH_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] |                                   |                     |                    |     |

### 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 8 CCE             | R.15 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 1.4 MHz   | 2 CCE             | R.16 TDD          | EPA5                  | 2 x 2 Low                                    | 1               | 4.2      |

#### 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                   |                       |  | Pm-dsg (%)      | SNR (dB) |
| 1           | 10 MHz    | 4 CCE             | R.17 TDD          | EVA5                  | 4 x 2 Medium                                 | 1               | 1.2      |

## 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

**Table 8.5.1-1: Test Parameters for PHICH**

| Parameter  |           | Unit      | Single antenna port                                    | Transmit diversity |  |
|--|-----------|-----------|--|--------------------|--|
| Downlink power allocation                        | PHICH_RA  | dB        | 0  | -3                 |  |
|  | PHICH_RB  | dB        |  |                    |  |
|  | PCFICH_RA | dB        | 0  | -3                 |  |
|  | PCFICH_RB | dB        |  |                    |  |
|  | PDCCH_RA  | dB        |  |                    |  |
| PDCCH_RB   | dB        |           |  |                    |  |
| PHICH duration                                   |           |           | Normal   | Normal             |  |
| Number of PHICH groups (Note 1)                  |           |           | Ng = 1   | Ng = 1             |  |
| Cell ID  |           |           | 0  | 0                  |  |
| PDCCH content                                    |           |           | All PDCCH resources shall be occupied by non-zero data |                    |  |
| $N_{oc}$ 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | $P_{m-an}$ (%)  | SNR (dB) |
| 1           | 10 MHz    | R.18              | ETU70                 | 1 x 2 Low                                    | 0.1             | 5.5      |
| 2           | 10 MHz    | R.24              | 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 8.5.1.2.1-1. 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | $P_{m-an}$ (%)  | SNR (dB) |
| 1           | 1.4 MHz   | R.19              | EPA5                  | 2 x 2 Low                                    | 0.1             | 5.6      |

#### 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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.20              | EVA5                  | 4 x 2 Medium                                 | 0.1             | 6.0      |

## 8.5.2 TDD

**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  | PHICH_RA  | dB   | -3                 |
|  | PHICH_RB  | dB   |                    |
|  | PCFICH_RA | dB   |                    |
|  | PCFICH_RB | dB   | -3                 |
|  | PDCCH_RA  | dB   |                    |
|  | PDCCH_RB  | dB   |                    |
| PHICH duration   |           | Normal   | Normal             |
| Number of PHICH groups (Note 3)  |           | Ng = 1   | Ng = 1             |
| Cell ID  |           | 0  | 0                  |
| PDCCH content  |           | All PDCCH resources shall be occupied by non-zero data |                    |
| $N_{oc}$ 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] |           |  |                    |

### 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 (Pm-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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.18              | ETU70                 | 1 x 2 Low                                    | 0.1             | 5.8      |
| 2           | 10 MHz    | R.24              | 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 (Pm-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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 1.4 MHz   | R.19              | EPA5                  | 2 x 2 Low                                    | 0.1             | 5.3      |

#### 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 (Pm-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 | Propagation Condition | Antenna configuration and correlation Matrix | Reference value |          |
|-------------|-----------|-------------------|-----------------------|--|-----------------|----------|
|             |           |                   |                       |  | Pm-an (%)       | SNR (dB) |
| 1           | 10 MHz    | R.20              | EVA5                  | 4 x 2 Medium                                 | 0.1             | 6.1      |

## 8.6 Demodulation of PBCH

The receiver characteristics of the PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch).

### 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     |

## 8.6.2 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                  |    |
| 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] |                     |                    |    |

### 8.6.2.1 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     |

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## 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 is in accordance with the one given in clause 8.1.1.

### 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 36.211 [4]. 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

### 9.2.1.1 FDD

The following requirements apply to UE Category 2-5. For the parameters specified in Table 9.2.1.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to 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 9.2.1.1-1: 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      |     |
| 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  | $N_P = 5$      |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 6              |     |        |     |
| Note 1:   | Reference measurement channel 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. |                |     |        |     |

### 9.2.1.2 TDD

The following requirements apply to UE Category 2-5. 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 Table A.4-2 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      |     |
| 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           | $N_P = 5$      |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 3              |     |        |     |
| ACK/NACK feedback mode   |          |              | Multiplexing   |     |        |     |
| <p>Note 1: Reference measurement channel according to Table A.4-2 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

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 2-5. 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  $\text{CQI}_1$  shall be within the set  $\{\text{median CQI}_1 - 1, \text{median CQI}_1 + 1\}$  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 9.2.2.1-1: 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     |     |
| Propagation condition and antenna configuration |   | Clause B.1 (2 x 2) |     |        |     |
| CodeBookSubsetRestriction 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 transmissions                |   | 1                  |     |        |     |
| Physical channel for CQI/PMI reporting          |   | PUCCH Format 2     |     |        |     |
| PUCCH Report Type                               |   | 2                  |     |        |     |
| Reporting periodicity                           | ms  | $N_p = 5$          |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>               |   | 6                  |     |        |     |
| RI report                                       |   | OFF                |     |        |     |
| Note 1:   | Reference measurement channel 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. |                    |     |        |     |

### 9.2.2.2 TDD

The following requirements apply to UE Category 2-5. 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  $\{\text{median CQI}_1 - 1, \text{median CQI}_1 + 1\}$  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 configuration   |          |              |                    |     | 4      |     |
| Downlink power allocation  | $\rho_A$ | dB           |                    |     | -3     |     |
|  | $\rho_B$ | dB           |                    |     | -3     |     |
| Propagation condition and antenna configuration  |          |              | Clause B.1 (2 x 2) |     |        |     |
| CodeBookSubsetRestriction 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 transmissions   |          |              | 1                  |     |        |     |
| Physical channel for CQI/PMI reporting   |          |              | PUSCH (Note 3)     |     |        |     |
| PUCCH Report Type  |          |              | 2                  |     |        |     |
| Reporting periodicity  |          | ms           | $N_p = 5$          |     |        |     |
| <i>cqi-pmi-ConfigurationIndex</i>  |          |              | 3                  |     |        |     |
| RI report  |          |              | OFF                |     |        |     |
| ACK/NACK feedback mode   |          |              | Multiplexing       |     |        |     |
| <p>Note 1: Reference measurement channel according to Table A.4-2 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> |          |              |                    |     |        |     |

## 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 any one of 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

##### 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, 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;

- 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. 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 sub-band size.

**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)  |     |        |     |
| 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 |     |        |     |
| Correlation  |              | Full  |     |        |     |
| Reporting interval   | ms           | 5   |     |        |     |
| CQI delay  | ms           | 8   |     |        |     |
| Reporting mode   |              | PUSCH 3-0   |     |        |     |
| 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 according to Table A.4-4 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 9.3.1.1.1-2 Minimum requirement (FDD)**

|              | Test 1 | Test 2 |  |
|--------------|--------|--------|--|
| $\alpha$ [%] | 2      | 2      |  |
| $\beta$ [%]  | 55     | 55     |  |
| $\gamma$     | 1.1    | 1.1    |  |
| UE Category  | 1-5    | 1-5    |  |

### 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, 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. 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 sub-band size.

**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)  |     |        |     |
| 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 $\tau_d = 0.45 \mu\text{s}$ ,<br>$a = 1$ , $f_D = 5 \text{ Hz}$ |     |        |     |
| Correlation   |              | Full  |     |        |     |
| Reporting interval  | ms           | 5   |     |        |     |
| CQI delay   | ms           | 10 or 11  |     |        |     |
| Reporting mode  |              | PUSCH 3-0   |     |        |     |
| 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)<br>Note 2: Reference measurement channel according to Table A.4-5 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.<br>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  | 1-5    | 1-5    |



## 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 a double-sided percentile of the reported CQI, 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

#### 9.3.2.1.1 FDD

For the parameters specified in Table 9.3.2.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.2.1.1-2 and by the following

- a) a CQI index not in the set {median CQI -1, 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

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  $N_{\text{PRB}}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the maximum transmission configuration (Table 5.6-1).

**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)     |     |        |     |
| 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                        |  | High           |     |        |     |
| Reporting mode                     |  | PUCCH 1-0      |     |        |     |
| Reporting periodicity              | ms   | $N_p = 2$      |     |        |     |
| 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 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 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  | 2-5    | 2-5    |  |

### 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, the minimum requirements are specified in Table 9.3.2.1.2-2 and by the following

- a CQI index not in the set {median CQI -1, 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 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 maximum transmission configuration (Table 5.6-1).

**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)     |     |        |     |
| 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   |              | High           |     |        |     |
| Reporting mode  |              | PUCCH 1-0      |     |        |     |
| Reporting periodicity   | ms           | $N_p = 5$      |     |        |     |
| 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   |     |        |     |
| <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 according to Table A.4-2 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.</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> <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 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> |              |                |     |        |     |

**Table 9.3.2.1.2-2 Minimum requirement (TDD)**

|              | Test 1 | Test 2 |  |
|--------------|--------|--------|--|
| $\alpha$ [%] | 20     | 20     |  |
| $\gamma$     | 1.05   | 1.05   |  |
| UE Category  | 2-5    | 2-5    |  |

### 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 double-sided 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 any one of 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

#### 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, 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. 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 sub-band size.

**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) |
| $I_{ot}^{(j)}$ 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 $\tau_d = 0.45 \mu s$ ,<br>$a = 1$ , $f_D = 5$ Hz |            |
| Correlation                      |   | Full  |            |
| Reporting interval               | ms  | 5   |            |
| 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 according to Table A.4-4 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  | 1-5    | 1-5    |

## 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, the minimum requirements are specified in Table 9.3.3.1.2-2 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. 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 sub-band size.

**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) |
| 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 $\tau_d = 0.45 \mu\text{s}$ ,<br>$a = 1$ , $f_D = 5 \text{ Hz}$ |            |
| Correlation                      |  | Full  |            |
| 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) |   |            |
| Note 2:                          | Reference measurement channel according to table A.4-5 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  | 1-5    | 1-5    |

## 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. Transmission mode 6 is used with a fixed transport format (FRC) configured. The requirements are specified in terms of the ratio

$$\gamma = \frac{t_{ue}}{t_{rnd}}$$

where  $t_{rnd}$  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.

### 9.4.1 Single PMI

#### 9.4.1.1 Minimum requirement PUSCH 3-1

##### 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, 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 |
| $N_{oc}^{(j)}$                        | 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 | 1-5    |

## 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, 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    |
| $N_{oc}^{(j)}$                        | 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 | 1-5    |

## 9.4.2 Multiple PMI

## 9.4.2.1 Minimum requirement PUSCH 1-2

## 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, 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  | 20        |
| Transmission mode                     |  | 6         |
| Propagation channel                   |  | EPA5      |
| Precoding granularity                 | PRB  | 8         |
| Correlation and antenna configuration |  | Low 2 x 2 |
| $N_{oc}^{(j)}$                        | dB[mW/15kHz]   | -98       |
| Reporting mode                        |  | PUSCH 1-2 |
| Reporting interval                    | ms   | 1         |
| PMI delay                             | ms   | 8         |
| Measurement channel                   |  | R.30 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 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) |           |

**Table 9.4.2.1.1-2 Minimum requirement (FDD)**

| Parameter   | Test 1 |
|-------------|--------|
| $\gamma$    | 1.2    |
| UE Category | 2-5    |

#### 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, 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  | 20           |
| Transmission mode                     |  | 6            |
| Uplink downlink configuration         |  | 1            |
| Special subframe configuration        |  | 4            |
| Propagation channel                   |  | EPA5         |
| Precoding granularity                 | PRB  | 8            |
| Correlation and antenna configuration |  | Low 2 x 2    |
| $N_{oc}^{(j)}$                        | dB[mW/15kHz]   | -98          |
| Reporting mode                        |  | PUSCH 1-2    |
| Reporting interval                    | ms   | 1            |
| PMI delay                             | ms   | 10 or 11     |
| Measurement channel                   |  | R.30 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 precoders 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 9.4.2.1.2-2 Minimum requirement (TDD)**

| Parameter   | Test 1 |
|-------------|--------|
| $\gamma$    | 1.2    |
| UE Category | 2-5    |

## 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.

For fixed rank 1 transmission, the RI and PMI reporting is restricted to two single-layer precoders, For fixed rank 2 transmission, the RI and PMI reporting is restricted to one two-layer precoder, For follow RI transmission, 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.

