ETSI TS 136 101 V8.29.0 (2018-01)

TECHNICAL SPECIFICATION

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) radio transmission and reception
(3GPP TS 36.101 version 8.29.0 Release 8)

Reference

RTS/TSGR-0436101v8t0

Keywords

LTE

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights 2
Foreword 2
Modal verbs terminology 2
Foreword 9
1 Scope 10
2 References 10
3 Definitions, symbols and abbreviations 10
3.1 Definitions 10
3.2 Symbols 11
3.3 Abbreviations 12
4 General 13
4.1 Relationship between minimum requirements and test requirements 13
4.2 Applicability of minimum requirements 13
4.3 Uplink 64-QAM modulation format 13
4.4 RF requirements in later releases 13
5 Operating bands and channel arrangement 14
5.1 General 14
5.2 Void 14
5.3 Void 14
5.4 Void 14
5.5 Operating bands 14
5.6 Channel bandwidth 15
5.6.1 Channel bandwidths per operating band 15
5.7 Channel arrangement 16
5.7.1 Channel spacing 16
5.7.2 Channel raster 17
5.7.3 Carrier frequency and EARFCN 17
5.7.4 TX–RX frequency separation 17
6 Transmitter characteristics 19
6.1 General 19
6.2 Transmit power 19
6.2.1 Void 19
6.2.2 UE Maximum Output Power 19
6.2.3 UE Maximum Output power for modulation / channel bandwidth 19
6.2.4 UE Maximum Output Power with additional requirements 20
6.2.5 Configured transmitted Power 21
6.3 Output power dynamics 22
6.3.1 (Void) 22
6.3.2 Minimum output power 22
6.3.2.1 Minimum requirement 22
6.3.3 Transmit OFF power 22
6.3.3.1. Minimum requirement 22
6.3.4 ON/OFF time mask 23
6.3.4.1 General ON/OFF time mask 23
6.3.4.2 PRACH and SRS time mask 23
6.3.4.2.1 PRACH time mask 23
6.3.4.2.2 SRS time mask 24
6.3.4.3 Slot / Sub frame boundary time mask 25
6.3.4.4 PUCCH / PUSCH / SRS time mask 25
6.3.5 Power Control 26
6.3.5.1 Absolute Power Tolerance 26
6.3.5.1.1 Minimum requirements 27

6.3.5.2 Relative Power tolerance....27
6.3.5.3 Aggregate power control tolerance....28
6.3.5.3.1 Minimum requirement....28
6.4 Void....29
6.5 Transmit signal quality....29
6.5.1 Frequency error....29
6.5.2 Transmit modulation quality....29
6.5.2.1 Error Vector Magnitude....29
6.5.2.1.1 Minimum requirement....30
6.5.2.2 Carrier leakage....30
6.5.2.2.1 Minimum requirements....30
6.5.2.3 In-band emissions....30
6.5.2.3.1 Minimum requirements....30
6.5.2.4 EVM equalizer spectrum flatness....31
6.5.2.4.1 Minimum requirements....31
6.6 Output RF spectrum emissions....32
6.6.1 Occupied bandwidth....33
6.6.2 Out of band emission....33
6.6.2.1 Spectrum emission mask....33
6.6.2.1.1 Minimum requirement....33
6.6.2.2 Additional Spectrum Emission Mask....34
6.6.2.2.1 Minimum requirement (network signalled value "NS_03")....34
6.6.2.2.2 Minimum requirement (network signalled value "NS_04")....35
6.6.2.2.3 Minimum requirement (network signalled value "NS_06" or “NS_07”)....35
6.6.2.3 Adjacent Channel Leakage Ratio....36
6.6.2.3.1 Minimum requirement E-UTRA....36
6.6.2.3.2 Minimum requirements UTRA....36
6.6.2.4 Additional ACLR requirements....37
6.6.2.4.1 Void....37
6.6.3 Spurious emissions....37
6.6.3.1 Minimum requirements....38
6.6.3.2 Spurious emission band UE co-existence....38
6.6.3.3 Additional spurious emissions....42
6.6.3.3.1 Minimum requirement (network signalled value "NS_05")....42
6.6.3.3.2 Minimum requirement (network signalled value “NS_07”)....43
6.7 Transmit intermodulation....44
6.7.1 Minimum requirement....44

7 Receiver characteristics....44
7.1 General....44
7.2 Diversity characteristics....44
7.3 Reference sensitivity power level....45
7.3.1 Minimum requirements (QPSK)....45
7.3.2 Requirement for large transmission configurations....47
7.4 Maximum input level....47
7.4.1 Minimum requirements....47
7.5 Adjacent Channel Selectivity (ACS)....48
7.5.1 Minimum requirements....48
7.6 Blocking characteristics....49
7.6.1 In-band blocking....49
7.6.1.1 Minimum requirements....49
7.6.2 Out-of-band blocking....50
7.6.2.1 Minimum requirements....50
7.6.3 Narrow band blocking....51
7.6.3.1 Minimum requirements....51
7.7 Spurious response....51
7.7.1 Minimum requirements....51
7.8 Intermodulation characteristics....52
7.8.1 Wide band intermodulation....52
7.8.1.1 Minimum requirements....52
7.8.2 Void....53
7.9 Spurious emissions....53

7.9.1 Minimum requirements....53
8 Performance requirement....54
8.1 General....54
8.1.1 Dual-antenna receiver capability....54
8.1.1.1 Simultaneous unicast and MBMS operations....54
8.1.1.2 Dual-antenna receiver capability in idle mode....54
8.2 Demodulation of PDSCH (Cell-Specific Reference Symbols)....54
8.2.1 FDD (Fixed Reference Channel)....54
8.2.1.1 Single-antenna port performance....55
8.2.1.1.1 Minimum Requirement....55
8.2.1.1.2 Void....56
8.2.1.1.3 Void....56
8.2.1.1.4 Minimum Requirement 1 PRB allocation in presence of MBSFN....56
8.2.1.2 Transmit diversity performance....57
8.2.1.2.1 Minimum Requirement 2 Tx Antenna Port....57
8.2.1.2.2 Minimum Requirement 4 Tx Antenna Port....58
8.2.1.3 Open-loop spatial multiplexing performance....58
8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port....58
8.2.1.3.2 Minimum Requirement 4 Tx Antenna Port....59
8.2.1.4 Closed-loop spatial multiplexing performance....59
8.2.1.4.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port....59
8.2.1.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port....60
8.2.1.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port....61
8.2.1.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port....62
8.2.1.5 MU-MIMO....62
8.2.1.6 [Control channel performance: D-BCH and PCH]....62
8.2.2 TDD (Fixed Reference Channel)....62
8.2.2.1 Single-antenna port performance....63
8.2.2.1.1 Minimum Requirement....63
8.2.2.1.2 Void....64
8.2.2.1.3 Void....64
8.2.2.1.4 Minimum Requirement 1 PRB allocation in presence of MBSFN....64
8.2.2.2 Transmit diversity performance....65
8.2.2.2.1 Minimum Requirement 2 Tx Antenna Port....65
8.2.2.2.2 Minimum Requirement 4 Tx Antenna Port....65
8.2.2.3 Open-loop spatial multiplexing performance....66
8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port....66
8.2.2.3.2 Minimum Requirement 4 Tx Antenna Port....67
8.2.2.4 Closed-loop spatial multiplexing performance....67
8.2.2.4.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port....67
8.2.2.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port....68
8.2.2.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port....68
8.2.2.4.3 Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port....69
8.2.2.5 MU-MIMO....70
8.2.2.6 [Control channel performance: D-BCH and PCH]....70
8.3 Demodulation of PDSCH (User-Specific Reference Symbols)....70
8.3.1 FDD....70
8.3.2 TDD....70
8.4 Demodulation of PDCCH/PCFICH....72
8.4.1 FDD....72
8.4.1.1 Single-antenna port performance....72
8.4.1.2 Transmit diversity performance....73
8.4.1.2.1 Minimum Requirement 2 Tx Antenna Port....73
8.4.1.2.2 Minimum Requirement 4 Tx Antenna Port....73
8.4.2 TDD....73
8.4.2.1 Single-antenna port performance....74
8.4.2.2 Transmit diversity performance....74
8.4.2.2.1 Minimum Requirement 2 Tx Antenna Port....74
8.4.2.2.2 Minimum Requirement 4 Tx Antenna Port....74
8.5 Demodulation of PHICH....74
8.5.1 FDD....75

8.5.1.1 Single-antenna port performance 75
8.5.1.2 Transmit diversity performance 75
8.5.1.2.1 Minimum Requirement 2 Tx Antenna Port 75
8.5.1.2.2 Minimum Requirement 4 Tx Antenna Port 76
8.5.2 TDD 76
8.5.2.1 Single-antenna port performance 76
8.5.2.2 Transmit diversity performance 77
8.5.2.2.1 Minimum Requirement 2 Tx Antenna Port 77
8.5.2.2.2 Minimum Requirement 4 Tx Antenna Port 77
8.6 Demodulation of PBCH 77
8.6.1 FDD 77
8.6.1.1 Single-antenna port performance 77
8.6.1.2 Transmit diversity performance 78
8.6.1.2.1 Minimum Requirement 2 Tx Antenna Port 78
8.6.1.2.2 Minimum Requirement 4 Tx Antenna Port 78
8.6.2 TDD 78
8.6.2.1 Single-antenna port performance 79
8.6.2.2 Transmit diversity performance 79
8.6.2.2.1 Minimum Requirement 2 Tx Antenna Port 79
8.6.2.2.2 Minimum Requirement 4 Tx Antenna Port 79
9 Reporting of Channel State Information 79
9.1 General 79
9.2 CQI reporting definition under AWGN conditions 79
9.2.1 Minimum requirement PUCCH 1-0....80
9.2.1.1 FDD....80
9.2.1.2 TDD 80
9.2.2 Minimum requirement PUCCH 1-1....81
9.2.2.1 FDD....81
9.2.2.2 TDD 82
9.3 CQI reporting under fading conditions....83
9.3.1 Frequency-selective scheduling mode 83
9.3.1.1 Minimum requirement PUSCH 3-0 83
9.3.1.1.1 FDD 83
9.3.1.1.2 TDD....85
9.3.2 Frequency non-selective scheduling mode 86
9.3.2.1 Minimum requirement PUCCH 1-0....86
9.3.2.1.1 FDD 86
9.3.2.1.2 TDD....87
9.3.3 Frequency-selective interference 88
9.3.3.1 Minimum requirement PUSCH 3-0 89
9.3.3.1.1 FDD 89
9.3.3.1.2 TDD....90
9.4 Reporting of Precoding Matrix Indicator (PMI)....91
9.4.1 Single PMI 91
9.4.1.1 Minimum requirement PUSCH 3-1 91
9.4.1.1.1 FDD 91
9.4.1.1.2 TDD....92
9.4.2 Multiple PMI 93
9.4.2.1 Minimum requirement PUSCH 1-2 93
9.4.2.1.1 FDD 93
9.4.2.1.2 TDD....93
9.5 Reporting of Rank Indicator (RI) 94
9.5.1 Minimum requirement 95
9.5.1.1 FDD....95
9.5.1.2 TDD 96
A.1 General 98
A.2 UL reference measurement channels 98
A.2.1 General 98
A.2.1.1 Applicability and common parameters 98
A.2.1.2 Determination of payload size 98

A.2.1.3 Overview of UL reference measurement channels 99
A.2.2 Reference measurement channels for FDD 104
A.2.2.1 Full RB allocation 104
A.2.2.1.1 QPSK 104
A.2.2.1.2 16-QAM 105
A.2.2.1.3 64-QAM 105
A.2.2.2 Partial RB allocation 105
A.2.2.2.1 QPSK 106
A.2.2.2.2 16-QAM 107
A.2.2.2.3 64-QAM 107
A.2.3 Reference measurement channels for TDD 107
A.2.3.1 Full RB allocation 108
A.2.3.1.1 QPSK 108
A.2.3.1.2 16-QAM 108
A.2.3.1.3 64-QAM 108
A.2.3.2 Partial RB allocation 109
A.2.3.2.1 QPSK 110
A.2.3.2.2 16-QAM 111
A.2.3.2.3 64-QAM 111

A.3 DL reference measurement channels 112
A.3.1 General 112
A.3.1.1 Overview of DL reference measurement channels 112
A.3.2 Reference measurement channel for receiver characteristics 116
A.3.3 Reference measurement channels for PDSCH performance requirements (FDD) 124
A.3.3.1 Single-antenna transmission (Common Reference Symbols) 124
A.3.3.2 Multi-antenna transmission (Common Reference Symbols) 128
A.3.3.2.1 Two antenna ports 128
A.3.3.2.2 Four antenna ports 129
A.3.3.3 [RMC for UE-Specific Reference Symbols] 130
A.3.4 Reference measurement channels for PDSCH performance requirements (TDD) 130
A.3.4.1 Single-antenna transmission (Common Reference Symbols) 130
A.3.4.2 Multi-antenna transmission (Common Reference Signals) 135
A.3.4.2.1 Two antenna ports 135
A.3.4.2.2 Four antenna ports 136
A.3.4.3 [RMC for UE-Specific Reference Symbols] 137
A.3.5 Reference measurement channels for PDCCH/PCFICH performance requirements 138
A.3.5.1 FDD 138
A.3.5.2 TDD 138
A.3.6 Reference measurement channels for PHICH performance requirements 138
A.3.7 Reference measurement channels for PBCH performance requirements 139

A.4 CSI reference measurement channels 139

A.5 OFDMA Channel Noise Generator (OCNG) 141
A.5.1 OCNG Patterns for FDD 141
A.5.1.1 OCNG FDD pattern 1: One sided dynamic OCNG FDD pattern 141
A.5.1.2 OCNG FDD pattern 2: Two sided dynamic OCNG FDD pattern 142
A.5.1.3 OCNG FDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz 142
A.5.2 OCNG Patterns for TDD 143
A.5.2.1 OCNG TDD pattern 1: One sided dynamic OCNG TDD pattern 143
A.5.2.2 OCNG TDD pattern 2: Two sided dynamic OCNG TDD pattern 144
A.5.2.3 OCNG TDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz 145

Annex B (normative): Propagation conditions 146

B.1 Static propagation condition 146

B.2 Multi-path fading propagation conditions 146
B.2.1 Delay profiles 146
B.2.2 Combinations of channel model parameters 147
B.2.3 MIMO Channel Correlation Matrices 147
B.2.3.1 Definition of MIMO Correlation Matrices 147
B.2.3.2 MIMO Correlation Matrices at High, Medium and Low Level 149

B.2.4 Propagation conditions for CQI tests ... 151
B.3 High speed train scenario ... 152
B.4 Beamforming Model ... 153
B.4.1 Single-layer beamforming (Antenna port 5) ... 153
Annex C (normative): Downlink Physical Channels ... 154
C.1 General ... 154
C.2 Set-up ... 154
C.3 Connection ... 154
C.3.1 Measurement of Receiver Characteristics ... 154
C.3.2 Measurement of Performance requirements ... 155
Annex D (normative): Characteristics of the interfering signal ... 156
D.1 General ... 156
D.2 Interference signals ... 156
Annex E (normative): Environmental conditions ... 157
E.1 General ... 157
E.2 Environmental ... 157
E.2.1 Temperature ... 157
E.2.2 Voltage ... 157
E.2.3 Vibration ... 158
Annex F (normative): Transmit modulation ... 159
F.1 Measurement Point ... 159
F.2 Basic Error Vector Magnitude measurement ... 159
F.3 Basic in-band emissions measurement ... 160
F.4 Modified signal under test ... 160
F.5 Window length ... 162
F.5.1 Timing offset ... 162
F.5.2 Window length ... 162
F.5.3 Window length for normal CP ... 162
F.5.4 Window length for Extended CP ... 163
F.5. 5 Window length for PRACH ... 163
F.6 Averaged EVM ... 164
F.7 Spectrum Flatness ... 165
Annex G (informative): Change history ... 166
History ... 173

Foreword

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

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

Version x.y.z

Where:

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

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 ".

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 β/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:

$BW_{Channel}$	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 averaged received energy per RE of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set of REs used for the transmission of physical channels (including user specific RSs when present), divided by the number of REs within the set, and normalized to the subcarrier spacing
F	Frequency
$F_{Interferer}$ (offset)	Frequency offset of the interferer
$F_{Interferer}$	Frequency of the interferer
F_C	Frequency of the carrier centre frequency
F_{DL_low}	The lowest frequency of the downlink operating band
F_{DL_high}	The highest frequency of the downlink operating band
F_{UL_low}	The lowest frequency of the uplink operating band
F_{UL_high}	The highest frequency of the uplink operating band
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 $N_{Offs-DL}$ Offset used for calculating downlink EARFCN
$N_{Offs-UL}$	Offset used for calculating uplink EARFCN

N_{otx}	The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing) simulating eNode B transmitter impairments as measured at the eNode B transmit antenna connector
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{UL}	Uplink EARFCN
Rav	Minimum average throughput per RB
P_{CMAX}	The configured maximum UE output power.
P_{EMAX}	Maximum allowed UE output power signalled by higher layers. Same as IE *P-Max,* defined in [7].
$P_{Interferer}$	Modulated mean power of the interfere
$P_{PowerClass}$	$P_{PowerClass}$ is the nominal UE power (i.e., no tolerance)r
P_{UMAX}	The measured configured maximum UE output power.
ΔF_{OOB}	Δ Frequency of Out Of Band emission
σ	Test specific auxiliary variable used for the purpose of downlink power allocation, defined in Annex C.3.2.

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

a) In this specification the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios

b) For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.

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

d) Note: Receiver sensitivity degradation may occur when:

   1) the UE simultaneously transmits and receives with bandwidth allocations less than the transmission bandwidth configuration (see Figure 5.6-1), and

   2) any part of the downlink transmission bandwidth is within an uplink transmission bandwidth from the downlink center subcarrier.

e) The spurious emissions power requirements are for the long term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal.

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 Operating Band	Uplink (UL) operating band BS receive UE transmit			Downlink (DL) operating band BS transmit UE receive			Duplex 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	–	894MHz	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	699 MHz	–	716 MHz	729 MHz	–	746 MHz	FDD
13	777 MHz	–	787 MHz	746 MHz	–	756 MHz	FDD
14	788 MHz	–	798 MHz	758 MHz	–	768 MHz	FDD
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 $BW_{Channel}$ [MHz]	1.4	3	5	10	15	20
Transmission bandwidth configuration N_{RB}	6	15	25	50	75	100

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

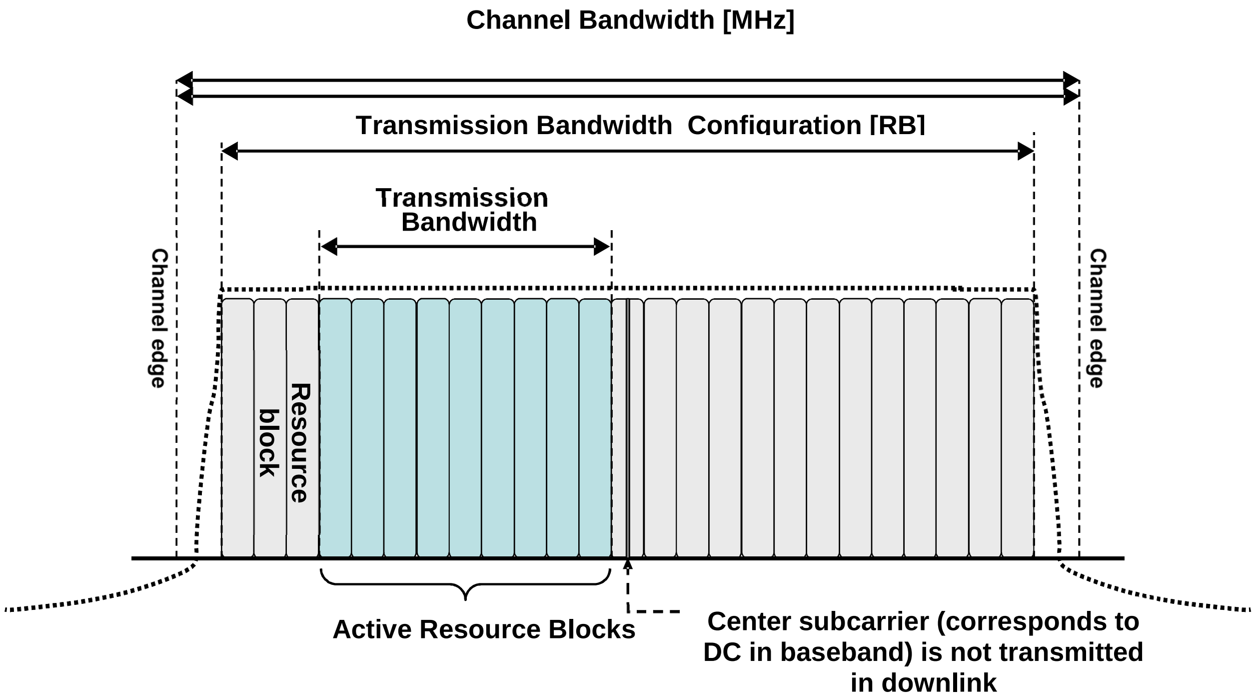

Figure 5.6-1 Definition of Channel Bandwidth and Transmission Bandwidth Configuration for one E-UTRA carrier

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[1]	Yes[1]
3	Yes	Yes	Yes	Yes	Yes[1]	Yes[1]
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes[1]		
6			Yes	Yes[1]		
7			Yes	Yes	Yes[2]	Yes[1,2]
8	Yes	Yes	Yes	Yes[1]		
9			Yes	Yes	Yes[1]	Yes[1]
10			Yes	Yes	Yes	Yes
11			Yes	Yes[1]		
12	Yes	Yes	Yes[1]	Yes[1]		
13			Yes[1]	Yes[1]		
14			Yes[1]	Yes[1]		
...						
17			Yes[1]	Yes[1]		
...						
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[2]	Yes[2]
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. NOTE 2: bandwidth for which the uplink transmission bandwidth can be restricted by the network for some channel assignments in FDD/TDD co-existence scenarios in order to meet unwanted emissions requirements (Clause 6.6.3.2).						

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:

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

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

5.7.2 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 $N_{Offs\text{-}DL}$ are given in table 5.7.3-1 and N_{DL} is the downlink EARFCN.

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

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

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

Table 5.7.3-1 E-UTRA channel numbers

E-UTRA Operating Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs\text{-}DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs\text{-}UL}$	Range of N_{UL}
1	2110	0	0 – 599	1920	18000	18000 – 18599
2	1930	600	600 – 1199	1850	18600	18600 – 19199
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
4	2110	1950	1950 – 2399	1710	19950	19950 – 20399
5	869	2400	2400 – 2649	824	20400	20400 – 20649
6	875	2650	2650 – 2749	830	20650	20650 – 20749
7	2620	2750	2750 – 3449	2500	20750	20750 – 21449
8	925	3450	3450 – 3799	880	21450	21450 – 21799
9	1844.9	3800	3800 – 4149	1749.9	21800	21800 – 22149
10	2110	4150	4150 – 4749	1710	22150	22150 – 22749
11	1475.9	4750	4750 – 4949	1427.9	22750	22750 – 22949
12	729	5010	5010 - 5179	699	23010	23010 - 23179
13	746	5180	5180 – 5279	777	23180	23180 – 23279
14	758	5280	5280 – 5379	788	23280	23280 – 23379
…						
17	734	5730	5730 – 5849	704	23730	23730 - 23849
…						
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 carrier centre frequency separation
1	190 MHz
2	80 MHz.
3	95 MHz.
4	400 MHz
5	45 MHz
6	45 MHz
7	120 MHz
8	45 MHz
9	95 MHz
10	400 MHz
11	48 MHz
12	30 MHz
13	-31 MHz
14	-30 MHz
17	30 MHz

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 (1ms).

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	±2		
2					23	±2[2]		
3					23	±2[2]		
4					23	±2		
5					23	±2		
6					23	±2		
7					23	±2[2]		
8					23	±2[2]		
9					23	±2		
10					23	±2		
11					23	±2		
12					23	±2[2]		
13					23	±2		
14					23	±2		
17					23	±2		
…								
33					23	±2		
34					23	±2		
35					23	±2		
36					23	±2		
37					23	±2		
38					23	±2		
39					23	±2		
40					23	±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 6.2.2-1due 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 6.6.3.3.2	13	10	Table 6.2.4-2	Table 6.2.4-2
..					
NS_32	-	-	-	-	-

Table 6.2.4-2: A-MPR for “NS0_7”

	Region A		Region B		Region C
RB_start[1]	0 - 12		13 – 18	19 – 42	43 – 49
L_CRB[2] [RBs]	6-8	1 to 5 and 9-50	≥8	≥18	≤2
A-MPR [dB]	≤ 8	≤ 12	≤ 12	≤ 6	≤ 3
Note 1 RB_start indicates the lowest RB index of transmitted resource blocks 2 L_CRB is the length of a contiguous resource block allocation 3 For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis. 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_{CMAX}. The configured maximum output power P_{CMAX} is set within the following bounds:

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

Where

- $P_{CMAX\_L} = \text{MIN} \{ P_{EMAX} - \Delta T_C,\ P_{PowerClass} - \text{MPR} - \text{A-MPR} - \Delta T_C \}$
- $P_{CMAX\_H} = \text{MIN} \{P_{EMAX},\ P_{PowerClass}\}$
- P_{EMAX} is the value given to IE *P-Max*, defined in [7]
- $P_{PowerClass}$ 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
- ΔT_C = 1.5 dB when Note 2 in Table 6.2.2-1 applies
- ΔT_C = 0 dB when Note 2 in Table 6.2.2-1 does not apply

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

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

Where $T(P_{CMAX})$ is defined by the tolerance table below and applies to P_{CMAX_L} and P_{CMAX_H} separately.