### 9.5.1 Minimum requirement

#### 9.5.1.1 FDD

The minimum performance requirement in Table 9.5.1.1-2 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  $\geq \gamma_2$ ;

TBS selection is based on the UE wideband CQI feedback. The transport block size TBS is that resulting from the code rate which is closest to that indicated by  $M = \text{wideband CQI}$  and the  $N_{\text{PRB}}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the transmission bandwidth configuration (Table 5.6-1).

For the parameters specified in Table 9.5.1.1-1, and using the downlink physical channels specified in Annex C, 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                       |                          |
| CodeBookSubsetRestriction bitmap                |  | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI |                          |                          |
| Propagation condition and antenna configuration |  | 2 x 2 EPA5  |                          |                          |
| Antenna correlation                             |  | Low   | Low                      | High                     |
| RI configuration                                |  | Fixed RI=2 and follow RI  | Fixed RI=1 and follow RI | Fixed RI=2 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          |  | 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   | $N_p = 5$   |                          |                          |
| PMI and CQI delay                               | ms   | 8   |                          |                          |
| <i>cqi-pmi-ConfigurationIndex</i>               |  | 6   |                          |                          |
| <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 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. |   |                          |                          |

**Table 9.5.1.1-2 Minimum requirement (FDD)**

|             | Test 1 | Test 2 | Test 3 |
|-------------|--------|--------|--------|
| $\gamma_1$  | N/A    | 1.05   | N/A    |
| $\gamma_2$  | 1      | N/A    | 1.1    |
| UE Category | 2-5    | 2-5    | 2-5    |

### 9.5.1.2 TDD

The minimum performance requirement in Table 9.5.1.2-2 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  $\geq \gamma_2$ ;

TBS selection is based on the UE wideband CQI feedback. The transport block size TBS is that resulting from the code rate which is closest to that indicated by  $M =$  wideband CQI and the  $N_{PRB}$  entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the transmission bandwidth configuration (Table 5.6-1).

For the parameters specified in Table 9.5.1.2-1, and using the downlink physical channels specified in Annex C, 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                       |                          |
| 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=2 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).<br>Note 2: Reference measurement channel according to Table A.4-2 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.<br>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] | N/A    |
| $\gamma_2$  | [1]    | N/A    | [1.1]  |
| UE Category | 2-5    | 2-5    | 2-5    |

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## Annex A (normative): Measurement channels

### A.1 General

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## A.2 UL reference measurement channels

### A.2.1 General

#### A.2.1.1 Applicability and common parameters

The following sections define the UL signal applicable to the Transmitter Characteristics (clause 6) and for the Receiver Characteristics (clause 7) where the UL signal is relevant.

The Reference channels in this section assume transmission of PUSCH and Demodulation Reference signal 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,

$$\min |R - (A + 24) / N_{ch}|,$$

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) Segmentation is not included in this formula, but should be considered in the TBS calculation.
- c) 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.

## 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 |      |      |       |       |       |
|--|------|-------|------|------|-------|-------|-------|
|  |      | 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   |
| 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  |      | 1-5   | 1-5  | 1-5  | 1-5   | 1-5   | 1-5   |
| 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.2.2.1.2 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  |      | 1-5   | 1-5   | 1-5   | 2-5   | 2-5   | 2-5   |
| 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.2.2.1.3 64-QAM

[FFS]

## 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 1.4MHz QPSK with partial RB allocation

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 1.4   |
| Allocated resource blocks  |      | 1     | 5     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   |
| Payload size   | Bits | 72    | 424   |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 1440  |
| Total symbols per Sub-Frame  |      | 144   | 720   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.1-2 Reference Channels for 3MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 3     | 3     |
| Allocated resource blocks  |      | 1     | 4     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   |
| Payload size   | Bits | 72    | 392   |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 1152  |
| Total symbols per Sub-Frame  |      | 144   | 576   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.1-3 Reference Channels for 5MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value |
|--|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 5     | 5     | 5     |
| Allocated resource blocks  |      | 1     | 8     | 20    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   |
| Payload size   | Bits | 72    | 808   | 1736  |
| Transport block CRC  | Bits | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 2304  | 5760  |
| Total symbols per Sub-Frame  |      | 144   | 1152  | 2880  |
| UE Category  |      | 1-5   | 1-5   | 1-5   |
| 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.2.2.2.1-4 Reference Channels for 10MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value | Value |
|--|------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 10    | 10    | 10    | 10    |
| Allocated resource blocks  |      | 1     | 12    | 20    | 25    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   | Bits | 72    | 1224  | 1736  | 2216  |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 3456  | 5760  | 7200  |
| Total symbols per Sub-Frame  |      | 144   | 1728  | 2880  | 3600  |
| UE Category  |      | 1-5   | 1-5   | 1-5   | 1-5   |
| 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.2.2.2.1-5 Reference Channels for 15MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value |
|--|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 15    | 15    | 15    |
| Allocated resource blocks  |      | 1     | 16    | 50    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   |
| Payload size   | Bits | 72    | 1384  | 5160  |
| Transport block CRC  | Bits | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 4608  | 14400 |
| Total symbols per Sub-Frame  |      | 144   | 2304  | 7200  |
| UE Category  |      | 1-5   | 1-5   | 1-5   |
| 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.2.2.2.1-6 Reference Channels for 20MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value | Value | Value |
|--|------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 20    | 20    | 20    | 20    | 20    |
| Allocated resource blocks  |      | 1     | 18    | 25    | 50    | 75    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/5   |
| Payload size   | Bits | 72    | 1864  | 2216  | 5160  | 4392  |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 288   | 5184  | 7200  | 14400 | 21600 |
| Total symbols per Sub-Frame  |      | 144   | 2592  | 3600  | 7200  | 10800 |
| UE Category  |      | 1-5   | 1-5   | 1-5   | 1-5   | 1-5   |
| 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.2.2.2.2 16-QAM

**Table A.2.2.2.2-1 Reference Channels for 1.4MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 1.4   |
| Allocated resource blocks  |      | 1     | 5     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   | Bits | 408   | 2152  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 2880  |
| Total symbols per Sub-Frame  |      | 144   | 720   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.2-2 Reference Channels for 3MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 3     | 3     |
| Allocated resource blocks  |      | 1     | 4     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   | Bits | 408   | 1736  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 2304  |
| Total symbols per Sub-Frame  |      | 144   | 576   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.2-3 Reference Channels for 5MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 5     | 5     |
| Allocated resource blocks  |      | 1     | 8     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   | Bits | 408   | 3496  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 4608  |
| Total symbols per Sub-Frame  |      | 144   | 1152  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.2-4 Reference Channels for 10MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 10    | 10    |
| Allocated resource blocks  |      | 1     | 12    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   | Bits | 408   | 5160  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 6912  |
| Total symbols per Sub-Frame  |      | 144   | 1728  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2-5 Reference Channels for 15MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 15    | 15    |
| Allocated resource blocks  |      | 1     | 16    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   |
| Payload size   | Bits | 408   | 4584  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 9216  |
| Total symbols per Sub-Frame  |      | 144   | 2304  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2-6 Reference Channels for 20MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 20    | 20    |
| Allocated resource blocks  |      | 1     | 18    |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   |
| Payload size   | Bits | 408   | 5160  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits | 576   | 10368 |
| Total symbols per Sub-Frame  |      | 144   | 2592  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.2.2.3 64-QAM

[FFS]

## A.2.3 Reference measurement channels for TDD

For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL:2UL.

## 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 |      |      |       |       |       |
|--|--|-------|------|------|-------|-------|-------|
| 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                                  |  | 1-5   | 1-5  | 1-5  | 1-5   | 1-5   | 1-5   |
| 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.2.3.1.2 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                                  |  | 1-5   | 1-5   | 1-5   | 2-5   | 2-5   | 2-5   |
| 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

[FFS]

## 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 1.4MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 1.4   |
| Allocated resource blocks  |      | 1     | 5     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 424   |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 288   | 1440  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 720   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.1-2 Reference Channels for 3MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 3     | 3     |
| Allocated resource blocks  |      | 1     | 4     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 392   |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 288   | 1152  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 576   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.1-3 Reference Channels for 5MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value |
|--|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 5     | 5     | 5     |
| Allocated resource blocks  |      | 1     | 8     | 20    |
| Uplink-Downlink Configuration  |      | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   |
| Payload size   |      |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 808   | 1736  |
| Transport block CRC  | Bits | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   | Bits |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 288   | 2304  | 5760  |
| Total symbols per Sub-Frame  |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 1152  | 2880  |
| UE Category  |      | 1-5   | 1-5   | 1-5   |
| 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.2.3.2.1-4 Reference Channels for 10MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value | Value |
|--|------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 10    | 10    | 10    | 10    |
| Allocated resource blocks  |      | 1     | 12    | 20    | 25    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   |
| Payload size   |      |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 1224  | 1736  | 2216  |
| Transport block CRC  | Bits | 24    | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 288   | 3456  | 5760  | 7200  |
| Total symbols per Sub-Frame  |      |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 1728  | 2880  | 3600  |
| UE Category  |      | 1-5   | 1-5   | 1-5   | 1-5   |
| 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.2.3.2.1-5 Reference Channels for 15MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value |
|--|------|-------|-------|-------|
| Channel bandwidth  | MHz  | 15    | 15    | 15    |
| Allocated resource blocks  |      | 1     | 16    | 50    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   |
| Payload size   |      |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 1384  | 5160  |
| Transport block CRC  | Bits | 24    | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 288   | 4608  | 14400 |
| Total symbols per Sub-Frame  |      |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 2304  | 7200  |
| UE Category  |      | 1-5   | 1-5   | 1-5   |
| 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.2.3.2.1-6 Reference Channels for 20MHz QPSK with partial RB allocation**

| Parameter  | Unit | Value | Value | Value | Value | Value |
|--|------|-------|-------|-------|-------|-------|
| Channel bandwidth  | MHz  | 20    | 20    | 20    | 20    | 20    |
| Allocated resource blocks  |      | 1     | 18    | 25    | 50    | 75    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     | 1     | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    | 12    | 12    | 12    |
| Modulation   |      | QPSK  | QPSK  | QPSK  | QPSK  | QPSK  |
| Target Coding rate   |      | 1/3   | 1/3   | 1/3   | 1/3   | 1/5   |
| Payload size   |      |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 72    | 1864  | 2216  | 5160  | 4392  |
| Transport block CRC  | Bits | 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     |
| Total number of bits per Sub-Frame   |      |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 288   | 5184  | 7200  | 14400 | 21600 |
| Total symbols per Sub-Frame  |      |       |       |       |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 2592  | 3600  | 7200  | 10800 |
| UE Category  |      | 1-5   | 1-5   | 1-5   | 1-5   | 1-5   |
| 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 1.4MHz 16-QAM with partial RB allocation