Table 6.2.5-1: P_{CMAX} tolerance

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

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

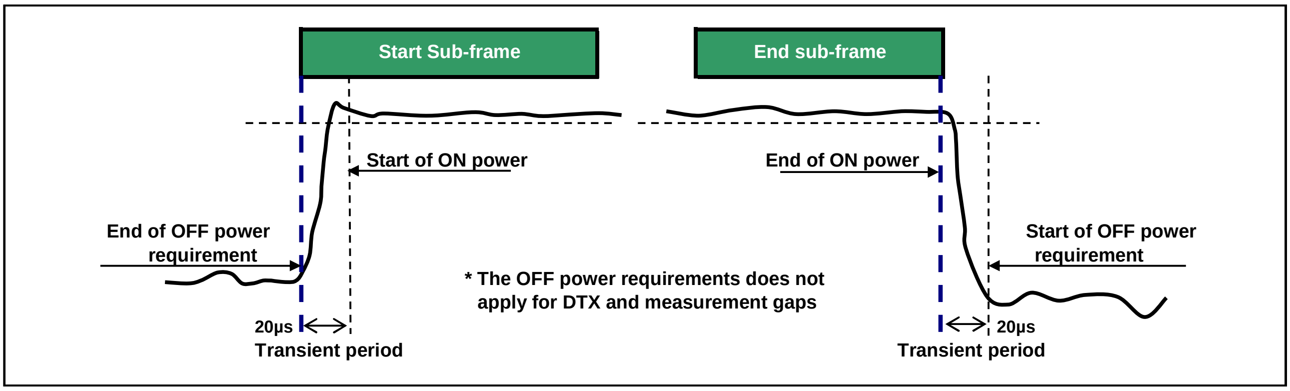

Figure 6.3.4.1-1: General ON/OFF time mask

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

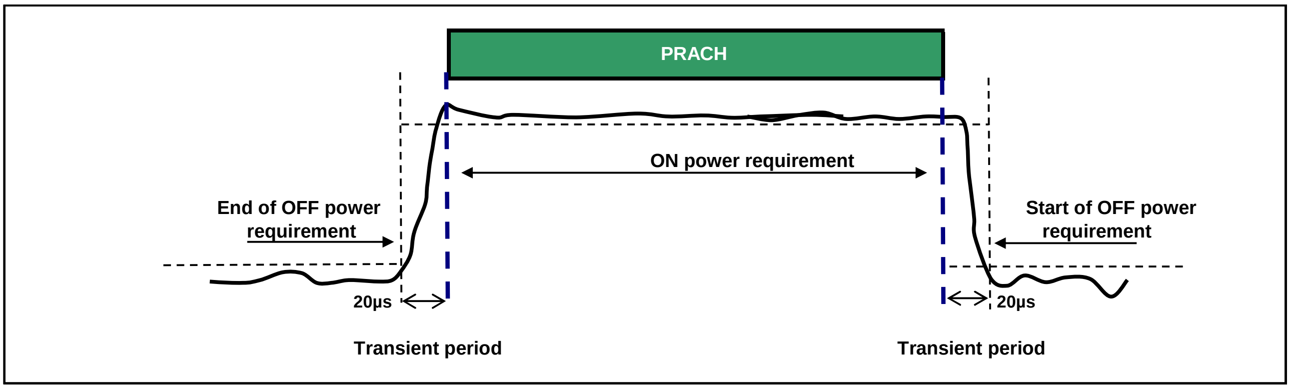

Figure 6.3.4.2-1: PRACH ON/OFF time mask

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

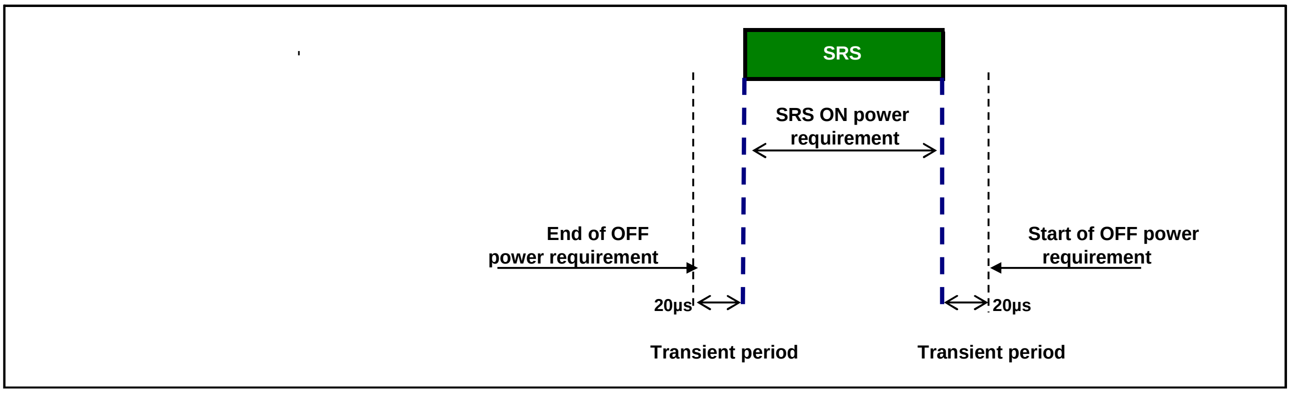

Figure 6.3.4.2.2-1: Single SRS time mask

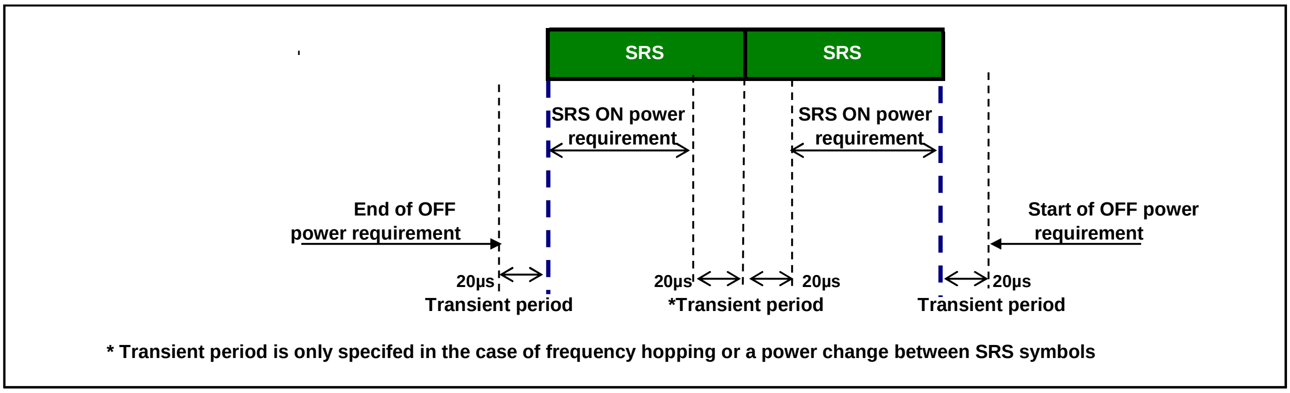

Figure 6.3.4.3-1: Dual SRS time mask for the case of UpPTS transmissions

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

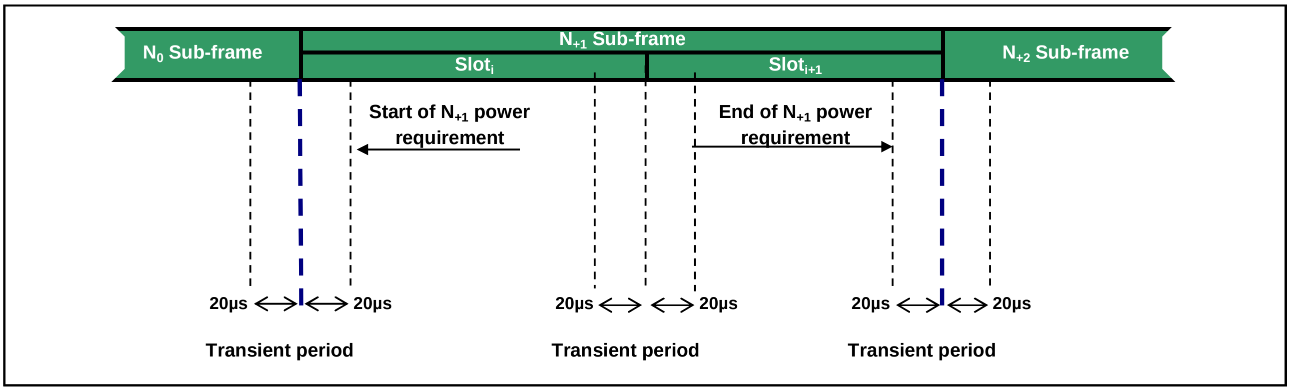

Figure 6.3.4.3-1: Transmission power template

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

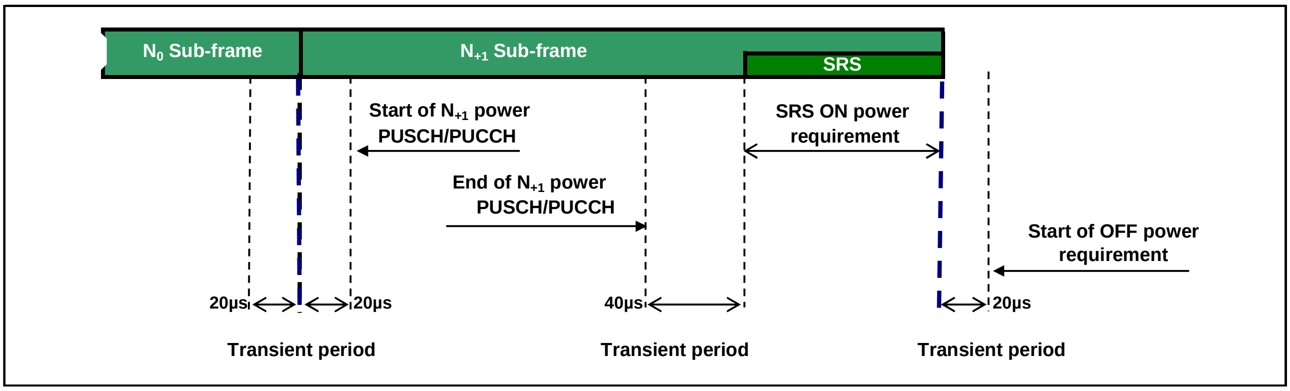

Figure 6.3.4.4-1: PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after

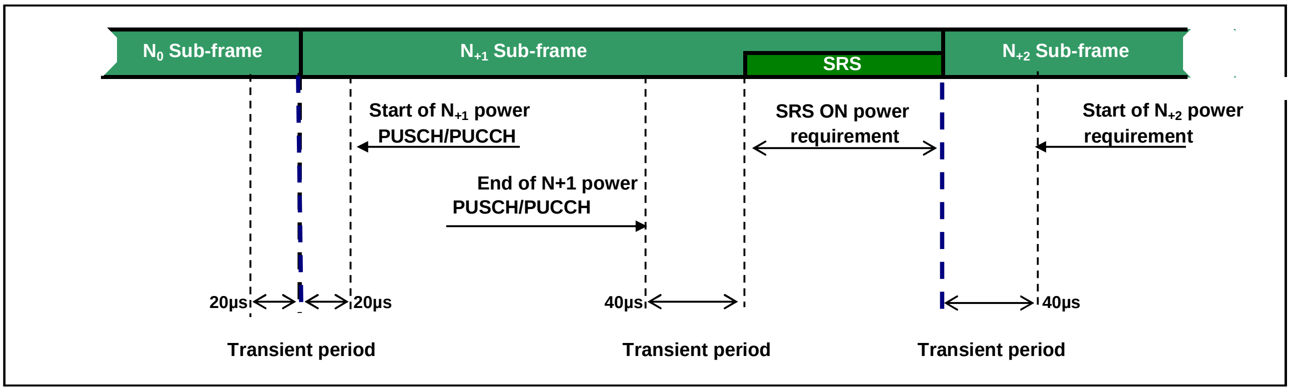

Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS

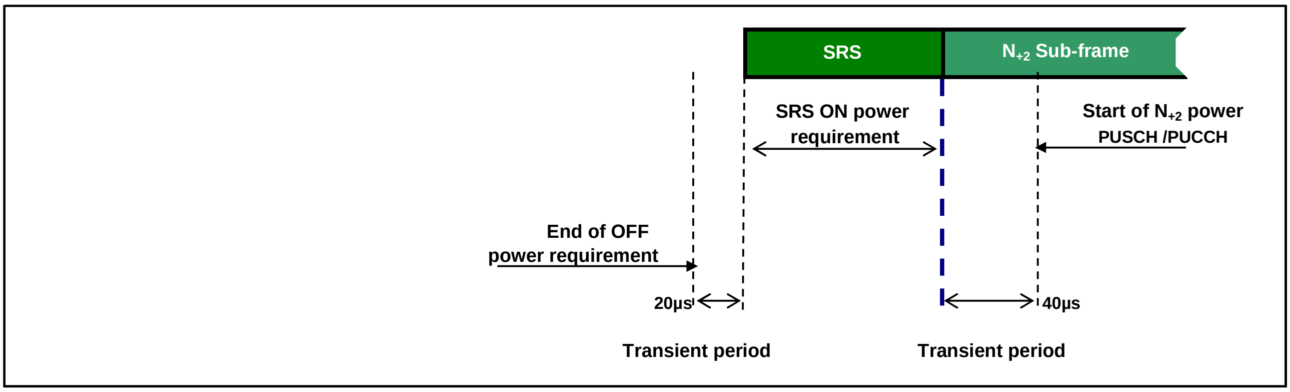

Figure 6.3.4.4-3: PUSCH/PUCCH/SRS time mask when there is a transmission after SRS but not before

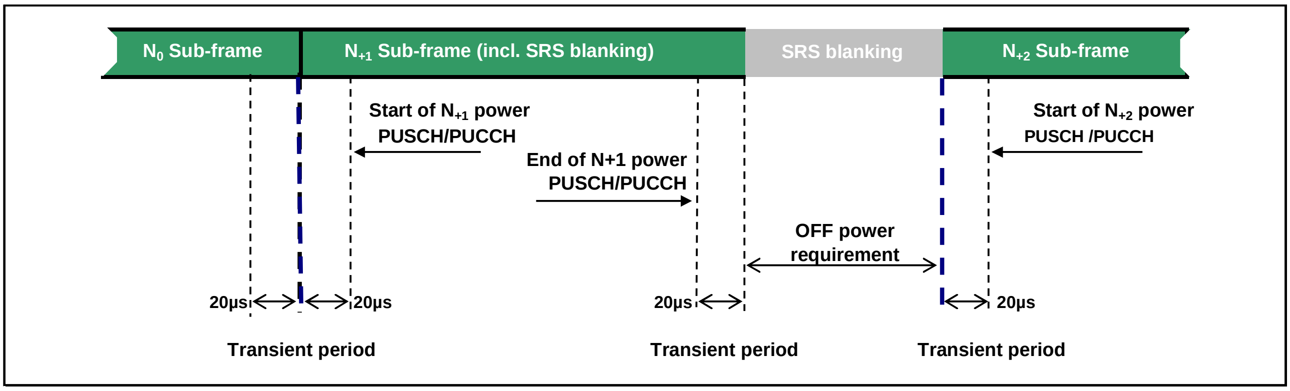

Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking

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	± 9.0 dB
Extreme	± 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 ≤ 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 ±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 ΔP (Up or down) [dB]	All combinations of PUSCH and PUCCH transitions [dB]	All combinations of PUSCH/PUCCH and SRS transitions between sub-frames [dB]	PRACH [dB]
ΔP < 2	±2.5 (Note 3)	±3.0	±2.5
2 ≤ ΔP < 3	±3.0	±4.0	±3.0
3 ≤ ΔP < 4	±3.5	±5.0	±3.5
4 ≤ ΔP ≤ 10	±4.0	±6.0	±4.0
10 ≤ ΔP < 15	±5.0	±8.0	±5.0
15 ≤ ΔP	±6.0	±9.0	±6.0
Note 1: For extreme conditions an additional ± 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 increasing the upper limit by 1.5 dB if the transmission bandwidth of the reference sub-frames is confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high} and the target sub-frame is not confined within any one of these frequency ranges; if the transmission bandwidth of the target sub-frame is confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high} and the reference sub-frame is not confined within any one of these frequency ranges, then the tolerance is relaxed by reducing the lower limit by 1.5 dB. 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 ΔP ≤ 1 dB, the relative power tolerance for transmission is ±1.0 dB.			

The power step (ΔP) 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 ΔP 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.

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 foraggregate 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	±2.5 dB
0 dB	PUSCH	±3.5 dB
Note: The UE transmission gap is 4 ms. TPC command is transmitted via PDCCH 4 subframes preceding each PUCCH/PUSCH transmission.		

6.4 Void

6.5 Transmit signal quality

6.5.1 Frequency error

The UE modulated carrier frequency shall be accurate to within ±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 μs 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	≥ -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
General	dB	$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRBs}),$ $20\cdot\log_{10} EVM -3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRBs},$ $-57\ dBm/180\ kHz - P_{RB}\}$		Any non-allocated (Note 2)
IQ Image	dB	-25		Image frequencies (Notes 2, 3)
Carrier leakage	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	

Note 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in Note 10.

Note 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.

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.

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.

Note 5: The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB.

Note 6: L_{CRBs} is the Transmission Bandwidth (see Figure 5.6-1).

Note 7: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.6-1).

Note 8: EVM is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

Note 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth.

Note 10: P_{RB} is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

6.5.2.4 EVM equalizer spectrum flatness

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex F) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block. The basic measurement interval is the same as for EVM.

6.5.2.4.1 Minimum requirements

The peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.5.2.4.1-1 for normal conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 5 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 7 dB (see Figure 6.5.2.4.1-1).

The EVM equalizer spectral flatness shall not exceed the values specified in Table 6.5.2.4.1-2 for extreme conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 10 dB (see Figure 6.5.2.4.1-1).

Table 6.5.2.4.1-1: Minimum requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency Range	Maximum Ripple [dB]
$F_{UL\_Meas} - F_{UL\_Low} \geq 3$ MHz and $F_{UL\_High} - F_{UL\_Meas} \geq 3$ MHz (Range 1)	4 (p-p)
$F_{UL\_Meas} - F_{UL\_Low} < 3$ MHz or $F_{UL\_High} - F_{UL\_Meas} < 3$ MHz (Range 2)	8 (p-p)
Note 1: FUL_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated Note 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

Table 6.5.2.4.1-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

Frequency Range	Maximum Ripple [dB]
$F_{UL\_Meas} - F_{UL\_Low} \geq 5$ MHz and $F_{UL\_High} - F_{UL\_Meas} \geq 5$ MHz (Range 1)	4 (p-p)
$F_{UL\_Meas} - F_{UL\_Low} < 5$ MHz or $F_{UL\_High} - F_{UL\_Meas} < 5$ MHz (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	

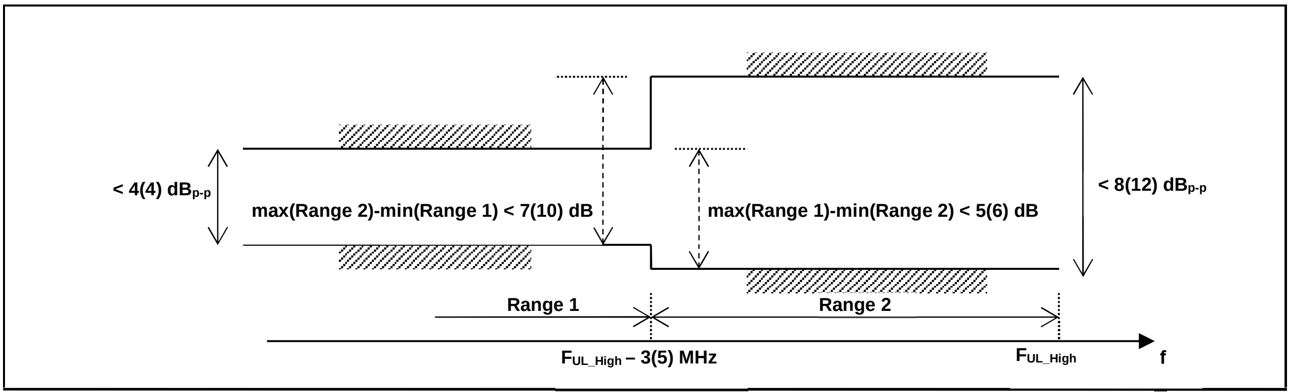

Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).

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.

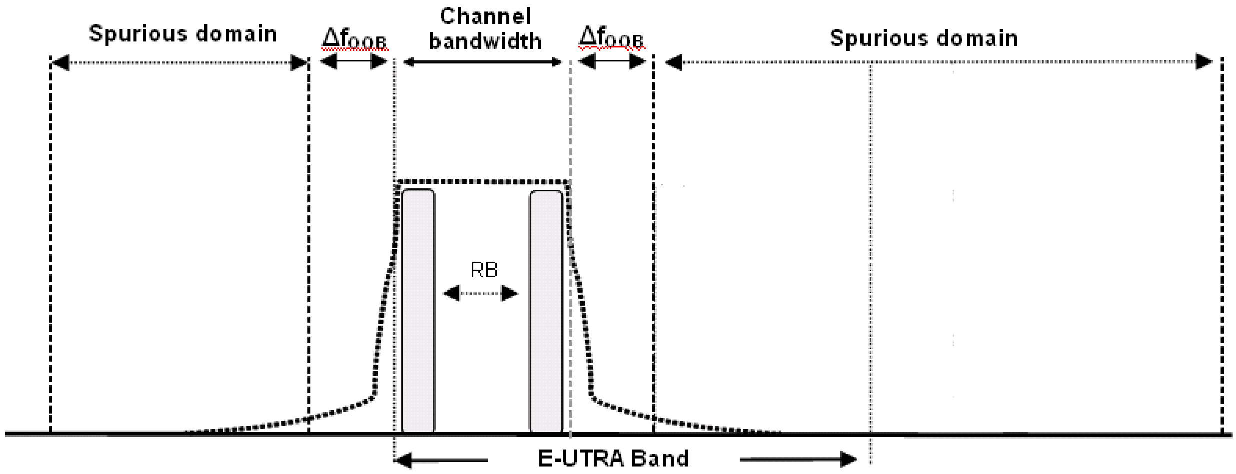

Figure 6.6-1: Transmitter RF spectrum

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

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

6.6.2 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 (Δf_{OOB}) starting from the ± edge of the assigned E-UTRA channel bandwidth. For frequencies greater than (Δf_{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							
Δf$_{OOB}$ (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-10	-10	-10	-10	-10	-10	1 MHz
± 2.5-2.8	-25	-10	-10	-10	-10	-10	1 MHz
± 2.8-5		-10	-10	-10	-10	-10	1 MHz
± 5-6		-25	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 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

	Spectrum emission limit (dBm)/ Channel bandwidth						
Δf$_{OOB}$ (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-13	-13	-13	-13	-13	-13	1 MHz
± 2.5-2.8	-25	-13	-13	-13	-13	-13	1 MHz
± 2.8-5		-13	-13	-13	-13	-13	1 MHz
± 5-6		-25	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 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

	Spectrum emission limit (dBm)/ Channel bandwidth						
Δf$_{OOB}$ (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-13	-13	-13	-13	-13	-13	1 MHz
± 2.5-2.8	-25	-13	-13	-13	-13	-13	1 MHz
± 2.8-5		-13	-13	-13	-13	-13	1 MHz
± 5-6		-25	-25	-25	-25	-25	1 MHz
± 6-10			-25	-25	-25	-25	1 MHz
± 10-15				-25	-25	-25	1 MHz
± 15-20					-25	-25	1 MHz
± 20-25						-25	1 MHz

Note: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.6.2.2.3 Minimum requirement (network signalled value "NS_06" or “NS_07”)

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_06" or “NS_07” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.3-1.

Table 6.6.2.2.3-1: Additional requirements

	Spectrum emission limit (dBm)/ Channel bandwidth				
Δf$_{OOB}$ (MHz)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	Measurement bandwidth
± 0-0.1	-13	-13	-15	-18	30 kHz
± 0.1-1	-13	-13	-13	-13	100 kHz
± 1-2.5	-13	-13	-13	-13	1 MHz
± 2.5-2.8	-25	-13	-13	-13	1 MHz
± 2.8-5		-13	-13	-13	1 MHz
± 5-6		-25	-13	-13	1 MHz
± 6-10			-25	-13	1 MHz
± 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.

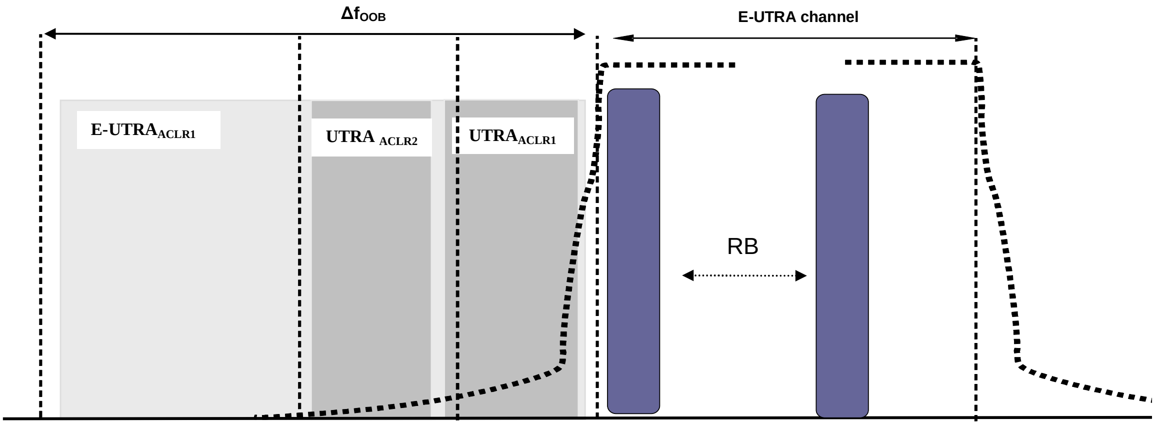

Figure 6.6.2.3-1: Adjacent Channel Leakage requirements

6.6.2.3.1 Minimum requirement E-UTRA

E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned E-UTRA channel power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.1-1. If the measured adjacent channel power is greater than –50dBm then the E-UTRA$_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.1-1.

Table 6.6.2.3.1-1: General requirements for E-UTRA$_{ACLR}$

	Channel bandwidth / E-UTRA$_{ACLR1}$ / measurement bandwidth					
	1.4 MHz	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
E-UTRA$_{ACLR1}$	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$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned E-UTRA channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel (UTRA$_{ACLR1}$) and the 2nd UTRA adjacent channel (UTRA$_{ACLR2}$). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor α =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 –50dBm then the UTRA$_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.2-1.

Table 6.6.2.3.2-1: Requirements for $UTRA_{ACLR1/2}$

	Channel bandwidth / $UTRA_{ACLR1/2}$ / measurement bandwidth					
	1.4 MHz	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
$UTRA_{ACLR1}$	33 dB	33 dB	33 dB	33 dB	33 dB	33 dB
Adjacent channel centre frequency offset (in MHz)	$0.7+BW_{UTRA}/2$ / $-0.7-BW_{UTRA}/2$	$1.5+BW_{UTRA}/2$ / $-1.5-BW_{UTRA}/2$	$+2.5+BW_{UTRA}/2$ / $-2.5-BW_{UTRA}/2$	$+5+BW_{UTRA}/2$ / $-5-BW_{UTRA}/2$	$+7.5+BW_{UTRA}/2$ / $-7.5-BW_{UTRA}/2$	$+10+BW_{UTRA}/2$ / $-10-BW_{UTRA}/2$
$UTRA_{ACLR2}$	-	-	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 $UTRA_{ACLR2}$ 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 Δf_{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 Δf_{OOB} and spurious emission domain

Channel bandwidth	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Δf_{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 Δf_{OOB} (MHz) from the edge of the channel bandwidth, the minimum offset of the measurement frequency from each edge of the channel should be Δf_{OOB} + 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 kHz ≤ f < 150 kHz	-36 dBm	1 kHz
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz
1 GHz ≤ f < 12.75 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 MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.6.3.2-1: Requirements