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 1.4   | 1.4   |
| Allocated resource blocks  |      | 1     | 5     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 2152  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 2880  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 720   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.2-2 Reference Channels for 3MHz 16-QAM with partial RB allocation

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 3     | 3     |
| Allocated resource blocks  |      | 1     | 4     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 1736  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 2304  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 576   |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.2-3 Reference Channels for 5MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 5     | 5     |
| Allocated resource blocks  |      | 1     | 8     |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 3496  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 4608  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 1152  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.2-4 Reference Channels for 10MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 10    | 10    |
| Allocated resource blocks  |      | 1     | 12    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 3/4   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 5160  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 6912  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 1728  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.2-5 Reference Channels for 15MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 15    | 15    |
| Allocated resource blocks  |      | 1     | 16    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 4584  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 9216  |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 2304  |
| UE Category  |      | 1-5   | 1-5   |
| 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.2.3.2.2-6 Reference Channels for 20MHz 16-QAM with partial RB allocation**

| Parameter  | Unit | Value | Value |
|--|------|-------|-------|
| Channel bandwidth  | MHz  | 20    | 20    |
| Allocated resource blocks  |      | 1     | 18    |
| Uplink-Downlink Configuration (Note 2)   |      | 1     | 1     |
| DFT-OFDM Symbols per Sub-Frame   |      | 12    | 12    |
| Modulation   |      | 16QAM | 16QAM |
| Target Coding rate   |      | 3/4   | 1/2   |
| Payload size   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 408   | 5160  |
| Transport block CRC  | Bits | 24    | 24    |
| Number of code blocks per Sub-Frame (Note 1)   |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 1     | 1     |
| Total number of bits per Sub-Frame   |      |       |       |
| For Sub-Frame 2,3,7,8  | Bits | 576   | 10368 |
| Total symbols per Sub-Frame  |      |       |       |
| For Sub-Frame 2,3,7,8  |      | 144   | 2592  |
| UE Category  |      | 1-5   | 1-5   |
| 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

[FFS]

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## 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.

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,

$$\min |R - (A + 24) / N_{ch}|,$$

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) Segmentation is not included in this formula, but should be considered in the TBS calculation.
3. If there is more than one  $A$  that minimizes the equation above, then the larger value is chosen per default.
  4. For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL+DwPTS (12 OFDM symbol):  
2UL

## A.3.2 Reference measurement channel for receiver characteristics

Tables A.3.2-1 and A.3.2-2 are applicable for measurements on the Receiver Characteristics (clause 7) with the exception of sub-clause 7.4 (Maximum input level).

Tables A.3.2-3 and A.3.2-4 are applicable for sub-clause 7.4 (Maximum input level).

Tables A.3.2-1 and A.3.2-2 also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

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          |  | 10    | 10         | 10         | 10         | 10         | 10    |
| 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 4) |  |       |            |            |            |            |       |
| 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.<br>2 | 1952.<br>8 | 3952.<br>8 | 6040.<br>8 | 7884  |
| UE Category                                  |  | 1-5   | 1-5        | 1-5        | 1-5        | 1-5        | 1-5   |
| 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.3.2-2 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 6)       |   | 1     | 1    | 1    | 1      | 1      | 1      |
| Allocated subframes per Radio Frame (D+S)    |   | 4     | 4+2  | 4+2  | 4+2    | 4+2    | 4+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 5) |   |       |      |      |        |        |        |
| 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                                  |   | 1-5   | 1-5  | 1-5  | 1-5    | 1-5    | 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]   |       |      |      |        |        |        |

Table A.3.2-3 Fixed Reference Channel for Maximum input level for UE Categories 3-5 (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          |   | 10     | 10     | 10    | 10    | 10    | 10    |
| 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 4) |   |        |        |       |       |       |       |
| 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          |   | 10     | 10     | 10     | 10     | 10     | 10     |
| 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  |        |       |       |       |       |
|--|---|--------|--------|-------|-------|-------|-------|
|  |   | 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    |
| Allocated subframes per Radio Frame          |   | 10     | 10     | 10    | 10    | 10    | 10    |
| 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 | 48936 |
| 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     | 8     |
| 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 | 45713 |
| 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.3.2-4 Fixed Reference Channel for Maximum input level for UE Categories 3-5 (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 6)       |   | 1     | 1      | 1      | 1     | 1     | 1     |
| Allocated subframes per Radio Frame          |   | 4     | 4+2    | 4+2    | 4+2   | 4+2   | 4+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 5) |   |       |        |        |       |       |       |
| For Sub-Frames 4,9                           |   | 1     | 2      | 3      | 5     | 8     | 11    |
| For Sub-Frames 1,6                           |   | n/a   | 2      | 3      | 5     | 7     | 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     | 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          |   | 4     | 4+2    | 4+2    | 4+2    | 4+2    | 4+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 5) |   |       |        |        |        |        |        |
| 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          |   | 4     | 4+2    | 4+2    | 4+2   | 4+2   | 4+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 5) |   |       |        |        |       |       |       |
| 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     | 8     |
| 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]   |       |        |        |       |       |       |

## 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<br>FDD |   |   | R.2<br>FDD |    |    |
| Reference channel                            |   |            |   |   |            |    |    |
| Channel bandwidth                            | MHz   | 1.4        | 3 | 5 | 10         | 15 | 20 |
| Allocated resource blocks                    |   | 6          |   |   | 50         |    |    |
| Allocated subframes per Radio Frame          |   | 10         |   |   | 10         |    |    |
| Modulation                                   |   | QPSK       |   |   | QPSK       |    |    |
| Target Coding Rate                           |   | 1/3        |   |   | 1/3        |    |    |
| Information Bit Payload                      |   |            |   |   |            |    |    |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits  | 408        |   |   | 4392       |    |    |
| For Sub-Frame 5                              | Bits  | n/a        |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits  | 152        |   |   | 4392       |    |    |
| 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  | 1368       |   |   | 13800      |    |    |
| For Sub-Frame 5                              | Bits  | n/a        |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits  | 528        |   |   | 12960      |    |    |
| Max. Throughput averaged over 1 frame        | Mbps  | 0.342      |   |   | 3.953      |    |    |
| UE Category                                  |   | 1-5        |   |   | 1-5        |    |    |
| 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)                            |            |   |   |            |    |    |

Table A.3.3.1-2: Fixed Reference Channel 16QAM R=1/2

| Parameter   | Unit | Value |   |   |         |    |     |
|---|------|-------|---|---|---------|----|-----|
|   |      |       |   |   | R.3 FDD |    |     |
| Reference channel   |      |       |   |   |         |    |     |
| Channel bandwidth   | MHz  | 1.4   | 3 | 5 | 10      | 15 | 20  |
| Allocated resource blocks   |      |       |   |   | 50      |    |     |
| Allocated subframes per Radio Frame   |      |       |   |   | 10      |    |     |
| Modulation  |      |       |   |   | 16QAM   |    |     |
| Target Coding Rate  |      |       |   |   | 1/2     |    |     |
| Information Bit Payload   |      |       |   |   |         |    |     |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |       |   |   | 14112   |    |     |
| For Sub-Frame 5   | Bits |       |   |   | n/a     |    |     |
| For Sub-Frame 0   | Bits |       |   |   | 12960   |    |     |
| Number of Code Blocks per Sub-Frame (Note 3)  |      |       |   |   |         |    |     |
| For Sub-Frames 1,2,3,4,6,7,8,9  |      |       |   |   | 3       |    |     |
| For Sub-Frame 5   |      |       |   |   | n/a     |    |     |
| For Sub-Frame 0   |      |       |   |   | 3       |    |     |
| Binary Channel Bits Per Sub-Frame   |      |       |   |   |         |    |     |
| For Sub-Frames 1,2,3,4,6,7,8,9  | Bits |       |   |   | 27600   |    |     |
| For Sub-Frame 5   | Bits |       |   |   | n/a     |    |     |
| For Sub-Frame 0   | Bits |       |   |   | 25920   |    |     |
| Max. Throughput averaged over 1 frame   | Mbps |       |   |   | 12.586  |    |     |
| UE Category   |      |       |   |   |         |    | 2-5 |
| <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   |      |       | 10      | 10      | 10      | 10      | 10      |
| 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   |      |       | 1-5     | 2-5     | 2-5     | 2-5     | 3-5     |
| <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.3.3.1-4: Fixed Reference Channel Single PRB (Channel Edge)

| Parameter                                       | Unit  | Value |            |   |            |    |    |
|---|---|-------|------------|---|------------|----|----|
|   |   |       | R.0<br>FDD |   | R.1<br>FDD |    |    |
| Reference channel                               |   |       |            |   |            |    |    |
| Channel bandwidth                               | MHz   | 1.4   | 3          | 5 | 10/20      | 15 | 20 |
| Allocated resource blocks                       |   |       | 1          |   | 1          |    |    |
| Allocated subframes per Radio Frame             |   |       | 10         |   | 10         |    |    |
| 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<br>(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                                     |   |       | 1-5        |   | 1-5        |    |    |
| 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)                            |       |            |   |            |    |    |

**Table A.3.3.1-5: Fixed Reference Channel Single PRB (MBSFN Configuration)**

| Parameter                                    | Unit   | Value            |
|--|--|------------------|
| Reference channel                            |  | R.29 FDD (MBSFN) |
| Channel bandwidth                            | MHz  | 10               |
| Allocated resource blocks                    |  | 1                |
| MBSFN Configuration                          |  | TBD              |
| Allocated subframes per Radio Frame          |  | 4                |
| Modulation                                   |  | 16QAM            |
| Target Coding Rate                           |  | 1/2              |
| Information Bit Payload                      |  |                  |
| For Sub-Frames 4,9                           | Bits   | 256              |
| For Sub-Frame 5                              | Bits   | n/a              |
| For Sub-Frame 0                              | Bits   | 256              |
| For Sub-Frame 1,2,3,6,7,8                    | Bits   | 0 (MBSFN)        |
| Number of Code Blocks per Sub-Frame (Note 3) |  |                  |
| For Sub-Frames 4,9                           |  | 1                |
| For Sub-Frame 5                              |  | n/a              |
| For Sub-Frame 0                              |  | 1                |
| For Sub-Frame 1,2,3,6,7,8                    |  | 0 (MBSFN)        |
| Binary Channel Bits Per Sub-Frame            |  |                  |
| For Sub-Frames 4,9                           | Bits   | 552              |
| For Sub-Frame 5                              | Bits   | n/a              |
| For Sub-Frame 0                              | Bits   | 552              |
| For Sub-Frame 1,2,3,6,7,8                    | Bits   | 0 (MBSFN)        |
| Max. Throughput averaged over 1 frame        | kbps   | 76.8             |
| UE Category                                  |  | 1-5              |
| 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) |                  |