E-UTRA Band	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	Comment
1	E-UTRA Band 1, 3, 7, 8, 9, 11, 34, 38, 40	FDL_low	-	FDL_high	-50	1	
	Frequency range	860	-	895	-50	1	
	Frequency range	1475.9	-	1510.9	-50	1	
	Frequency range	1895	-	1915	-15.5	5	Note[14], Note[17]
	Frequency range	1915	-	1920	+1.6	5	Note[14], Note[17]
2	E-UTRA Band 4, 5, 10, 12, 13, 14, 17	FDL_low	-	FDL_high	-50	1	
	E-UTRA Band 2	FDL_low	-	FDL_high	-50		Note[14]
3	E-UTRA Band 1, 7, 8, 33, 34, 38	FDL_low	-	FDL_high	-50	1	
	E-UTRA Band 3	FDL_low	-	FDL_high	-50		Note[14]
	Frequency range	860	-	895	-50	1	Note[13]
	Frequency range	1475.9	-	1510.9	-50	1	Note[13]
	Frequency range	1884.5	-	1915.7	-41	0.3	Note[13]
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[7]
		1884.5	-	1915.7			Note[8]
7	E-UTRA Band 1, 3, 7, 8, 33, 34	FDL_low	-	FDL_high	-50	1	
	Frequency range	2570	-	2575	+1.6	5	Note[14] , Note[15], Note[18]
	Frequency range	2575	-	2595	-15.5	5	Note[14], Note[15], Note[18]
8	E-UTRA Band 1, 33, 34, 38, 39, 40	FDL_low	-	FDL_high	-50	1	
	E-UTRA band 3	FDL_low	-	FDL_high	-50	1	Note [2]
	E-UTRA band 7	FDL_low	-	FDL_high	-50	1	Note [2]
	E-UTRA Band 8	FDL_low	-	FDL_high	-50	1	Note[14]
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	-	1915.7	-41	0.3	Note[8]
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	-	1915.7	-41	0.3	Note[8]
12	E-UTRA Band 2, 5, 13, 14, 17	FDL_low	-	FDL_high	-50	1	
	E-UTRA Band 4, 10	FDL_low	-	FDL_high	-50	1	Note[2]
	E-UTRA Band 12	FDL_low	-	FDL_high	-50	1	Note[14]
13	E-UTRA Band 2, 4, 5, 10, 12, 13, 17	FDL_low	-	FDL_high	-50	1	
	E-UTRA Band 14	FDL_low	-	FDL_high	-50	1	Note[14]
	Frequency range	769	-	775	-35	0.00625	Note[14]
	Frequency range	799	-	805	-35	0.00625	Note[11], Note[14]
14	E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17	FDL_low	-	FDL_high	-50	1	
	Frequency range	769	-	775	-35	0.00625	Note[12] Note[14]
	Frequency range	799	-	805	-35	0.00625	Note[11], Note[12] Note[14]
17	E-UTRA Band 2, 5, 13, 14, 17	FDL_low	-	FDL_high	-50	1	
	E-UTRA Band 4, 10	FDL_low	-	FDL_high	-50	1	Note[2]
	E-UTRA Band 12	FDL_low	-	FDL_high	-50	1	Note[14]
…							
33	E-UTRA Band 1, 7, 8, 34, 38, 40	FDL_low	-	FDL_high	-50	1	Note[5]
	E-UTRA Band 3	FDL_low	-	FDL_high	-50	1	Note[14]
34	E-UTRA Band 1, 3, 7, 8, 9, 11, 33, 38,39, 40	FDL_low	-	FDL_high	-50	1	Note[5]
	Frequency range	860	-	895	-50	1	
	Frequency range	1475.9	-	1510.9	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	Note[8]
35							
36							
37			-				
38	E-UTRA Band 1, 3, 8, 33, 34	FDL_low	-	FDL_high	-50	1	
	Frequency range	2620	-	2645	-15.5	5	Note[14], Note[16], Note[18]
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	N/A.
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.
9	N/A
10	N/A
11	Whether the applicable frequency range should be 793-805MHz instead of 799-805MHz is TBD
12	The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB
13	Applicable when UE transmits anywhere within 1749.9 – 1784.9MHz.Applicable when the assigned E-UTRA UL operating channel is ≥1 749.9MHz and ≤ 1 784.9MHz.
14	These requirements also apply for the frequency ranges that are less than Δf_{OOB} (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.
15	This requirement is applicable for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 2552 - 2560 MHz. This requirement is applicable without any other uplink transmission bandwidth restriction for channel bandwidths within the range 2500 - 2570 MHz.
16	This requirement is applicable for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 2597 – 2605 MHz. This requirement is applicable without any other uplink transmission bandwidth restriction for channel bandwidths within the range 2570 – 2615 MHz. For assigned carriers with bandwidths overlapping the frequency range 2615-2620 MHz the requirements apply with the maximum output power configured to +19 dBm in the IE *P-Max*.
17	This requirement is applicable for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1930 - 1938 MHz. This requirement is applicable without any other uplink transmission bandwidth restriction for channel bandwidths within the range 1920 - 1980 MHz.
18	For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.

NOTE: The restriction on the maximum uplink transmission to 54 RB in Notes 15, 16, and 17 of Table 6.6.3.2-1 is intended for conformance testing and may be applied to network operation to facilitate coexistence when the aggressor and victim bands are deployed in the same geographical area. The applicable spurious emission requirement of -15.5 dBm/5MHz is a least restrictive technical condition for FDD/TDD coexistence and may have to be revised in the future.

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 Δf_{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 ≤ f ≤1915.7*1	-41	-41	-41	-41	300 KHz
Note 1: 1Applicable 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. Additional restrictions apply for operations below this point.					

The requirements in Table 6.6.3.3.1-1 apply with the additional restrictions specified in Table 6.6.3.3.1-2 when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is less than the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned.

Table 6.6.3.3.1-2: RB restrictions for additional requirement (PHS).

15 MHz channel bandwidth with f_c = 1932.5 MHz			
RB_{start}	0-7	8-66	67-74
L_{CRB}	N/A	≤ MIN(30, 67 – RB_{start})	N/A
20 MHz channel bandwidth with f_c = 1930 MHz			
RB_{start}	0-23	24-75	76-99
L_{CRB}	N/A	≤ MIN(24, 76 – RB_{start})	N/A

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. This requirement also applies for the frequency ranges that are less than Δf_{OOB} (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

Table 6.6.3.3.2-1: Additional requirements

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	10 MHz	
769 ≤ f ≤ 775	-57	6.25 kHz
Note: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB.		

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 (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 REFSENS 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 ≥ 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 $P_{REFSENS}$

Channel bandwidth							
E-UTRA Band	1.4 MHz (dBm)	3 MHz (dBm)	5 MHz (dBm)	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	Duplex Mode
1			-100	-97	-95.2	-94	FDD
2	-102.7	-99.7	-98	-95	-93.2	-92	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	FDD
4	-104.7	-101.7	-100	-97	-95.2	-94	FDD
5	-103.2	-100.2	-98	-95			FDD
6			-100	-97			FDD
7			-98	-95	-93.2	-92	FDD
8	-102.2	-99.2	-97	-94			FDD
9			-99	-96	-94.2	-93	FDD
10			-100	-97	-95.2	-94	FDD
11			-100	-97			FDD
12	-101.7	-98.7	-97	-94			FDD
13			-97	-94			FDD
14			-97	-94			FDD
…							
17			-97	-94			FDD
…							
33			-100	-97	-95.2	-94	TDD
34			-100	-97	-95.2		TDD
35	-106.2	-102.2	-100	-97	-95.2	-94	TDD
36	-106.2	-102.2	-100	-97	-95.2	-94	TDD
37			-100	-97	-95.2	-94	TDD
38			-100	-97	-95.2	-94	TDD
39			-100	-97	-95.2	-94	TDD
40			-100	-97	-95.2	-94	TDD
Note 1: The transmitter shall be set to P_{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 is FFS.							

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[1]	50[1]	FDD
3	6	15	25	50	50[1]	50[1]	FDD
4	6	15	25	50	75	100	FDD
5	6	15	25	25[1]			FDD
6			25	25[1]			FDD
7			25	50	75[1]	75[1]	FDD
8	6	15	25	25[1]			FDD
9			25	50	50[1]	50[1]	FDD
10			25	50	75	100	FDD
11			25	25[1]			FDD
12	6	15	20[1]	20[1]			FDD
13			20[1]	20[1]			FDD
14			15[1]	15[1]			FDD
...							
17			20[1]	20[1]			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

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

Channel bandwidth							
E-UTRA Band	**1.4 MHz (dB)**	**3 MHz (dB)**	**5 MHz (dB)**	**10 MHz (dB)**	**15 MHz (dB)**	**20 MHz (dB)**	**Duplex Mode**
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: 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 ≥ 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
Power in Transmission Bandwidth Configuration	dBm	-25					
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. 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 ≥ 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

		Channel bandwidth					
Rx Parameter	Units	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
ACS	dB	33.0	33.0	33.0	33.0	30	27

Table 7.5.1-2: Test parameters for Adjacent channel selectivity, Case 1

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB					
$P_{Interferer}$	dBm	REFSENS +45.5dB	REFSENS +45.5dB	REFSENS +45.5dB*	REFSENS +45.5dB	REFSENS +42.5dB	REFSENS +39.5dB
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Interferer}$ (offset)	MHz	1.4+0.0025 / -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_{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: 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**
Power in Transmission Bandwidth Configuration	dBm	-56.5	-56.5	-56.5	-56.5	-53.5	-50.5
$P_{Interferer}$	dBm	-25					
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Interferer}$ (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 24dB 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: 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 ≥ 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**
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	9
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Ioffset, case 1}$	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
$F_{Ioffset, case 2}$	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_{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: 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
	$P_{Interferer}$	dBm	-56	-44	Void
	$F_{Interferer}$ (Offset)	MHz	=-BW/2 - $F_{Ioffset, case 1}$ & =+BW/2 + $F_{Ioffset, case 1}$	≤ -BW/2- $F_{Ioffset, case 2}$ & ≥ +BW/2 + $F_{Ioffset, case 2}$	
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12, 13, 14, 17, 33, 34, 35, 36, 37, 38, 39, 40	$F_{Interferer}$	MHz	(Note 2)	F_{DL_low} -15 to F_{DL_high} +15	

Note 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band.
Note 2: For each carrier frequency the requirement is valid for two frequencies:
a) the carrier frequency -BW/2 -FIoffset, case 1 and
b) the carrier frequency + BW/2 + FIoffset, case 1.
Note 3: $F_{interferer}$ range values for unwanted modulated interfering signal are interferer center frequencies.

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 ≥ 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 $\max\left(24,\ \ 6\cdot\lceil N_{RB}/6\rceil\right)$ 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 $\max\left(8,\ \ \lceil (N_{RB}+2\cdot L_{CRBs})/8\rceil\right)$ 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
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	9

Note 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.1-2 with P_{CMAX_L} as defined in 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, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 33, 34, 35, 36, 37, 38, 39, 40	$F_{Interferer}$ (CW)	MHz	F_{DL_low} -15 to F_{DL_low} -60	F_{DL_low} -60 to F_{DL_low} -85	F_{DL_low} -85 to 1 MHz	-
			F_{DL_high} +15 to F_{DL_high} + 60	F_{DL_high} +60 to F_{DL_high} +85	F_{DL_high} +85 to +12750 MHz	-
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 ≥ 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 Δf = 15 kHz)	MHz	0.9075	1.7025	2.7075	5.2125	7.7025	10.2075
F_{uw} (offset for Δf = 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. 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 ≥ 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**
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	9
Note: 1. The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.1-2 with P_{CMAX_L} as defined in 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
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.8 Intermodulation characteristics

Intermodulation response rejection is a measure of the capability of the receiver to receiver 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 ≥ 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**
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below					
		12	8	6	6	7	9

<table>
<tr><td>$P_{Interferer\ 1}$
(CW)</td><td>dBm</td><td colspan="3">-46</td></tr>
<tr><td>$P_{Interferer\ 2}$
(Modulated)</td><td>dBm</td><td colspan="3">-46</td></tr>
<tr><td>$BW_{Interferer\ 2}$</td><td></td><td>1.4</td><td>3</td><td>5</td></tr>
<tr><td>$F_{Interferer\ 1}$
(Offset)</td><td>MHz</td><td>-BW/2 –2.1
/
+BW/2+ 2.1</td><td>-BW/2 –4.5
/
+BW/2 + 4.5</td><td>-BW/2 – 7.5
/
+BW/2 + 7.5</td></tr>
<tr><td>$F_{Interferer\ 2}$
(Offset)</td><td>MHz</td><td colspan="3">2*$F_{Interferer\ 1}$</td></tr>
<tr><td colspan="5">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.
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.3.1The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥5MHz</td></tr>
</table>

7.8.2 Void

7.9 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

7.9.1 Minimum requirements

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.1-1

Table 7.9.1-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

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 above SNR definition assumes that the REs are not precoded. The SNR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in Table C.3.2-1. The SNR requirement applies for the UE categories 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 {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, 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	ρ_A	dB	0	0	0	0
	ρ_B	dB	0 (Note 1)	0 (Note 1)	0 (Note 1)	0 (Note 1)
	σ	dB	0	0	0	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)
Modulation			QPSK	16QAM	64QAM	16QAM
PDSCH transmission mode			1	1	1	1

Note 1: $P_B = 0$.

Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

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	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	ρ_A	dB	0
	ρ_B	dB	0 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
Symbols for MBSFN portion of MBSFN subframes (Note 2)			OCNG (Note 3)
PDSCH transmission mode			1
Note 1: $P_B = 0$. Note 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe except the first two symbols in the first slot. Note 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead.			

Table 8.2.1.1.4-2: Minimum performance 1PRB (FRC)

Test number	Bandwidth	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	10 MHz	R.29 FDD	OP.3 FDD	ETU70	1x2 Low	30	2.0	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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
PDSCH transmission mode			2
Note 1: $P_B = 1$.			

Table 8.2.1.2.1-2: Minimum performance Transmit Diversity (FRC)

Test number	Band-width	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	10 MHz	R.11 FDD	OP.1 FDD	EVA5	2x2 Medium	70	6.8	2-5
2	10 MHz	R.10 FDD	OP.1 FDD	HST	2x2	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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
PDSCH transmission mode			2
Note 1: $P_B = 1$.			

Table 8.2.1.2.2-2: Minimum performance Transmit Diversity (FRC)

Test number	Band-width	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	1.4 MHz	R.12 FDD	OP.1 FDD	EPA5	4x2 Medium	70	0.6	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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
PDSCH transmission mode			3
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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
N_{oc} at antenna port		dBm/15kHz	-98
PDSCH transmission mode			3
Note 1: $P_B = 1$.			

Table 8.2.1.3.2-2: Minimum performance Large Delay CDD (FRC)

Test number	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	ρ_A	dB	-3	-3
	ρ_B	dB	-3 (Note 1)	-3 (Note 1)
	σ	dB	0	0
N_{oc} at antenna port		dBm/15kHz	-98	-98
Precoding granularity		PRB	6	50
PMI delay (Note 2)		ms	8	8
Reporting interval		ms	1	1
Reporting mode			PUSCH 1-2	PUSCH 3-1
CodeBookSubsetRestriction bitmap			001111	001111
PDSCH transmission mode			4	4
Note 1: $P_B = 1$. Note 2: If the UE reports in an available uplink reporting instance at subrame 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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
		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
CodeBookSubsetRestriction bitmap			0000000000000000 0000000000000000 0000000000000000 1111111111111111
PDSCH transmission mode			4
Note 1: $P_B = 1$. Note 2: If the UE reports in an available uplink reporting instance at subrame 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	ρ_A	dB	-3	-3
	ρ_B	dB	-3 (Note 1)	-3 (Note 1)
	σ	dB	0	0
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
CodeBookSubsetRestriction bitmap			110000	110000
PDSCH transmission mode			4	4

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at subrame 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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
N_{oc} at antenna port		dBm/15kHz	-98
Precoding granularity		PRB	6
PMI delay (Note 2)		ms	8
Reporting interval		ms	1
Reporting mode			PUSCH 1-2
CodeBookSubsetRestriction bitmap			0000000000000 0000000000000 0000001111111 1111111110000 000000000000
PDSCH transmission mode			4
Note 1: $P_B = 1$. Note 2: If the UE reports in an available uplink reporting instance at subrame 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	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	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 {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, 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	ρ_A	dB	0	0	0	0
	ρ_B	dB	0 (Note 1)	0 (Note 1)	0 (Note 1)	0 (Note 1)
	σ	dB	0	0	0	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)
Modulation			QPSK	16QAM	64QAM	16QAM
ACK/NACK feedback mode			Multiplexing	Multiplexing	Multiplexing	Multiplexing
PDSCH transmission mode			1	1	1	1
Note 1: $P_B = 0$. Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.						

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	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	ρ_A	dB	0
	ρ_B	dB	0 (Note 1)
	σ	dB	0
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
PDSCH transmission mode			1
Note 1: $P_B = 0$. Note 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe except the first two symbols in the first slot. Note 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead.			

Table 8.2.2.1.4-2: 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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
ACK/NACK feedback mode			Multiplexing
PDSCH transmission mode			2
Note 1: $P_B = 1$			

Table 8.2.2.2.1-2: Minimum performance Transmit Diversity (FRC)

Test number	Bandwidth	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	10 MHz	R.11 TDD	OP.1 TDD	EVA5	2x2 Medium	70	6.8	2-5
2	10 MHz	R.10 TDD	OP.1 TDD	HST	2x2	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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
ACK/NACK feedback mode			Multiplexing
PDSCH transmission mode			2
Note 1: $P_B = 1$.			

Table 8.2.2.2.2-2: Minimum performance Transmit Diversity (FRC)

Test number	Bandwidth	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	1.4 MHz	R.12 TDD	OP.1 TDD	EPA5	4x2 Medium	70	0.2	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	ρ_A	dB	-3
	ρ_B	dB	-3 (Note 1)
	σ	dB	0
N_{oc} at antenna port		dBm/15kHz	-98
ACK/NACK feedback mode			Bundling
PDSCH transmission mode			3
Note 1: $P_B = 1$.			

Table 8.2.2.3.1-2: 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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
N_{oc} at antenna port		dBm/15kHz	-98
ACK/NACK feedback mode			Bundling
PDSCH transmission mode			3
Note 1: $P_B = 1$.			

Table 8.2.2.3.2-2: Minimum performance Large Delay CDD (FRC)

Test number	Bandwidth	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	10 MHz	R.14 TDD	OP.1 TDD	EVA70	4x2 Low	70	14.2	2-5

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	ρ_A	dB	-3	-3
	ρ_B	dB	-3 (Note 1)	-3 (Note 1)
	σ	dB	0	0
N_{oc} at antenna port		dBm/15kHz	-98	-98
Precoding granularity		PRB	6	50
PMI delay (Note 2)		ms	10 or 11	10 or 11
Reporting interval		ms	1 or 4 (Note 3)	1 or 4 (Note 3)
Reporting mode			PUSCH 1-2	PUSCH 3-1
CodeBookSubsetRestriction bitmap			001111	001111
ACK/NACK feedback mode			Multiplexing	Multiplexing
PDSCH transmission mode			4	4
Note 1: $P_B = 1$. Note 2: If the UE reports in an available uplink reporting instance at subrame 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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
N_{oc} at antenna port		dBm/15kHz	-98
Precoding granularity		PRB	6
PMI delay (Note 2)		ms	10 or 11
Reporting interval		ms	1 or 4 (Note 3)
Reporting mode			PUSCH 1-2
CodeBookSubsetRestriction bitmap			0000000000000000000000000000000000000000000000011111111111111111
ACK/NACK feedback mode			Multiplexing
PDSCH transmission mode			4
Note 1: $P_B = 1$. Note 2: If the UE reports in an available uplink reporting instance at subrame 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 8.2.2.4.1A-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	ρ_A	dB	-3	-3
	ρ_B	dB	-3 (Note 1)	-3 (Note 1)
	σ	dB	0	0
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)	1or 4 (Note 3)
Reporting mode			PUSCH 3-1	PUSCH 3-1
ACK/NACK feedback mode			Bundling	Bundling
CodeBookSubsetRestriction bitmap			110000	110000
PDSCH transmission mode			4	4

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at subrame 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 8.2.2.4.2-2: 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	ρ_A	dB	-6
	ρ_B	dB	-6 (Note 1)
	σ	dB	3
N_{oc} at antenna port		dBm/15kHz	-98
Precoding granularity		PRB	6
PMI delay (Note 2)		ms	10 or 11
Reporting interval		ms	1 or 4 (Note 3)
Reporting mode			PUSCH 1-2
ACK/NACK feedback mode			Bundling
CodeBookSubsetRestriction bitmap			0000000000000 0000000000000 0000001111111 1111111110000 000000000000
PDSCH transmission mode			4

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at subrame 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 {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 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	ρ_A	dB	0	0	0	0
	ρ_B	dB	0 (Note 1)	0 (Note 1)	0 (Note 1)	0 (Note 1)
	σ	dB	0	0	0	0
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)
PDSCH transmission mode			7	7	7	7
Note 1: $P_B = 0$. Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.						

Table 8.3.2-3: 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
PHICH Ng (Note 1)			1	1
PHICH duration			Normal	Normal
Unused RE-s and PRB-s			OCNG	OCNG
Cell ID			0	0
Downlink power allocation	PDCCH_RA PHICH_RA OCNG_RA	dB	0	-3
	PCFICH_RB PDCCH_RB PHICH_RB OCNG_RB	dB	0	-3
N_{oc} at antenna port		dBm/15kHz	-98	-98
Cyclic prefix			Normal	Normal
Note 1: According to Clause 6.9 in TS 36.211 [4]				

8.4.1.1 Single-antenna port performance

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.4.1.1-1: Minimum performance PDCCH/PCFICH

Test number	Bandwidth	Aggregation level	Reference Channel	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	10 MHz	8 CCE	R.15 FDD	OP.1 FDD	ETU70	1x2 Low	1	-1.7

8.4.1.2 Transmit diversity performance

8.4.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.4.1.2.1-1: Minimum performance PDCCH/PCFICH

Test number	Bandwidth	Aggregation level	Reference Channel	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	1.4 MHz	2 CCE	R.16 FDD	OP.1 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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	10 MHz	4 CCE	R.17 FDD	OP.1 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
PHICH Ng (Note 3)			1	1
PHICH duration			Normal	Normal
Unused RE-s and PRB-s			OCNG	OCNG
Cell ID			0	0
Downlink power allocation	PDCCH_RA PHICH_RA OCNG_RA	dB	0	-3
	PCFICH_RB PDCCH_RB PHICH_RB OCNG_RB	dB	0	-3
N_{oc} at antenna port		dBm/15kHz	-98	-98
Cyclic prefix			Normal	Normal
ACK/NACK feedback mode			Multiplexing	Multiplexing
Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. Note 3: According to Clause 6.9 in TS 36.211 [4]				

8.4.2.1 Single-antenna port performance

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.4.2.1-1: Minimum performance PDCCH/PCFICH

Test number	Bandwidth	Aggregation level	Reference Channel	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	10 MHz	8 CCE	R.15 TDD	OP.1 TDD	ETU70	1x2 Low	1	-1.6

8.4.2.2 Transmit diversity performance

8.4.2.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.4.2.2.1-1: Minimum performance PDCCH/PCFICH

Test number	Bandwidth	Aggregation level	Reference Channel	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	1.4 MHz	2 CCE	R.16 TDD	OP.1 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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
							Pm-dsg (%)	SNR (dB)
1	10 MHz	4 CCE	R.17 TDD	OP.1 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	PDCCH_RA PHICH_RA OCNG_RA	dB	0	-3
	PCFICH_RB PDCCH_RB PHICH_RB OCNG_RB	dB	0	-3
PHICH duration			Normal	Normal
PHICH Ng (Note 1)			Ng = 1	Ng = 1
PDCCH Conctent			UL Grant should be included with the proper information aligned with A.3.6.	
Unused RE-s and PRB-s			OCNG	OCNG
Cell ID			0	0
N_{oc} at antenna port		dBm/15kHz	-98	-98
Cyclic prefix			Normal	Normal
Note 1: according to Clause 6.9 in TS 36.211 [4].				

8.5.1.1 Single-antenna port performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.5.1.1-1: Minimum performance PHICH

Test number	Bandwidth	Reference Channel	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	10 MHz	R.18	OP.1 FDD	ETU70	1 x 2 Low	0.1	5.5
2	10 MHz	R.24	OP.1 FDD	ETU70	1 x 2 Low	0.1	0.6

8.5.1.2 Transmit diversity performance

8.5.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (Pm-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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	1.4 MHz	R.19A	OP.1 FDD	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 (Pm-an) shall be below the specified value in Table 8.5.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

Table 8.5.1.2.2-1: Minimum performance PHICH

Test number	Bandwidth	Reference Channel	OCNG pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	10 MHz	R.20A	OP.1 FDD	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	PDCCH_RA PHICH_RA OCNG_RA	dB	0	-3
	PCFICH_RB PDCCH_RB PHICH_RB OCNG_RB	dB	0	-3
PHICH duration			Normal	Normal
PHICH Ng (Note 3)			Ng = 1	Ng = 1
PDCCH Conctent			UL Grant should be included with the proper information aligned with A.3.6.	
Unused RE-s and PRB-s			OCNG	OCNG
Cell ID			0	0
N_{oc} at antenna port		dBm/15kHz	-98	-98
Cyclic prefix			Normal	Normal
ACK/NACK feedback mode			Multiplexing	Multiplexing
Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. Note 3: according to Clause 6.9 in TS 36.211 [4].				

8.5.2.1 Single-antenna port performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	10 MHz	R.18	OP.1 TDD	ETU70	1 x 2 Low	0.1	5.8
2	10 MHz	R.24	OP.1 TDD	ETU70	1 x 2 Low	0.1	1.3

8.5.2.2 Transmit diversity performance

8.5.2.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	1.4 MHz	R.19	OP.1 TDD	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	OCNG Pattern	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
						Pm-an (%)	SNR (dB)
1	10 MHz	R.20	OP.1 TDD	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

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 RC.1 FDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. 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	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	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			
cqi-pmi-ConfigurationIndex			6			
Note 1: Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. 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 RC.1 TDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. 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	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	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	$N_P = 5$			
cqi-pmi-ConfigurationIndex			3			
ACK/NACK feedback mode			Multiplexing			

Note 1: Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.
Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.

9.2.2 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 CQI_1 shall be within the set {median CQI_1 -1, median CQI_1, median CQI_1 +1} for more than 90% of the time, where the resulting wideband values CQI_1 shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median $CQI_0 - 1$ and median $CQI_1 - 1$ shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median $CQI_0 + 1$ and median $CQI_1 + 1$ shall be greater than or equal to 0.1.

Table 9.2.2.1-1: PUCCH 1-1 static test (FDD)

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
PDSCH transmission mode			4			
Downlink power allocation	ρ_A	dB	-3			
	ρ_B	dB	-3			
	σ	dB	0			
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 for CQI/PMI			2			
PUCCH Report Type for RI			3			
Reporting periodicity		ms	N_P = 5			
cqi-pmi-ConfigurationIndex			6			
ri-ConfigIndex			1 (Note 3)			
Note 1: Reference measurement channel RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. Note 3: It is intended to have UL collisions between RI reports and HARQ-ACK, since the RI reports shall not be used by the eNB in this test.						

9.2.2.2 TDD

The following requirements apply to UE Category 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 CQI_1 shall be within the set {median CQI_1 -1, median CQI_1, median CQI_1 +1} for more than 90% of the time, where the resulting wideband values CQI_1 shall be used to determine the median CQI values for codeword #1. For both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median $CQI_0 - 1$ and median $CQI_1 - 1$ shall be less than or equal to 0.1. Furthermore, for both codewords #0 and #1, the PDSCH BLER using the transport format indicated by the respective median $CQI_0 + 1$ and median $CQI_1 + 1$ shall be greater than or equal to 0.1.

Table 9.2.2.2-1: 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	ρ_A	dB	-3			
	ρ_B	dB	-3			
	σ	dB	0			
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	$N_P = 5$			
cqi-pmi-ConfigurationIndex			3			
ri-ConfigIndex			805 (Note 4)			
ACK/NACK feedback mode			Multiplexing			

Note 1: Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.

Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.

Note 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.

9.3 CQI reporting under fading conditions

9.3.1 Frequency-selective scheduling mode

The accuracy of sub-band channel quality indicator (CQI) reporting under frequency selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level the corresponding transport format compared to the case for which a fixed format is transmitted on any sub-band in set *S* of TS 36.213 [6]. The purpose is to verify that preferred sub-bands can be used for frequently-selective scheduling. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

9.3.1.1 Minimum requirement PUSCH 3-0

9.3.1.1.1 FDD

For the parameters specified in Table 9.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.1-2 and by the following

a) sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% for each sub-band;

b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be $\geq \gamma$;

c) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

Table 9.3.1.1.1-1 Sub-band test for single antenna transmission (FDD)

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10 MHz			
Transmission mode			1 (port 0)			
Downlink power allocation	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	dB	0			
SNR (Note 3)		dB	9	10	14	15
$\hat{I}_{or}^{(j)}$		dB[mW/15kHz]	-89	-88	-84	-83
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98		-98	
Propagation channel			Clause B.2.4 with $\tau_d = 0.45$ μs, *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			
Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) Note 2: Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.						