## 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<br>FDD | R.11<br>FDD |  |  | R.30<br>FDD |
| Reference channel                               |   |             |             |  |  |             |
| Channel bandwidth                               | MHz   | 10          | 10          |  |  | 20          |
| Allocated resource blocks                       |   | 50          | 50          |  |  | 100         |
| Allocated subframes per Radio Frame             |   | 10          | 10          |  |  | 10          |
| Modulation                                      |   | QPSK        | 16QAM       |  |  | 16QAM       |
| Target Coding Rate                              |   | 1/3         | 1/2         |  |  | 1/2         |
| Information Bit Payload                         |   |             |             |  |  |             |
| For Sub-Frames 1,2,3,4,6,7,8,9                  | Bits  | 4392        | 12960       |  |  | 25456       |
| For Sub-Frame 5                                 | Bits  | n/a         | n/a         |  |  | n/a         |
| For Sub-Frame 0                                 | Bits  | 4392        | 12960       |  |  | 25456       |
| Number of Code Blocks per Sub-Frame<br>(Note 3) |   |             |             |  |  |             |
| For Sub-Frames 1,2,3,4,6,7,8,9                  | Bits  | 1           | 3           |  |  | 5           |
| For Sub-Frame 5                                 | Bits  | n/a         | n/a         |  |  | n/a         |
| For Sub-Frame 0                                 | Bits  | 1           | 3           |  |  | 5           |
| Binary Channel Bits Per Sub-Frame               |   |             |             |  |  |             |
| For Sub-Frames 1,2,3,4,6,7,8,9                  | Bits  | 13200       | 26400       |  |  | 52800       |
| For Sub-Frame 5                                 | Bits  | n/a         | n/a         |  |  | n/a         |
| For Sub-Frame 0                                 | Bits  | 12384       | 24768       |  |  | 51168       |
| Max. Throughput averaged over 1 frame           | Mbps  | 3.953       | 11.664      |  |  | 22.910      |
| UE Category                                     |   | 1-5         | 2-5         |  |  | 2-5         |
| 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)                            |             |             |  |  |             |

## 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 |  |  |
| Reference channel                            |   |             |             |             |  |  |
| Channel bandwidth                            | MHz   | 1.4         | 10          | 10          |  |  |
| Allocated resource blocks                    |   | 6           | 50          | 50          |  |  |
| Allocated subframes per Radio Frame          |   | 10          | 10          | 10          |  |  |
| Modulation                                   |   | QPSK        | QPSK        | 16QAM       |  |  |
| Target Coding Rate                           |   | 1/3         | 1/3         | 1/2         |  |  |
| Information Bit Payload                      |   |             |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits  | 408         | 4392        | 12960       |  |  |
| For Sub-Frame 5                              | Bits  | n/a         | n/a         | n/a         |  |  |
| For Sub-Frame 0                              | Bits  | 152         | 3624        | 11448       |  |  |
| Number of Code Blocks per Sub-Frame (Note 3) |   |             |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9               |   | 1           | 1           | 3           |  |  |
| For Sub-Frame 5                              |   | n/a         | n/a         | n/a         |  |  |
| For Sub-Frame 0                              |   | 1           | 1           | 2           |  |  |
| Binary Channel Bits Per Sub-Frame            |   |             |             |             |  |  |
| For Sub-Frames 1,2,3,4,6,7,8,9               | Bits  | 1248        | 12800       | 25600       |  |  |
| For Sub-Frame 5                              | Bits  | n/a         | n/a         | n/a         |  |  |
| For Sub-Frame 0                              | Bits  | 480         | 12032       | 24064       |  |  |
| Max. Throughput averaged over 1 frame        | Mbps  | 0.342       | 3.876       | 11.513      |  |  |
| UE Category                                  |   | 1-5         | 1-5         | 2-5         |  |  |
| 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)                            |             |             |             |  |  |



## A.3.3.3 [RMC for UE-Specific Reference Symbols]

## 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<br>TDD |   |   | R.2<br>TDD |    |    |
| Reference channel                            |  |            |   |   |            |    |    |
| Channel bandwidth                            | MHz  | 1.4        | 3 | 5 | 10         | 15 | 20 |
| Allocated resource blocks                    |  | 6          |   |   | 50         |    |    |
| Uplink-Downlink Configuration (Note 4)       |  | 1          |   |   | 1          |    |    |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2        |   |   | 4+2        |    |    |
| Modulation                                   |  | QPSK       |   |   | QPSK       |    |    |
| Target Coding Rate                           |  | 1/3        |   |   | 1/3        |    |    |
| Information Bit Payload                      |  |            |   |   |            |    |    |
| For Sub-Frames 4,9                           | Bits   | 408        |   |   | 4392       |    |    |
| For Sub-Frames 1,6                           | Bits   | n/a        |   |   | 3240       |    |    |
| For Sub-Frame 5                              | Bits   | n/a        |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits   | 208        |   |   | 4392       |    |    |
| Number of Code Blocks per Sub-Frame (Note 5) |  |            |   |   |            |    |    |
| For Sub-Frames 4,9                           |  | 1          |   |   | 1          |    |    |
| For Sub-Frames 1,6                           |  | n/a        |   |   | 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   | 1368       |   |   | 13800      |    |    |
| For Sub-Frames 1,6                           | Bits   | n/a        |   |   | 11256      |    |    |
| For Sub-Frame 5                              | Bits   | n/a        |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits   | 672        |   |   | 13104      |    |    |
| Max. Throughput averaged over 1 frame        | Mbps   | 0.102      |   |   | 1.966      |    |    |
| UE Category                                  |  | 1-5        |   |   | 1-5        |    |    |
| 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. 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)   |            |   |   |            |    |    |

Table A.3.4.1-2: Fixed Reference Channel 16QAM R=1/2

| Parameter                                    | Unit   | Value |   |   |            |    |    |
|--|--|-------|---|---|------------|----|----|
|  |  |       |   |   |            |    |    |
| Reference channel                            |  |       |   |   | R.3<br>TDD |    |    |
| Channel bandwidth                            | MHz  | 1.4   | 3 | 5 | 10         | 15 | 20 |
| Allocated resource blocks                    |  |       |   |   | 50         |    |    |
| Uplink-Downlink Configuration (Note 3)       |  |       |   |   | 1          |    |    |
| Allocated subframes per Radio Frame (D+S)    |  |       |   |   | 4+2        |    |    |
| Modulation                                   |  |       |   |   | 16QAM      |    |    |
| Target Coding Rate                           |  |       |   |   | 1/2        |    |    |
| Information Bit Payload                      |  |       |   |   |            |    |    |
| For Sub-Frames 4,9                           | Bits   |       |   |   | 14112      |    |    |
| For Sub-Frames 1,6                           | Bits   |       |   |   | 11448      |    |    |
| For Sub-Frame 5                              | Bits   |       |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits   |       |   |   | 12960      |    |    |
| Number of Code Blocks per Sub-Frame (Note 4) |  |       |   |   |            |    |    |
| For Sub-Frames 4,9                           |  |       |   |   | 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 4,9                           | Bits   |       |   |   | 27600      |    |    |
| For Sub-Frames 1,6                           | Bits   |       |   |   | 22512      |    |    |
| For Sub-Frame 5                              | Bits   |       |   |   | n/a        |    |    |
| For Sub-Frame 0                              | Bits   |       |   |   | 26208      |    |    |
| Max. Throughput averaged over 1 frame        | Mbps   |       |   |   | 6.408      |    |    |
| UE Category                                  |  |       |   |   | 2-5        |    |    |
| 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. 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<br>TDD | R.6 TDD | R.7<br>TDD | R.8<br>TDD | R.9<br>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)    |  |       | 4+2        | 4+2     | 4+2        | 4+2        | 4+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                                  |  |       | 1-5        | 2-5     | 2-5        | 2-5        | 3-5        |
| 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. 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.3.4.1-4: 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)    |  |       | 4+2        |   | 4+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                                  |  |       | 1-5        |   | 1-5     |    |    |
| 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. 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 (MBSFN) |
| Channel bandwidth                            | MHz  | 10               |
| Allocated resource blocks                    |  | 1                |
| MBSFN Configuration                          |  | [TBD]            |
| Uplink-Downlink Configuration (Note 3)       |  | 1                |
| Allocated subframes per Radio Frame (D+S)    |  | 2+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                                  |  | 1-5              |
| 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) |                  |

## 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.30<br>TDD |  |
| Reference channel                            |  |             |             |                 |  |             |  |
| Channel bandwidth                            | MHz  | 10          | 10          | 10              |  | 20          |  |
| Allocated resource blocks                    |  | 50          | 50          | 50              |  | 100         |  |
| Uplink-Downlink Configuration (Note 3)       |  | 1           | 1           | 1               |  | 1           |  |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2         | 4+2         | 4+2             |  | 4+2         |  |
| Modulation                                   |  | QPSK        | 16QAM       | 16QAM           |  | 16QAM       |  |
| Target Coding Rate                           |  | 1/3         | 1/2         | 1/2             |  | 1/2         |  |
| Information Bit Payload                      |  |             |             |                 |  |             |  |
| For Sub-Frames 4,9                           | Bits   | 4392        | 12960       | 12960           |  | 25456       |  |
| For Sub-Frames 1,6                           |  | 3240        | 9528        | 9528            |  | 22920       |  |
| For Sub-Frame 5                              | Bits   | n/a         | n/a         | n/a             |  | n/a         |  |
| For Sub-Frame 0                              | Bits   | 4392        | 12960       | n/a             |  | 25456       |  |
| Number of Code Blocks per Sub-Frame (Note 4) |  |             |             |                 |  |             |  |
| For Sub-Frames 4,9                           |  | 1           | 3           | 3               |  | 5           |  |
| For Sub-Frames 1,6                           |  | 1           | 2           | 2               |  | 4           |  |
| For Sub-Frame 5                              |  | n/a         | n/a         | n/a             |  | n/a         |  |
| For Sub-Frame 0                              |  | 1           | 3           | n/a             |  | 5           |  |
| Binary Channel Bits Per Sub-Frame            |  |             |             |                 |  |             |  |
| For Sub-Frames 4,9                           | Bits   | 13200       | 26400       | 26400           |  | 52800       |  |
| For Sub-Frames 1,6                           |  | 10656       | 21312       | 21312           |  | 42912       |  |
| For Sub-Frame 5                              | Bits   | n/a         | n/a         | n/a             |  | n/a         |  |
| For Sub-Frame 0                              | Bits   | 12528       | 25056       | n/a             |  | 51456       |  |
| Max. Throughput averaged over 1 frame        | Mbps   | 1.966       | 5.794       | 4.498           |  | 12.221      |  |
| UE Category                                  |  | 1-5         | 2-5         | 2-5             |  | 2-5         |  |
| 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. 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)   |             |             |                 |  |             |  |

## 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 |
| Reference channel                            |  |             |             |             |
| Channel bandwidth                            | MHz  | 1.4         | 10          | 10          |
| Allocated resource blocks                    |  | 6           | 50          | 50          |
| Uplink-Downlink Configuration (Note 4)       |  | 1           | 1           | 1           |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2         | 4+2         | 4+2         |
| Modulation                                   |  | QPSK        | QPSK        | 16QAM       |
| Target Coding Rate                           |  | 1/3         | 1/3         | 1/2         |
| Information Bit Payload                      |  |             |             |             |
| For Sub-Frames 4,9                           | Bits   | 408         | 4392        | 12960       |
| For Sub-Frames 1,6                           | Bits   | n/a         | 3240        | 9528        |
| For Sub-Frame 5                              | Bits   | n/a         | n/a         | n/a         |
| For Sub-Frame 0                              | Bits   | 208         | 4392        | n/a         |
| Number of Code Blocks per Sub-Frame (Note 5) |  |             |             |             |
| For Sub-Frames 4,9                           |  | 1           | 1           | 3           |
| For Sub-Frames 1,6                           |  | n/a         | 1           | 2           |
| For Sub-Frame 5                              |  | n/a         | n/a         | n/a         |
| For Sub-Frame 0                              |  | 1           | 1           | n/a         |
| Binary Channel Bits Per Sub-Frame            |  |             |             |             |
| For Sub-Frames 4,9                           | Bits   | 1248        | 12800       | 25600       |
| For Sub-Frames 1,6                           |  | n/a         | 10256       | 20512       |
| For Sub-Frame 5                              | Bits   | n/a         | n/a         | n/a         |
| For Sub-Frame 0                              | Bits   | 624         | 12176       | n/a         |
| Max. Throughput averaged over 1 frame        | Mbps   | 0.102       | 1.966       | 4.498       |
| UE Category                                  |  | 1-5         | 1-5         | 2-5         |
| 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. 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)   |             |             |             |