Table 9.3.1.1.1-2 Minimum requirement (FDD)

	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	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.3.2, the minimum requirements are specified in Table 9.3.1.1.2-2 and by the following

a) a sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% 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 ≥ γ;

c) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.05.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD.

Table 9.3.1.1.2-1 Sub-band test for single antenna transmission (TDD)

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10 MHz			
Transmission mode			1 (port 0)			
Downlink power allocation	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	dB	0			
Uplink downlink configuration			2			
Special subframe configuration			4			
SNR (Note 3)		dB	9	10	14	15
$\hat{I}_{or}^{(j)}$		dB[mW/15kHz]	-89	-88	-84	-83
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98		-98	
Propagation channel			Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ 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) Note 2: Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.						

Table 9.3.1.1.2-2 Minimum requirement (TDD)

	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	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 the reporting variance, and the relative increase of the throughput obtained when the transport format transmitted is that indicated by the reported CQI compared to the case for which a fixed transport format configured according to the reported median CQI is transmitted. In addition, the reporting accuracy is determined by a minimum BLER using the transport formats indicated by the reported CQI. The purpose is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for frequently non-selective scheduling. To account for sensitivity of the input SNR the CQI reporting under frequency non-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

9.3.2.1 Minimum requirement PUCCH 1-0

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.3.2, 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, median CQI +1} shall be reported at least α% of the time;

b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$;

c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02

Table 9.3.2.1.1-1 Fading test for single antenna (FDD)

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10 MHz			
Transmission mode			1 (port 0)			
Downlink power allocation	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	dB	0			
SNR (Note 3)		dB	6	7	12	13
$\hat{I}_{or}^{(j)}$		dB[mW/15kHz]	-92	-91	-86	-85
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98		-98	
Propagation channel			EPA5			
Correlation			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			
cqi-pmi-ConfigurationIndex			1			
Max number of HARQ transmissions			1			
Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4) Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 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
α [%]	20	20
γ	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.3.2, the minimum requirements are specified in Table 9.3.2.1.2-2 and by the following

a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α% of the time;

b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$;

c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

Table 9.3.2.1.2-1 Fading test for single antenna (TDD)

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10 MHz			
Transmission mode			1 (port 0)			
Downlink power allocation	ρ_A	dB	0			
	ρ_B	dB	0			
	σ	dB	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			
cqi-pmi-ConfigurationIndex			3			
Max number of HARQ transmissions			1			
ACK/NACK feedback mode			Multiplexing			

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).

Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.

Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.

Table 9.3.2.1.2-2 Minimum requirement (TDD)

	Test 1	Test 2	
α [%]	20	20	
γ	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 percentile of the reported differential CQI offset level +2 for a preferred sub-band, and the relative increase of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level the corresponding transport format compared to the case for which a fixed format is transmitted on any sub-band in set *S* of TS 36.213 [6]. The purpose is to verify that preferred sub-bands are used for frequently-selective scheduling under frequency-selective interference conditions.

9.3.3.1 Minimum requirement PUSCH 3-0

9.3.3.1.1 FDD

For the parameters specified in Table 9.3.3.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.3.1.1-2 and by the following

a) a sub-band differential CQI offset level of +2 shall be reported at least α% for at least one of the sub-bands of full size at the channel edges;

b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be ≥ γ;

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

Table 9.3.3.1.1-1 Sub-band test for single antenna transmission (FDD)

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	10 MHz	10 MHz
Transmission mode			1 (port 0)	1 (port 0)
Downlink power allocation	ρ_A	dB	0	0
	ρ_B	dB	0	0
	σ	dB	0	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, *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 RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.				

Table 9.3.3.1.1-2 Minimum requirement (FDD)

	Test 1	Test 2
α [%]	60	60
γ	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.3.2, the minimum requirements are specified in Table 9.3.3.1.2-2 and by the following

a) a sub-band differential CQI offset level of +2 shall be reported at least α% for at least one of the sub-bands of full size at the channel edges;

b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be ≥ γ;

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD, each available downlink transmission instance for TDD. Sub-bands of a size smaller than full size are excluded from the test.

Table 9.3.3.1.2-1 Sub-band test for single antenna transmission (TDD)

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	10 MHz	10 MHz
Transmission mode			1 (port 0)	1 (port 0)
Downlink power allocation	ρ_A	dB	0	0
	ρ_B	dB	0	0
	σ	dB	0	0
Uplink downlink configuration			2	
Special subframe configuration			4	
$I_{ot}^{(j)}$ for RB 0…5		dB[mW/15kHz]	-102	-93
$I_{ot}^{(j)}$ for RB 6…41		dB[mW/15kHz]	-93	-93
$I_{ot}^{(j)}$ for RB 42…49		dB[mW/15kHz]	-93	-102
$\hat{I}_{or}^{(j)}$		dB[mW/15kHz]	-94	-94
Max number of HARQ transmissions			1	
Propagation channel			Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ 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 RC.3 TDD according to table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.				

Table 9.3.3.1.2-2 Minimum requirement (TDD)

	Test 1	Test 2
α [%]	60	60
γ	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. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. 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.3.2, the minimum requirements are specified in Table 9.4.1.1.1-2.

Table 9.4.1.1.1-1 PMI test for single-layer (FDD)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Transmission mode			6
Propagation channel			EVA5
Precoding granularity		PRB	50
Correlation and antenna configuration			Low 2 x 2
Downlink power allocation	ρ_A	dB	-3
	ρ_B	dB	-3
	σ	dB	0
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98
Reporting mode			PUSCH 3-1
Reporting interval		ms	1
PMI delay (Note 2)		ms	8
Measurement channel			R.10 FDD
OCNG Pattern			OP.1 FDD
Max number of HARQ transmissions			4
Redundancy version coding sequence			{0,1,2,3}
Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at subrame 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
γ	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.3.2, the minimum requirements are specified in 9.4.1.1.2-2.

Table 9.4.1.1.2-1 PMI test for single-layer (TDD)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Transmission mode			6
Uplink downlink configuration			1
Special subframe configuration			4
Propagation channel			EVA5
Precoding granularity		PRB	50
Correlation and antenna configuration			Low 2 x 2
Downlink power allocation	ρ_A	dB	-3
	ρ_B	dB	-3
	σ	dB	0
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98
Reporting mode			PUSCH 3-1
Reporting interval		ms	1
PMI delay (Note 2)		ms	10 or 11
Measurement channel			R.10 TDD
OCNG Pattern			OP.1 TDD
Max number of HARQ transmissions			4
Redundancy version coding sequence			{0,1,2,3}
ACK/NACK feedback mode			Multiplexing
Note 1: For random precoder selection, the precoder shall be updated in each available downlink transmission instance. Note 2: If the UE reports in an available uplink reporting instance at subrame 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
γ	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.3.2, the minimum requirements are specified in 9.4.2.1.1-2.

Table 9.4.2.1.1-1 PMI test for single-layer (FDD)

Parameter		Unit	Test 1
Bandwidth		MHz	20
Transmission mode			6
Propagation channel			EPA5
Precoding granularity (only for reporting and following PMI)		PRB	8
Correlation and antenna configuration			Low 2 x 2
Downlink power allocation	ρ_A	dB	-3
	ρ_B	dB	-3
	σ	dB	0
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98
Reporting mode			PUSCH 1-2
Reporting interval		ms	1
PMI delay		ms	8
Measurement channel			R.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 subrame 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
γ	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.3.2, the minimum requirements are specified in 9.4.2.1.2-2.

Table 9.4.2.1.2-1 PMI test for single-layer (TDD)

Parameter		Unit	Test 1
Bandwidth		MHz	20
Transmission mode			6
Uplink downlink configuration			1
Special subframe configuration			4
Propagation channel			EPA5
Precoding granularity (only for reporting and following PMI)		PRB	8
Correlation and antenna configuration			Low 2 x 2
Downlink power allocation	ρ_A	dB	-3
	ρ_B	dB	-3
	σ	dB	0
$N_{oc}^{(j)}$		dB[mW/15kHz]	-98
Reporting mode			PUSCH 1-2
Reporting interval		ms	1
PMI delay		ms	10 or 11
Measurement channel			R.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 subrame 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
γ	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 $\geq \gamma_2$;

For the parameters specified in Table 9.5.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.1.1-2.

Table 9.5.1.1-1 RI Test (FDD)

Parameter		Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	10		
PDSCH transmission mode			4		
Downlink power allocation	ρ_A	dB	-3		
	ρ_B	dB	-3		
	σ	dB	0		
CodeBookSubsetRestriction bitmap			000011 for fixed RI = 1 010000 for fixed RI = 2 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 (Note 4)		
Physical channel for CQI/PMI reporting			PUCCH Format 2		
PUCCH Report Type for CQI/PMI			2		
Physical channel for RI reporting			PUSCH (Note 3)		
PUCCH Report Type for RI			3		
Reporting periodicity		ms	N_P = 5		
PMI and CQI delay		ms	8		
cqi-pmi-ConfigurationIndex			6		
ri-ConfigurationInd			1 (Note 5)		

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).

Note 2: Reference measurement channel RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.

Note 3: To avoid collisions between RI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.

Note 4: The bit field for precoding information in DCI format 2 shall be mapped as:
- For reported RI = 1 and PMI = 0 >> precoding information bit field index = 1
- For reported RI = 1 and PMI = 1 >> precoding information bit field index = 2
- For reported RI = 2 and PMI = 0 >> precoding information bit field index = 0

Note 5: To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.

Table 9.5.1.1-2 Minimum requirement (FDD)

	Test 1	Test 2	Test 3
γ_1	N/A	1.05	N/A
γ_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

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 ≥ γ_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 ≥ γ_2;

For the parameters specified in Table 9.5.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.1.2-2.

Table 9.5.1.2-1 RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	10		
PDSCH transmission mode			4		
Downlink power allocation	ρ_A	dB	-3		
	ρ_B	dB	-3		
	σ	dB	0		
Uplink downlink configuration			2		
Special subframe configuration			4		
Propagation condition and antenna configuration			2 x 2 EPA5		
CodeBookSubsetRestriction bitmap			000011 for fixed RI = 1 010000 for fixed RI = 2 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). Note 2: Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. Note 3: Reported wideband CQI and PMI are used and sub-band CQI is discarded.					

Table 9.5.1.2-2 Minimum requirement (TDD)

	Test 1	Test 2	Test 3
γ_1	N/A	1.05	N/A
γ_2	1	N/A	1.1
UE Category	2-5	2-5	2-5

Annex A (normative):
Measurement channels

A.1 General

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per datastream (codeword). For multi-stream (more than one codeword) transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all datastreams (codewords).

The UE category entry in the definition of the reference measurement channel in Annex A is only informative and reveals the UE categories, which can support the corresponding measurement channel. Whether the measurement channel is used for testing a certain UE category or not is specified in the individual minimum requirements.

A.2 UL reference measurement channels

A.2.1 General

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,

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

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.2.1.3 Overview of UL reference measurement channels

In Table A.2.1.3-1 are listed the UL reference measurement channels specified in annexes A.2.2 and A.2.3 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.2.2 and A.2.3 as appropriate.

Table A.2.1.3-1: Overview of UL reference measurement channels

Duplex	Table	Name	BW	Mod	TCR	RB	RB Off set	UE Categ	Notes
FDD, Full RB allocation, QPSK									
FDD	Table A.2.2.1.1-1		1.4	QPSK	1/3	6		≥ 1	
FDD	Table A.2.2.1.1-1		3	QPSK	1/3	15		≥ 1	
FDD	Table A.2.2.1.1-1		5	QPSK	1/3	25		≥ 1	
FDD	Table A.2.2.1.1-1		10	QPSK	1/3	50		≥ 1	
FDD	Table A.2.2.1.1-1		15	QPSK	1/5	75		≥ 1	
FDD	Table A.2.2.1.1-1		20	QPSK	1/6	100		≥ 1	
FDD, Full RB allocation, 16-QAM									
FDD	Table A.2.2.1.2-1		1.4	16QAM	3/4	6		≥ 1	
FDD	Table A.2.2.1.2-1		3	16QAM	1/2	15		≥ 1	
FDD	Table A.2.2.1.2-1		5	16QAM	1/3	25		≥ 1	
FDD	Table A.2.2.1.2-1		10	16QAM	3/4	50		≥ 2	
FDD	Table A.2.2.1.2-1		15	16QAM	1/2	75		≥ 2	
FDD	Table A.2.2.1.2-1		20	16QAM	1/3	100		≥ 2	