## A.3.4.3 [RMC for UE-Specific Reference Symbols]

Table A.3.4.3-1: Fixed Reference Channel for UE-specific reference symbols

| Parameter                                    | Unit   | Value           |                 |                 |             |
|--|--|-----------------|-----------------|-----------------|-------------|
|  |  | R.25<br>TDD     | R.26<br>TDD     | R.27<br>TDD     | R.28<br>TDD |
| Reference channel                            |  |                 |                 |                 |             |
| Channel bandwidth                            | MHz  | 10              | 10              | 10              | 10          |
| Allocated resource blocks                    |  | 50 <sup>4</sup> | 50 <sup>4</sup> | 50 <sup>4</sup> | 1           |
| Uplink-Downlink Configuration (Note 3)       |  | 1               | 1               | 1               | 1           |
| Allocated subframes per Radio Frame (D+S)    |  | 4+2             | 4+2             | 4+2             | 4+2         |
| Modulation                                   |  | QPSK            | 16QAM           | 64QAM           | 16QAM       |
| Target Coding Rate                           |  | 1/3             | 1/2             | 3/4             | 1/2         |
| Information Bit Payload                      |  |                 |                 |                 |             |
| For Sub-Frames 4,9                           | Bits   | 4392            | 12960           | 28336           | 224         |
| For Sub-Frames 1,6                           | Bits   | 3240            | 9528            | 22920           | 176         |
| For Sub-Frame 5                              | Bits   | n/a             | n/a             | n/a             | n/a         |
| For Sub-Frame 0                              | Bits   | 2984            | 9528            | 22152           | 224         |
| Number of Code Blocks per Sub-Frame (Note 5) |  |                 |                 |                 |             |
| For Sub-Frames 4,9                           |  | 1               | 3               | 5               | 1           |
| For Sub-Frames 1,6                           |  | 1               | 2               | 4               | 1           |
| For Sub-Frame 5                              |  | n/a             | n/a             | n/a             | n/a         |
| For Sub-Frame 0                              |  | 1               | 2               | 4               | 1           |
| Binary Channel Bits Per Sub-Frame            |  |                 |                 |                 |             |
| For Sub-Frames 4,9                           | Bits   | 12600           | 25200           | 37800           | 504         |
| For Sub-Frames 1,6                           | Bits   | 10356           | 20712           | 31068           | 420         |
| For Sub-Frame 5                              | Bits   | n/a             | n/a             | n/a             | n/a         |
| For Sub-Frame 0                              | Bits   | 10332           | 20664           | 30996           | 504         |
| Max. Throughput averaged over 1 frame        | Mbps   | 1.825           | 5.450           | 12.466          | 0.102       |
| UE Category                                  |  | 1-5             | 2-5             | 2-5             | 1-5         |
| 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. 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 1–9 and 41 resource blocks (RB0–RB20 and RB30–RB49) 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)   |                 |                 |                 |             |



## 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.15 FDD | R.16 FDD | R.17 FDD |
| Reference channel                |         | R.15 FDD | R.16 FDD | R.17 FDD |
| Number of transmitter antennas   |         | 1        | 2        | 4        |
| Channel bandwidth                | MHz     | 10       | 1.4      | 10       |
| Number of OFDM symbols for PDCCH | symbols | 2        | 2        | 2        |
| Aggregation level                | CCE     | 8        | 2        | 4        |
| DCI Format                       |         | Format 1 | Format 2 | Format 2 |
| Cell ID                          |         | 0        | 0        | 0        |
| Payload (without CRC)            | Bits    | 31       | 31       | 46       |

### A.3.5.2 TDD

Table A.3.5.2-1: Reference Channel TDD

| Parameter                        | Unit    | Value    |          |          |
|----------------------------------|---------|----------|----------|----------|
|                                  |         | R.15 TDD | R.16 TDD | R.17 TDD |
| Reference channel                |         | R.15 TDD | R.16 TDD | R.17 TDD |
| Number of transmitter antennas   |         | 1        | 2        | 4        |
| Channel bandwidth                | MHz     | 10       | 1.4      | 10       |
| Number of OFDM symbols for PDCCH | symbols | 2        | 2        | 2        |
| Aggregation level                | CCE     | 8        | 2        | 4        |
| DCI Format                       |         | Format 1 | Format 2 | Format 2 |
| Cell ID                          |         | 0        | 0        | 0        |
| Payload (without CRC)            | Bits    | 34       | 34       | 49       |

## 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.20                | R.24          |
| Reference channel              |  | R.18                | R.19                | R.20                | R.24          |
| Number of transmitter antennas |  | 1                   | 2                   | 4                   | 1             |
| Channel bandwidth              | MHz  | 10                  | 1.4                 | 10                  | 10            |
| User roles (Note 1)            |  | [W I1 I2]           | [W I1 I2]           | [W I1 I2]           | [W I1]        |
| Resource allocation (Note 2)   |  | [(0,0) (0,1) (0,4)] | [(0,0) (0,1) (0,4)] | [(0,0) (0,1) (0,4)] | [(0,0) (0,1)] |
| Power offsets (Note 3)         | dB   | [-4 0 -3]           | [-4 0 -3]           | [-4 0 -3]           | [0 -3]        |
| Payload (Note 4)               |  | [A R R]             | [A R R]             | [A R R]             | [A R]         |
| Note 1:                        | W=wanted user, I1=interfering user 1, I2=interfering user 2.   |                     |                     |                     |               |
| Note 2:                        | The resource allocation per user is given as (N_group_PHICH, N_seq_PHICH). The remaining PHICH groups (other than group zero) shall contain zeros. |                     |                     |                     |               |
| 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.      |                     |                     |                     |               |
| 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    |
| Reference channel              |      |         |         |         |
| Number of transmitter antennas |      | 1       | 2       | 4       |
| Channel bandwidth              | MHz  | 1.4     | 1.4     | 1.4     |
| Modulation                     |      | QPSK    | QPSK    | QPSK    |
| Target coding rate             |      | 40/1920 | 40/1920 | 40/1920 |
| Payload (without CRC)          | Bits | 24      | 24      | 24      |

## A.4 CSI reference measurement channels

This section defines the DL signal applicable to the reporting of channel quality information (Clause 9.2, 9.3 and 9.5).

The reference channel in Table A.4-1 complies with the CQI definition specified in Sec. 7.2.3 of [6]. Table A.4-3 specifies the transport format corresponding to each CQI for single antenna transmission. Table A.4-3a specifies the transport format corresponding to each CQI for dual antenna transmission.

**Table A.4-1: Reference channel for CQI requirements (FDD) full PRB 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 |
| Subcarriers per resource block  |           | 12    | 12 | 12 | 12          | 12           | 12  |
| Allocated subframes per Radio Frame   |           | 8     | 8  | 8  | 8           | 8            | 8   |
| Modulation  |           |       |    |    | Table A.4-3 | Table A.4-3a |     |
| Target coding rate  |           |       |    |    | Table A.4-3 | Table A.4-3a |     |
| Number of HARQ Processes  | Processes | 8     | 8  | 8  | 8           | 8            | 8   |
| Maximum number of HARQ transmissions  |           | 1     | 1  | 1  | 1           | 1            | 1   |
| Note 1: 3 symbols allocated to PDCCH  |           |       |    |    |             |              |     |
| Note 2: Only subframes 1,2,3,4,6,7,8, and 9 are allocated to avoid PBCH and synchronization signal overhead |           |       |    |    |             |              |     |

**Table A.4-2: Reference channel for CQI requirements (TDD) full PRB 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 |
| Subcarriers per resource block  |           | 12    | 12 | 12 | 12          | 12           | 12  |
| Allocated subframes per Radio Frame   |           | 4     | 4  | 4  | 4           | 4            | 4   |
| Modulation  |           |       |    |    | Table A.4-3 | Table A.4-3a |     |
| Target coding rate  |           |       |    |    | Table A.4-3 | Table A.4-3a |     |
| Number of HARQ Processes  | Processes | 10    | 10 | 10 | 10          | 10           | 10  |
| Maximum number of HARQ transmissions  |           | 1     | 1  | 1  | 1           | 1            | 1   |
| Note 1: 3 symbols allocated to PDCCH  |           |       |    |    |             |              |     |
| Note 2: UL-DL configuration 2 is used and only subframes 3, 4, 8, and 9 are allocated to avoid PBCH and synchronization signal overhead |           |       |    |    |             |              |     |

**Table A.4-3: Transport format corresponding to each CQI index for 50 PRB allocation single antenna transmission**

| CQI index | Modulation   | Target code rate | Imcs | Information Bit Payload (Subframes 1,2,3,4,6,7,8,9) | Binary Channel Bits Per Sub-Frame (Subframes 1,2,3,4,6,7,8,9) | Actual Code rate |
|-----------|--------------|------------------|------|---|---|------------------|
| 0         | out of range | out of range     | DTX  | -   | -   | -                |
| 1         | QPSK         | 0.0762           | 0    | 1384  | 12600   | 0.1117           |
| 2         | QPSK         | 0.1172           | 0    | 1384  | 12600   | 0.1117           |
| 3         | QPSK         | 0.1885           | 2    | 2216  | 12600   | 0.1778           |
| 4         | QPSK         | 0.3008           | 4    | 3624  | 12600   | 0.2895           |
| 5         | QPSK         | 0.4385           | 6    | 5160  | 12600   | 0.4114           |
| 6         | QPSK         | 0.5879           | 8    | 6968  | 12600   | 0.5549           |
| 7         | 16QAM        | 0.3691           | 11   | 8760  | 25200   | 0.3486           |
| 8         | 16QAM        | 0.4785           | 13   | 11448   | 25200   | 0.4552           |
| 9         | 16QAM        | 0.6016           | 16   | 15264   | 25200   | 0.6067           |
| 10        | 64QAM        | 0.4551           | 18   | 16416   | 37800   | 0.4349           |
| 11        | 64QAM        | 0.5537           | 21   | 21384   | 37800   | 0.5663           |
| 12        | 64QAM        | 0.6504           | 23   | 25456   | 37800   | 0.6741           |
| 13        | 64QAM        | 0.7539           | 25   | 28336   | 37800   | 0.7503           |
| 14        | 64QAM        | 0.8525           | 27   | 31704   | 37800   | 0.8394           |
| 15        | 64QAM        | 0.9258           | 27   | 31704   | 37800   | 0.8394           |

Note1: Sub-frame#0 and #5 are not used for the corresponding requirement.

**Table A.4-3a: Transport format corresponding to each CQI index for 50 PRB allocation dual antenna transmission**

| CQI index | Modulation   | Target code rate | Imcs | Information Bit Payload (Subframes 1,2,3,4,6,7,8,9) | Binary Channel Bits Per Sub-Frame (Subframes 1,2,3,4,6,7,8,9) | Actual Code rate |
|-----------|--------------|------------------|------|---|---|------------------|
| 0         | out of range | out of range     | DTX  | -   | -   | -                |
| 1         | QPSK         | 0.0762           | 0    | 1384  | 12000   | 0.1173           |
| 2         | QPSK         | 0.1172           | 0    | 1384  | 12000   | 0.1173           |
| 3         | QPSK         | 0.1885           | 2    | 2216  | 12000   | 0.1867           |
| 4         | QPSK         | 0.3008           | 4    | 3624  | 12000   | 0.3040           |
| 5         | QPSK         | 0.4385           | 6    | 5160  | 12000   | 0.4320           |
| 6         | QPSK         | 0.5879           | 8    | 6968  | 12000   | 0.5827           |
| 7         | 16QAM        | 0.3691           | 11   | 8760  | 24000   | 0.3660           |
| 8         | 16QAM        | 0.4785           | 13   | 11448   | 24000   | 0.4780           |
| 9         | 16QAM        | 0.6016           | 15   | 14112   | 24000   | 0.5890           |
| 10        | 64QAM        | 0.4551           | 18   | 16416   | 36000   | 0.4567           |
| 11        | 64QAM        | 0.5537           | 20   | 19848   | 36000   | 0.5520           |
| 12        | 64QAM        | 0.6504           | 22   | 22920   | 36000   | 0.6373           |
| 13        | 64QAM        | 0.7539           | 24   | 27376   | 36000   | 0.7611           |
| 14        | 64QAM        | 0.8525           | 26   | 30576   | 36000   | 0.8500           |
| 15        | 64QAM        | 0.9258           | 27   | 31704   | 36000   | 0.8813           |

Note1: 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 the retransmission.

**Table A.4-4: Reference channel for CQI requirements (FDD) 6 PRB 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     | 6  | 6  | 6           | 6  | 6  |
| Subcarriers per resource block  |           | 12    | 12 | 12 | 12          | 12 | 12 |
| Allocated subframes per Radio Frame   |           | 8     | 8  | 8  | 8           | 8  | 8  |
| Modulation  |           |       |    |    | Table A.4-6 |    |    |
| Target coding rate  |           |       |    |    | Table A.4-6 |    |    |
| Number of HARQ Processes  | Processes | 8     | 8  | 8  | 8           | 8  | 8  |
| Maximum number of HARQ transmissions  |           | 1     | 1  | 1  | 1           | 1  | 1  |
| Note 1: 3 symbols allocated to PDCCH  |           |       |    |    |             |    |    |
| Note 2: Only subframes 1,2,3,4,6,7,8, and 9 are allocated to avoid PBCH and synchronization signal overhead |           |       |    |    |             |    |    |

**Table A.4-5: Reference channel for CQI requirements (TDD) 6 PRB 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     | 6  | 6  | 6           | 6  | 6  |
| Subcarriers per resource block  |           | 12    | 12 | 12 | 12          | 12 | 12 |
| Allocated subframes per Radio Frame   |           | 4     | 4  | 4  | 4           | 4  | 4  |
| Modulation  |           |       |    |    | Table A.4-6 |    |    |
| Target coding rate  |           |       |    |    | Table A.4-6 |    |    |
| Number of HARQ Processes  | Processes | 10    | 10 | 10 | 10          | 10 | 10 |
| Maximum number of HARQ transmissions  |           | 1     | 1  | 1  | 1           | 1  | 1  |
| Note 1: 3 symbols allocated to PDCCH  |           |       |    |    |             |    |    |
| Note 2: UL-DL configuration 2 is used and only subframes 3, 4, 8, and 9 are allocated to avoid PBCH and synchronization signal overhead |           |       |    |    |             |    |    |

**Table A.4-6: Transport format corresponding to each CQI index for 6 PRB allocation**

| CQI index | Modulation   | Target code rate | Imcs | Information Bit Payload (Subframes 1,2,3,4,6,7,8,9) | Binary Channel Bits Per Sub-Frame (Subframes 1,2,3,4,6,7,8,9) | Actual Code rate |
|-----------|--------------|------------------|------|---|---|------------------|
| 0         | out of range | out of range     | DTX  | -   | -   | -                |
| 1         | QPSK         | 0.0762           | 0    | 152   | 1512  | 0.1005           |
| 2         | QPSK         | 0.1172           | 0    | 152   | 1512  | 0.1005           |
| 3         | QPSK         | 0.1885           | 2    | 256   | 1512  | 0.1693           |
| 4         | QPSK         | 0.3008           | 4    | 408   | 1512  | 0.2698           |
| 5         | QPSK         | 0.4385           | 6    | 600   | 1512  | 0.3968           |
| 6         | QPSK         | 0.5879           | 8    | 808   | 1512  | 0.5344           |
| 7         | 16QAM        | 0.3691           | 11   | 1032  | 3024  | 0.3413           |
| 8         | 16QAM        | 0.4785           | 13   | 1352  | 3024  | 0.4471           |
| 9         | 16QAM        | 0.6016           | 16   | 1800  | 3024  | 0.5952           |
| 10        | 64QAM        | 0.4551           | 19   | 2152  | 4536  | 0.4744           |
| 11        | 64QAM        | 0.5537           | 21   | 2600  | 4536  | 0.5732           |
| 12        | 64QAM        | 0.6504           | 23   | 2984  | 4536  | 0.6578           |
| 13        | 64QAM        | 0.7539           | 25   | 3496  | 4536  | 0.7707           |
| 14        | 64QAM        | 0.8525           | 27   | 3752  | 4536  | 0.8272           |
| 15        | 64QAM        | 0.9258           | 27   | 3752  | 4536  | 0.8272           |

Note1: Sub-frame#0 and #5 are not used for the corresponding requirement.

## 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). 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.5.1.1 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 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.<br>Note 2: 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. |  |  |            |

### 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     |
| 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: 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. |   |   |            |

### 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 $n_{PRB}$ | 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:<br>all empty<br>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.5.2 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 Data    |
|---|--|---|--|---------------|
| Subframe (only if available for DL)   |  |   |  |               |
| 0   | 5  | 3, 4, 7, 8, 9<br>and 6 (as normal subframe) <sup>Note 2</sup> | 1<br>and 6 (as special 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  | <b>Note 1</b> |
| <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 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> |  |   |  |               |

### 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) <sup>Note 2</sup>                       | 1,6<br>(6 as special subframe) <sup>Note 2</sup>                                   |               |
| Allocation  |  |  |  |               |
| 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) – ( $N_{RB} - 1$ )  | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) – ( $N_{RB} - 1$ ) | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) – ( $N_{RB} - 1$ ) | 0 –<br>(First allocated PRB-1)<br>and<br>(Last allocated PRB+1) – ( $N_{RB} - 1$ ) |               |
| [0]   | [0]  | [0]  | [0]  | <b>Note 1</b> |
| <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 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> |  |  |  |               |



### 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        | <b>Note 3</b> |

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: 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

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.

N/A: Not Applicable

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## Annex B (normative): Propagation conditions

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### B.1 Static propagation condition

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}.$$

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### 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                      | 45 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

Table B.2.2-1 shows propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies

**Table B.2.2-1 Channel model parameters**

| Model     | Maximum Doppler frequency |
|-----------|---------------------------|
| EPA 5Hz   | 5 Hz                      |
| EVA 5Hz   | 5 Hz                      |
| EVA 70Hz  | 70 Hz                     |
| ETU 70Hz  | 70 Hz                     |
| ETU 300Hz | 300 Hz                    |

## B.2.3 MIMO Channel Correlation Matrices

### 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   |
|----------------------------|---------------|---|---|
| <b>eNode B Correlation</b> | $R_{eNB} = 1$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \mathbf{1} \end{pmatrix}$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ |

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  |
|-----------------------|--------------|--|--|
| <b>UE Correlation</b> | $R_{UE} = 1$ | $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & \mathbf{1} \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{pmatrix}$ |

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 case</b> | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$  |
| <b>2x2 case</b> | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$  |
| <b>4x2 case</b> | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$  |
| <b>4x4 case</b> | $R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{bmatrix}$ |

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**

| Low correlation |         | Medium Correlation |         | High Correlation |         |
|-----------------|---------|--------------------|---------|------------------|---------|
| $\alpha$        | $\beta$ | $\alpha$           | $\beta$ | $\alpha$         | $\beta$ |
| 0               | 0       | 0.3                | 0.9     | 0.9              | 0.9     |

The correlation matrices for high, medium and low correlation are defined in Table B.2.3.1-2, B.2.3.2-3 and B.2.3.2-4, 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 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 = 0.00012.

**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>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} = \begin{bmatrix} 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \\ 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 \end{bmatrix}$ |

**Table B.2.3.2-3: MIMO correlation matrices for medium correlation**

|             |   |
|-------------|---|
| <b>case</b> | N/A   |
| <b>case</b> | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ |

|      |   |
|------|---|
| case | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{pmatrix}$   |
| case | $R_{medium} = \begin{pmatrix} 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 \end{pmatrix}$ |

**Table B.2.3.2-4: MIMO correlation matrices for low correlation**

|                 |                             |
|-----------------|-----------------------------|
| <b>1x2 case</b> | $R_{low} = \mathbf{I}_2$    |
| <b>2x2 case</b> | $R_{low} = \mathbf{I}_4$    |
| <b>4x2 case</b> | $R_{low} = \mathbf{I}_8$    |
| <b>4x4 case</b> | $R_{low} = \mathbf{I}_{16}$ |

In Table B.2.3.2-4,  $\mathbf{I}_d$  is the  $d \times d$  identity matrix.

## 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. ]

## 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 for Band 7.



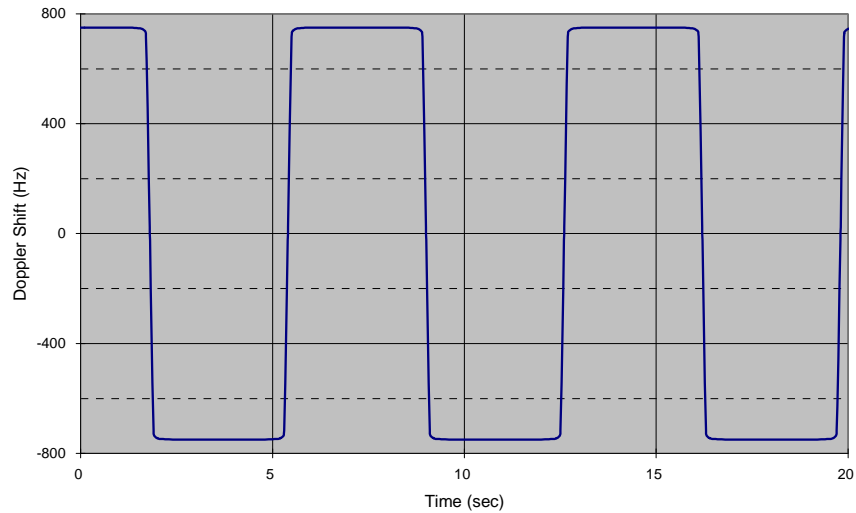


Figure B.3-1: Doppler shift trajectory

## B.4 Beamforming Model

### B.4.1 Single-layer beamforming (Antenna port 5)

Transmission on antenna port 5 is defined by using a precoder vector  $W(i)$  of size  $2 \times 1$  randomly selected from Table 6.3.4.2.3-1 in [4] as the beamforming weight. This precoder takes as an input the signal  $y^{(p)}(i)$ ,  $i = 0, 1, \dots, M_{\text{symp}}^{\text{ap}} - 1$ , for antenna port  $p = 5$ , with  $M_{\text{symp}}^{\text{ap}}$  the number of modulation symbols including the user-specific reference symbols (DRS), and generates a block of signals  $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$  the elements of which is to be mapped onto the same physical RE but transmitted on different antenna elements:

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W(i)y^{(5)}(i)$$

Precoder update granularity is according to Table 8.3.2-1.

## 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            |
| 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

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.

**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.

**Table C.3.2-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)**

| Physical Channel | EPRE Ratio           |  |
|------------------|----------------------|--|
| PBCH             | PBCH_RA = $\rho_A$   |  |
|                  | PBCH_RB = $\rho_B$   |  |
| PSS              | PSS_RA = $\rho_A$    |  |
| SSS              | SSS_RA = $\rho_A$    |  |
| PCFICH           | PCFICH_RB = $\rho_B$ |  |
| PDCCH            | PDCCH_RA = $\rho_A$  |  |
|                  | PDCCH_RB = $\rho_B$  |  |
| PDSCH            | PDSCH_RA = $\rho_A$  |  |
|                  | PDSCH_RB = $\rho_B$  |  |
| OCNG             | OCNG_RA = $\rho_A$   |  |
|                  | OCNG_RB = $\rho_B$   |  |

NOTE 1:  $\rho_A = \rho_B = 0$  dB means no RS boosting.

**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 $p$                                |

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## Annex D (normative): Characteristics of the interfering signal

### D.1 General

When the channel band width is wider or equal to 5MHz, a modulated 5MHz full band width E-UTRA down link signal and CW signal are used as interfering signals when RF performance requirements for E-UTRA UE receiver are defined. For channel band widths below 5MHz, the band width of modulated interferer should be equal to band width of the received signal.

---

### D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel band width 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     |

## 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 of 25 % 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).

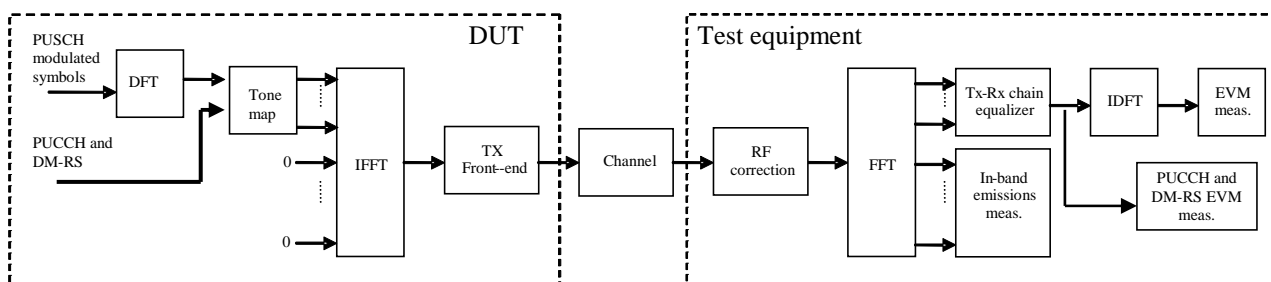


Figure F.1-1: EVM measurement points

## 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

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \frac{1}{|T_s|} \sum_{t \in T_s} \sum_{f_i + (12 \cdot \Delta_{RB} + 11) \Delta f}^{\max(f_{\min}, f_i + 12 \cdot \Delta_{RB} \cdot \Delta f)} |Y(t, f)|^2, \Delta_{RB} < 0 \\ \frac{1}{|T_s|} \sum_{t \in T_s} \sum_{f_h + (12 \cdot \Delta_{RB} - 11) \Delta f}^{\min(f_{\max}, f_h + 12 \cdot \Delta_{RB} \cdot \Delta f)} |Y(t, f)|^2, \Delta_{RB} > 0 \end{cases},$$

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 signal under test is modified and, in the case of PUSCH 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 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 IQ origin offset shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative IQ origin offset power (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, 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.5.4 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                         | [TBD]                                | [TBD]               |
| 1   | 21024                                      | 24576                         | [TBD]                                | [TBD]               |
| 2   | 6240                                       | 49152                         | [TBD]                                | [TBD]               |
| 3   | 21024                                      | 49152                         | [TBD]                                | [TBD]               |
| 4   | 448  | 4096                          | [TBD]                                | [TBD]               |
| 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.6 Averaged EVM

The general EVM is averaged over basic EVM measurements for 20 slots in the time domain.

$$\overline{EVM} = \sqrt{\frac{1}{20} \sum_{i=1}^{20} EVM_i^2}$$

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  $\overline{EVM}_{PRACH,l}$  is calculated using  $\Delta\tilde{t} = \Delta\tilde{t}_l$  and  $\overline{EVM}_{PRACH,h}$  is calculated using  $\Delta\tilde{t} = \Delta\tilde{t}_h$ .

Thus we get:

$$EVM_{PRACH} = \max(\overline{EVM}_{PRACH,l}, \overline{EVM}_{PRACH,h})$$

---

## 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): Change history

**Table G.1: Change History**

| Date    | TSG#  | TSG Doc.  | CR    | Subject   | Old   | New   |
|---------|-------|-----------|-------|---|-------|-------|
| 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   | 1.0.0 | 8.0.0 |
| 03-2008 | RP#39 | RP-080123 | 3     | TS36.101 - Combined updates of E-UTRA UE requirements                             | 8.0.0 | 8.1.0 |
| 05-2008 | RP#40 | RP-080325 | 4     | TS36.101 - Combined updates of E-UTRA UE requirements                             | 8.1.0 | 8.2.0 |
| 09-2008 | RP#41 | RP-080638 | 5r1   | Addition of Ref Sens figures for 1.4MHz and 3MHz Channel bandwidths               | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 7r1   | Transmitter intermodulation requirements  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 10    | CR for clarification of additional spurious emission requirement                  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 15    | Correction of In-band Blocking Requirement  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 18r1  | TS36.101: CR for section 6: NS_06   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 19r1  | TS36.101: CR for section 6: Tx modulation   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 20r1  | TS36.101: CR for UE minimum power   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 21r1  | TS36.101: CR for UE OFF power   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 24r1  | TS36.101: CR for section 7: Band 13 Rx sensitivity                                | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 26    | UE EVM Windowing  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 29    | Absolute ACLR limit   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 23r2  | TS36.101: CR for section 6: UE to UE co-existence                                 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 30    | Removal of [ ] for UE Ref Sens figures  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 31    | Correction of PA, PB definition to align with RAN1 specification                  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 37r2  | UE Spurious emission band UE co-existence   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 44    | Definition of specified bandwidths  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 48r3  | Addition of Band 17   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 50    | Alignment of the UE ACS requirement   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 52r1  | Frequency range for Band 12   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 54r1  | Absolute power tolerance for LTE UE power control                                 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 55    | TS36.101 section 6: Tx modulation   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 6r2   | DL FRC definition for UE Receiver tests   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 46    | Additional UE demodulation test cases   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 47    | Updated descriptions of FRC   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 49    | Definition of UE transmission gap   | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 51    | Clarification on High Speed train model in 36.101                                 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 53    | Update of symbol and definitions  | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080743 | 56    | Addition of MIMO (4x2) and (4x4) Correlation Matrices                             | 8.2.0 | 8.3.0 |
| 12-2008 | RP#42 | RP-080908 | 94r2  | CR TX RX channel frequency separation   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 105r1 | UE Maximum output power for Band 13   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 60    | UL EVM equalizer definition   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 63    | Correction of UE spurious emissions   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 66    | Clarification for UE additional spurious emissions                                | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 72    | Introducing ACLR requirement for coexistence with UTRA 1.6MHz channel from 36.803 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 75    | Removal of [ ] from Section 6 transmitter characteristics                         | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 81    | Clarification for PHS band protection   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 101   | Alignment for the measurement interval for transmit signal quality                | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 98r1  | Maximum power   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 57r1  | CR UE spectrum flatness   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 71r1  | UE in-band emission   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 58r1  | CR Number of TX exceptions  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080951 | 99r2  | CR UE output power dynamic  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080951 | 79r1  | LTE UE transmitter intermodulation  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080910 | 91    | Update of Clause 8  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080950 | 106r1 | Structure of Clause 9 including CSI requirements for PUCCH mode 1-0               | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 59    | CR UE ACS test frequency offset   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 65    | Correction of spurious response parameters  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 80    | Removal of LTE UE narrowband intermodulation                                      | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 90r1  | Introduction of Maximum Sensitivity Degradation                                   | 8.3.0 | 8.4.0 |

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| 12-2008 | RP#42 | RP-080911 | 103   | Removal of [ ] from Section 7 Receiver characteristic   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 62    | Alignment of TB size n Ref Meas channel for RX characteristics  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 78    | TDD Reference Measurement channel for RX characteristics  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 73r1  | Addition of 64QAM DL referenbce measurement channel   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 74r1  | Addition of UL Reference Measurement Channels   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 104   | Reference measurement channels for PDSCH performance requirements (TDD)   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080913 | 68    | MIMO Correlation Matrix Corrections   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080915 | 67    | Correction to the figure with the Transmission Bandwidth configuration  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080916 | 77    | Modification to EARFCN  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080917 | 85r1  | New Clause 5 outline  | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080919 | 102   | Introduction of Bands 12 and 17 in 36.101   | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080927 | 84r1  | Clarification of HST propagation conditions   | 8.3.0 | 8.4.0 |
| 03-2009 | RP#43 | RP-090170 | 156r2 | A-MPR table for NS_07   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 170   | Corrections of references (References to tables and figures)  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 108   | Removal of [ ] from Transmitter Intermodulation   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 155   | E-UTRA ACLR for below 5 MHz bandwidths  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 116   | Clarification of PHS band including the future plan   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 119   | Spectrum emission mask for 1.4 MHz and 3 MHz bandwidths   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 120   | Removal of 'Out-of-synchronization handling of output power' heading  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 126   | UE uplink power control   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 128   | Transmission BW Configuration   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 130   | Spectrum flatness   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 132r2 | PUCCH EVM   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 134   | UL DM-RS EVM  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 140   | Removal of ACLR2bis requirements  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 113   | In-band blocking  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 127   | In-band blocking and sensitivity requirement for band 17  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 137r1 | Wide band intermodulation   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 141   | Correction of reference sensitivity power level of Band 9   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 109   | AWGN level for UE DL demodulation performance tests   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 124   | Update of Clause 8: additional test cases   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 139r1 | Performance requirement structure for TDD PDSCH   | 8.4.0 | 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                     | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 145   | Number of information bits in DwPTS   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 160r1 | MBSFN-Unicast demodulation test case  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 163r1 | MBSFN-Unicast demodulation test case for TDD  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090173 | 162   | Clarification of EARFCN for 36.101  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 110   | Correction to UL Reference Measurement Channel  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 114   | Addition of MIMO (4x4, medium) Correlation Matrix   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 121   | Correction of 36.101 DL RMC table notes   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 125   | Update of Clause 9  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 138r1 | Clarification on OCNG   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 161   | CQI reference measurement channels  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 164   | PUCCH 1-1 Static Test Case  | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 111   | Reference Measurement Channel for TDD   | 8.4.0 | 8.5.0 |
| 03-2009 | RP#44 |           |       | Editorial correction in Table 6.2.4-1   | 8.5.0 | 8.5.1 |
| 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) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 168   | EARFCN correction for TDD DL bands. (Technically Endorsed CR in R4-50bis - R4-091206)   | 8.5.1 | 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)   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 171   | CR PRACH EVM. (Technically Endorsed CR in R4-50bis - R4-  | 8.5.1 | 8.6.0 |

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| 05-2009 | RP#44 | RP-090540 | 172   | CR EVM correction. (Technically Endorsed CR in R4-50bis - R4-091309)  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 177   | CR power control accuracy. (Technically Endorsed CR in R4-50bis - R4-091418)  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 179   | Correction of SRS requirements. (Technically Endorsed CR in R4-50bis - R4-091426)   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 186   | Clarification for EVM. (Technically Endorsed CR in R4-50bis - R4-091512)  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 187   | Removal of [ ] from band 17 Refsens values and ACS offset frequencies   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 191   | Completion of band17 requirements   | 8.5.1 | 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.   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 223   | CR: 64 QAM EVM  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 201   | CR In-band emissions  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 203   | CR EVM exclusion period   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 204   | CR In-band emissions timing   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 206   | CR Minimum Rx exceptions  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 207   | CR UL DM-RS EVM   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 218r1 | A-MPR table for NS_07   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 205r1 | CR In-band emissions in shortened subframes   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 200r1 | CR PUCCH EVM  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 178r2 | No additional emission mask indication. (Technically Endorsed CR in R4-50bis - R4-091421)                                   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 220r1 | Spectrum emission requirements for band 13  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 197r2 | CR on aggregate power tolerance   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 196r2 | CR: Rx IP2 performance  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090541 | 198r1 | Maximum output power relaxation   | 8.5.1 | 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) | 8.5.1 | 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)              | 8.5.1 | 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)                 | 8.5.1 | 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)                                  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 183   | Requirements for frequency-selective fading test. (Technically Endorsed CR in R4-50bis - R4-091505)                         | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 199   | CQI requirements under AWGN conditions  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 188r1 | Adaptation of UL-RMC-s for supporting more UE categories  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 193r1 | Correction of the LTE UE downlink reference measurement channels  | 8.5.1 | 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)                    | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 185r1 | Requirements for PMI reporting. (Technically Endorsed CR in R4-50bis - R4-091510)   | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 221r1 | Correction to DL RMC-s for Maximum input level for supporting more UE-Categories  | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 216   | Addition of 15 MHz and 20 MHz bandwidths into band 38   | 8.5.1 | 8.6.0 |
| 09-2009 | RP#45 | RP-090822 | 224   | LTE UTRA ACLR1 centre frequency definition for 1.4 and 3 MHz BW   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090822 | 226   | Harmonization of text for LTE Carrier leakage   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090822 | 228   | Sensitivity requirements for Band 38 15 MHz and 20 MHz bandwidths   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090822 | 237   | Addition of 5MHz channel bandwidth for Band 40  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090822 | 244   | Removal of unnecessary requirements for 1.4 and 3 MHz bandwidths on bands 13 and 17   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 260   | Correction of LTE UE ACS test parameter   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 262   | Correction of LTE UE ACLR test parameter  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 285   | Uplink power and RB allocation for receiver tests   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 301   | CR 64QAM MPR  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 319   | CR Sensitivity relaxation for small BW  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 323   | Correction of Band 3 spurious emission band UE co-existence   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 248R1 | CR Pcmx definition (working assumption)   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 329   | Spectrum flatness clarification   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 331   | Additional SRS relative power requirement and update of measurement definition  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 281R1 | Additional SRS relative power requirement and update of measurement definition  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090877 | 283R1 | Power range applicable for relative tolerance   | 8.6.0 | 8.7.0 |



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| 09-2009 | RP#45 | RP-090878 | 232   | TDD UL/DL configurations for CQI reporting  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 234   | Further clarification on CQI test configurations  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 242   | Corrections to UL- and DL-RMC-s   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 246   | Reference measurement channel for multiple PMI requirements   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 289   | CQI reporting test for a scenario with frequency-selective interference   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 264R2 | CQI reference measurement channels  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090878 | 304R2 | CR RI Test  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090875 | 230   | Correction of parameters for demodulation performance requirement   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090875 | 240R1 | UE categories for performance tests and correction to RMC references  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090875 | 277   | Clarification of $\hat{E}_s$ definition in the demodulation requirement   | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090875 | 325   | Editorial corrections and updates to PHICH PBCH test cases  | 8.6.0 | 8.7.0 |
| 09-2009 | RP#45 | RP-090875 | 258R2 | Test case numbering in section 8 Performance tests  | 8.6.0 | 8.7.0 |
| 12-2009 | RP#46 | RP-091264 | 334   | Test case numbering in TDD PDSCH performance test (Technically endorsed at RAN 4 52bis in R4-093522)                          | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 336   | Adding beamforming model for user-specific reference signal (Technically endorsed at RAN 4 52bis in R4-093524)                | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 338R1 | Adding redundancy sequences to PMI test (Technically endorsed at RAN 4 52bis in R4-093580)                                    | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 340   | Throughput value correction at FRC for Maximum input level (Technically endorsed at RAN 4 52bis in R4-093659)                 | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 342   | Correction to the modulated E-UTRA interferer (Technically endorsed at RAN 4 52bis in R4-093661)                              | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 344R1 | OCNG: Patterns and present use in tests (Technically endorsed at RAN 4 52bis in R4-093663)                                    | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 346   | OCNG: Use in receiver and performance tests (Technically endorsed at RAN 4 52bis in R4-093665)                                | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 348   | Miscellaneous corrections on CSI requirements (Technically endorsed at RAN 4 52bis in R4-093676)                              | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 350   | Removal of RLC modes (Technically endorsed at RAN 4 52bis in R4-093677)   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 352   | CR Rx diversity requirement (Technically endorsed at RAN 4 52bis in R4-093703)  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 354   | A-MPR notation in NS_07 (Technically endorsed at RAN 4 52bis in R4-093706)  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 358   | Single- and multi-PMI requirements (Technically endorsed at RAN 4 52bis in R4-093846)   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 362   | CQI reference measurement channel (Technically endorsed at RAN 4 52bis in R4-093970)  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 366   | Numbering of PDSCH (User-Specific Reference Symbols) Demodulation Tests   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 368   | Numbering of PDCCH/PCFICH, PHICH, PBCH Demod Tests  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 370   | Remove [ ] from Reference Measurement Channels in Annex A   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 372R1 | Corrections to RMC-s for Maximum input level test for low UE categories   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 376   | Correction of UE-category for R.30  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 383   | CR: Removal of 1.4 MHz and 3 MHz channel bandwidths from additional spurious emissions requirements for Band 1 PHS protection | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 385R3 | Clarification of measurement conditions of spurious emission requirements at the edge of spurious domain                      | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 389   | Spurious emission table correction for TDD bands 33 and 38.   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 391R2 | 36.101 Symbols and abbreviations for P <sub>cm</sub>  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 393   | UTRAACL1 requirement definition for 1.4 and 3 MHz BW completed  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 395   | Introduction of the ACK/NACK feedback modes for TDD requirements  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 403R2 | CR Power control exception R8   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 415R1 | Relative power tolerance: special case for receiver tests   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 419R1 | CSI reporting: test configuration for CQI fading requirements   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 424   | Editorial corrections and updates to Clause 8.2.1 FDD demodulation test cases   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 426   | CR: time mask   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091264 | 429   | Correction of the payload size for PDCCH/PCFICH performance requirements  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 431   | Transport format and test point updates to RI reporting test cases  | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 433   | Transport format and test setup updates to frequency-selective interference CQI tests   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091263 | 435   | CR RI reporting configuration in PUCCH 1-1 test   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091261 | 437   | Addition of R.11-1 TDD references   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091287 | 440   | Correction of Band 11 requirements for TS36.101 Rel-8   | 8.7.0 | 8.8.0 |
| 12-2009 | RP#46 | RP-091262 | 441   | In Band Emissions Requirements Correction CR  | 8.7.0 | 8.8.0 |

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| 12-2009 | RP#46 | RP-091262 | 443R1 | PCMAX definition   | 8.7.0 | 8.8.0  |
|         |       |           |       |  |       |        |
| 03-2010 | RP#47 | RP-100246 | 461r1 | UTRA ACLR measurement bandwidths for 1.4 and 3 MHz                               | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100246 | 492   | Band 8 Coexistence Requirement Table Correction                                  | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100246 | 488r1 | Rel 8 CR for Band 14   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100246 | 484r1 | CR Band 1- PHS coexistence   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100247 | 500   | Fading CQI requirements for FDD mode   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100247 | 498   | CR correction to RI test   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100249 | 450   | Reporting mode, Reporting Interval and Editorial corrections for demodulation    | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100249 | 463r1 | Corrections to 1PRB PDSCH performance test in presence of MBSFN.                 | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100249 | 457r1 | OCNG corrections   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100249 | 466   | Addition of OCNG configuration in DRS performance test                           | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100250 | 459r1 | Use of OCNG in CSI tests   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100250 | 490r1 | Corrections to CQI test configurations   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100250 | 468r1 | Corrections of some CSI test parameters  | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100251 | 455r1 | TBS correction for RMC UL TDD 16QAM full allocation BW 1.4 MHz                   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100264 | 447   | RF requirements for UE in later releases   | 8.8.0 | 8.9.0  |
| 03-2010 | RP#47 | RP-100238 | 477r4 | Modification of the spectral flatness requirement and some editorial corrections | 8.8.0 | 8.9.0  |
| 06-2010 | RP-48 | RP-100619 | 527r1 | Corrections on the definition of PCMAX   | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 556r2 | CR on UE coexistence requirement   | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 537   | Correction of transient time definition for EVM requirements                     | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 535   | CR: Corrections on MIMO demodulation performance requirements                    | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 546r1 | Correction of antenna configuration and beam-forming model for DRS               | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 558r1 | Corrections of tables for Additional Spectrum Emission Mask                      | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 567   | Relaxation of the PDSCH demodulation requirements due to control channel errors  | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100619 | 565   | Correction of the UE output power definition for RX tests                        | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 520   | Correction to FRC for CQI index 0  | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 504r1 | Fading CQI requirements for TDD mode   | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 515r1 | Correction to CQI test configuration   | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 525r1 | UE Categories for CSI reporting test   | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 531   | Correction of CQI and PMI delay configuration description for TDD                | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 570   | Minimum requirements for Rank indicator reporting                                | 8.9.0 | 8.10.0 |
| 06-2010 | RP-48 | RP-100620 | 573   | Correction to FDD and TDD CSI test configurations                                | 8.9.0 | 8.10.0 |
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## History

| <b>Document history</b> |               |             |
|-------------------------|---------------|-------------|
| V8.2.0                  | November 2008 | Publication |
| V8.3.0                  | November 2008 | Publication |
| V8.4.0                  | January 2009  | Publication |
| V8.5.1                  | April 2009    | Publication |
| V8.6.0                  | July 2009     | Publication |
| V8.7.0                  | October 2009  | Publication |
| V8.8.0                  | February 2010 | Publication |
| V8.9.0                  | April 2010    | Publication |
| V8.10.0                 | July 2010     | Publication |