FDD, Partial RB allocation, QPSK									
FDD	Table A.2.2.2.1-1		1.4 - 20	QPSK	1/3	1		≥ 1	
FDD	Table A.2.2.2.1-1		1.4 - 20	QPSK	1/3	2		≥ 1	
FDD	Table A.2.2.2.1-1		1.4 - 20	QPSK	1/3	3		≥ 1	
FDD	Table A.2.2.2.1-1		1.4 - 20	QPSK	1/3	4		≥ 1	
FDD	Table A.2.2.2.1-1		1.4 - 20	QPSK	1/3	5		≥ 1	
FDD	Table A.2.2.2.1-1		3 - 20	QPSK	1/3	6		≥ 1	
FDD	Table A.2.2.2.1-1		3 - 20	QPSK	1/3	8		≥ 1	
FDD	Table A.2.2.2.1-1		3 - 20	QPSK	1/3	9		≥ 1	
FDD	Table A.2.2.2.1-1		3 - 20	QPSK	1/3	10		≥ 1	
FDD	Table A.2.2.2.1-1		3 - 20	QPSK	1/3	12		≥ 1	
FDD	Table A.2.2.2.1-1		5 - 20	QPSK	1/3	15		≥ 1	
FDD	Table A.2.2.2.1-1		5 - 20	QPSK	1/3	16		≥ 1	
FDD	Table A.2.2.2.1-1		5 - 20	QPSK	1/3	18		≥ 1	
FDD	Table A.2.2.2.1-1		5 - 20	QPSK	1/3	20		≥ 1	
FDD	Table A.2.2.2.1-1		5 - 20	QPSK	1/3	24		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	25		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	27		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	30		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	32		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	36		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	40		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	45		≥ 1	
FDD	Table A.2.2.2.1-1		10 - 20	QPSK	1/3	48		≥ 1	
FDD	Table A.2.2.2.1-1		15 - 20	QPSK	1/3	50		≥ 1	
FDD	Table A.2.2.2.1-1		15 - 20	QPSK	1/3	54		≥ 1	
FDD	Table A.2.2.2.1-1		15 - 20	QPSK	1/4	60		≥ 1	
FDD	Table A.2.2.2.1-1		15 - 20	QPSK	1/4	64		≥ 1	
FDD	Table A.2.2.2.1-1		15 - 20	QPSK	1/4	72		≥ 1	
FDD	Table A.2.2.2.1-1		20	QPSK	1/5	75		≥ 1	
FDD	Table A.2.2.2.1-1		20	QPSK	1/5	80		≥ 1	
FDD	Table A.2.2.2.1-1		20	QPSK	1/5	81		≥ 1	
FDD	Table A.2.2.2.1-1		20	QPSK	1/6	90		≥ 1	
FDD	Table A.2.2.2.1-1		20	QPSK	1/6	96		≥ 1	
FDD, Partial RB allocation, 16-QAM									
FDD	Table A.2.2.2.2-1		1.4 - 20	16QAM	3/4	1		≥ 1	
FDD	Table A.2.2.2.2-1		1.4 - 20	16QAM	3/4	2		≥ 1	
FDD	Table A.2.2.2.2-1		1.4 - 20	16QAM	3/4	3		≥ 1	
FDD	Table A.2.2.2.2-1		1.4 - 20	16QAM	3/4	4		≥ 1	
FDD	Table A.2.2.2.2-1		1.4 - 20	16QAM	3/4	5		≥ 1	
FDD	Table A.2.2.2.2-1		3 - 20	16QAM	3/4	6		≥ 1	
FDD	Table A.2.2.2.2-1		3 - 20	16QAM	3/4	8		≥ 1	
FDD	Table A.2.2.2.2-1		3 - 20	16QAM	3/4	9		≥ 1	
FDD	Table A.2.2.2.2-1		3 - 20	16QAM	3/4	10		≥ 1	
FDD	Table A.2.2.2.2-1		3 - 20	16QAM	3/4	12		≥ 1	
FDD	Table A.2.2.2.2-1		5 - 20	16QAM	1/2	15		≥ 1	
FDD	Table A.2.2.2.2-1		5 - 20	16QAM	1/2	16		≥ 1	
FDD	Table A.2.2.2.2-1		5 - 20	16QAM	1/2	18		≥ 1	

FDD	Table A.2.2.2.2-1		5 - 20	16QAM	1/3	20		≥ 1	
FDD	Table A.2.2.2.2-1		5 - 20	16QAM	1/3	24		≥ 1	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	1/3	25		≥ 1	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	1/3	27		≥ 1	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	30		≥ 2	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	32		≥ 2	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	36		≥ 2	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	40		≥ 2	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	45		≥ 2	
FDD	Table A.2.2.2.2-1		10 - 20	16QAM	3/4	48		≥ 2	
FDD	Table A.2.2.2.2-1		15 - 20	16QAM	3/4	50		≥ 2	
FDD	Table A.2.2.2.2-1		15 - 20	16QAM	3/4	54		≥ 2	
FDD	Table A.2.2.2.2-1		15 - 20	16QAM	2/3	60		≥ 2	
FDD	Table A.2.2.2.2-1		15 - 20	16QAM	2/3	64		≥ 2	
FDD	Table A.2.2.2.2-1		15 - 20	16QAM	1/2	72		≥ 2	
FDD	Table A.2.2.2.2-1		20	16QAM	1/2	75		≥ 2	
FDD	Table A.2.2.2.2-1		20	16QAM	1/2	80		≥ 2	
FDD	Table A.2.2.2.2-1		20	16QAM	1/2	81		≥ 2	
FDD	Table A.2.2.2.2-1		20	16QAM	2/5	90		≥ 2	
FDD	Table A.2.2.2.2-1		20	16QAM	2/5	96		≥ 2	

TDD, Full RB allocation, QPSK									
TDD	Table A.2.3.1.1-1		1.4	QPSK	1/3	6		≥ 1	
TDD	Table A.2.3.1.1-1		3	QPSK	1/3	15		≥ 1	
TDD	Table A.2.3.1.1-1		5	QPSK	1/3	25		≥ 1	
TDD	Table A.2.3.1.1-1		10	QPSK	1/3	50		≥ 1	
TDD	Table A.2.3.1.1-1		15	QPSK	1/5	75		≥ 1	
TDD	Table A.2.3.1.1-1		20	QPSK	1/6	100		≥ 1	
TDD, Full RB allocation, 16-QAM									
TDD	Table A.2.3.1.2-1		1.4	16QAM	3/4	6		≥ 1	
TDD	Table A.2.3.1.2-1		3	16QAM	1/2	15		≥ 1	
TDD	Table A.2.3.1.2-1		5	16QAM	1/3	25		≥ 1	
TDD	Table A.2.3.1.2-1		10	16QAM	3/4	50		≥ 2	
TDD	Table A.2.3.1.2-1		15	16QAM	1/2	75		≥ 2	
TDD	Table A.2.3.1.2-1		20	16QAM	1/3	100		≥ 2	

TDD, Partial RB allocation, QPSK									
TDD	Table A.2.3.2.1-1		1.4 - 20	QPSK	1/3	1		≥ 1	
TDD	Table A.2.3.2.1-1		1.4 - 20	QPSK	1/3	2		≥ 1	
TDD	Table A.2.3.2.1-1		1.4 - 20	QPSK	1/3	3		≥ 1	
TDD	Table A.2.3.2.1-1		1.4 - 20	QPSK	1/3	4		≥ 1	
TDD	Table A.2.3.2.1-1		1.4 - 20	QPSK	1/3	5		≥ 1	
TDD	Table A.2.3.2.1-1		3 - 20	QPSK	1/3	6		≥ 1	
TDD	Table A.2.3.2.1-1		3 - 20	QPSK	1/3	8		≥ 1	
TDD	Table A.2.3.2.1-1		3 - 20	QPSK	1/3	9		≥ 1	
TDD	Table A.2.3.2.1-1		3 - 20	QPSK	1/3	10		≥ 1	
TDD	Table A.2.3.2.1-1		3 - 20	QPSK	1/3	12		≥ 1	
TDD	Table A.2.3.2.1-1		5 - 20	QPSK	1/3	15		≥ 1	
TDD	Table A.2.3.2.1-1		5 - 20	QPSK	1/3	16		≥ 1	
TDD	Table A.2.3.2.1-1		5 - 20	QPSK	1/3	18		≥ 1	
TDD	Table A.2.3.2.1-1		5 - 20	QPSK	1/3	20		≥ 1	
TDD	Table A.2.3.2.1-1		5 - 20	QPSK	1/3	24		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	25		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	27		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	30		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	32		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	36		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	40		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	45		≥ 1	
TDD	Table A.2.3.2.1-1		10 - 20	QPSK	1/3	48		≥ 1	
TDD	Table A.2.3.2.1-1		15 - 20	QPSK	1/3	50		≥ 1	
TDD	Table A.2.3.2.1-1		15 - 20	QPSK	1/3	54		≥ 1	
TDD	Table A.2.3.2.1-1		15 - 20	QPSK	1/4	60		≥ 1	
TDD	Table A.2.3.2.1-1		15 - 20	QPSK	1/4	64		≥ 1	
TDD	Table A.2.3.2.1-1		15 - 20	QPSK	1/4	72		≥ 1	
TDD	Table A.2.3.2.1-1		20	QPSK	1/5	75		≥ 1	
TDD	Table A.2.3.2.1-1		20	QPSK	1/5	80		≥ 1	
TDD	Table A.2.3.2.1-1		20	QPSK	1/5	81		≥ 1	
TDD	Table A.2.3.2.1-1		20	QPSK	1/6	90		≥ 1	
TDD	Table A.2.3.2.1-1		20	QPSK	1/6	96		≥ 1	
TDD, Partial RB allocation, 16-QAM									
TDD	Table A.2.3.2.2-1		1.4 - 20	16QAM	3/4	1		≥ 1	
TDD	Table A.2.3.2.2-1		1.4 - 20	16QAM	3/4	2		≥ 1	
TDD	Table A.2.3.2.2-1		1.4 - 20	16QAM	3/4	3		≥ 1	
TDD	Table A.2.3.2.2-1		1.4 - 20	16QAM	3/4	4		≥ 1	
TDD	Table A.2.3.2.2-1		1.4 - 20	16QAM	3/4	5		≥ 1	
TDD	Table A.2.3.2.2-1		3 - 20	16QAM	3/4	6		≥ 1	
TDD	Table A.2.3.2.2-1		3 - 20	16QAM	3/4	8		≥ 1	
TDD	Table A.2.3.2.2-1		3 - 20	16QAM	3/4	9		≥ 1	
TDD	Table A.2.3.2.2-1		3 - 20	16QAM	3/4	10		≥ 1	
TDD	Table A.2.3.2.2-1		3 - 20	16QAM	3/4	12		≥ 1	
TDD	Table A.2.3.2.2-1		5 - 20	16QAM	1/2	15		≥ 1	
TDD	Table A.2.3.2.2-1		5 - 20	16QAM	1/2	16		≥ 1	
TDD	Table A.2.3.2.2-1		5 - 20	16QAM	1/2	18		≥ 1	

TDD	Table A.2.3.2.2-1		5 - 20	16QAM	1/3	20		≥ 1	
TDD	Table A.2.3.2.2-1		5 - 20	16QAM	1/3	24		≥ 1	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	1/3	25		≥ 1	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	1/3	27		≥ 1	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	30		≥ 2	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	32		≥ 2	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	36		≥ 2	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	40		≥ 2	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	45		≥ 2	
TDD	Table A.2.3.2.2-1		10 - 20	16QAM	3/4	48		≥ 2	
TDD	Table A.2.3.2.2-1		15 - 20	16QAM	3/4	50		≥ 2	
TDD	Table A.2.3.2.2-1		15 - 20	16QAM	3/4	54		≥ 2	
TDD	Table A.2.3.2.2-1		15 - 20	16QAM	2/3	60		≥ 2	
TDD	Table A.2.3.2.2-1		15 - 20	16QAM	2/3	64		≥ 2	
TDD	Table A.2.3.2.2-1		15 - 20	16QAM	1/2	72		≥ 2	
TDD	Table A.2.3.2.2-1		20	16QAM	1/2	75		≥ 2	
TDD	Table A.2.3.2.2-1		20	16QAM	1/2	80		≥ 2	
TDD	Table A.2.3.2.2-1		20	16QAM	1/2	81		≥ 2	
TDD	Table A.2.3.2.2-1		20	16QAM	2/5	90		≥ 2	
TDD	Table A.2.3.2.2-1		20	16QAM	2/5	96		≥ 2	

A.2.2 Reference measurement channels for FDD

A.2.2.1 Full RB allocation

A.2.2.1.1 QPSK

Table A.2.2.1.1-1 Reference Channels for QPSK with full RB allocation

Parameter	Unit	Value					
Channel bandwidth	MHz	1.4	3	5	10	15	20
Allocated resource blocks		6	15	25	50	75	100
DFT-OFDM Symbols per Sub-Frame		12	12	12	12	12	12
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding rate		1/3	1/3	1/3	1/3	1/5	1/6
Payload size	Bits	600	1544	2216	5160	4392	4584
Transport block CRC	Bits	24	24	24	24	24	24
Number of code blocks per Sub-Frame (Note 1)		1	1	1	1	1	1
Total number of bits per Sub-Frame	Bits	1728	4320	7200	14400	21600	28800
Total symbols per Sub-Frame		864	2160	3600	7200	10800	14400
UE Category		≥ 1	≥ 1	≥ 1	≥ 1	≥ 1	≥ 1
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)							

A.2.2.1.2 16-QAM

Table A.2.2.1.2-1 Reference Channels for 16-QAM with full RB allocation

Parameter	Unit	Value					
Channel bandwidth	MHz	1.4	3	5	10	15	20
Allocated resource blocks		6	15	25	50	75	100
DFT-OFDM Symbols per Sub-Frame		12	12	12	12	12	12
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding rate		3/4	1/2	1/3	3/4	1/2	1/3
Payload size	Bits	2600	4264	4968	21384	21384	19848
Transport block CRC	Bits	24	24	24	24	24	24
Number of code blocks per Sub-Frame (Note 1)		1	1	1	4	4	4
Total number of bits per Sub-Frame	Bits	3456	8640	14400	28800	43200	57600
Total symbols per Sub-Frame		864	2160	3600	7200	10800	14400
UE Category		≥ 1	≥ 1	≥ 1	≥ 2	≥ 2	≥ 2
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)							

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 QPSK with partial RB allocation

Parameter	Ch BW	Allocated RBs	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size	Transport block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame	Total symbols per Sub-Frame	UE Category
Unit	MHz					Bits	Bits		Bits		
	1.4 - 20	1	12	QPSK	1/3	72	24	1	288	144	≥ 1
	1.4 - 20	2	12	QPSK	1/3	176	24	1	576	288	≥ 1
	1.4 - 20	3	12	QPSK	1/3	256	24	1	864	432	≥ 1
	1.4 - 20	4	12	QPSK	1/3	392	24	1	1152	576	≥ 1
	1.4 - 20	5	12	QPSK	1/3	424	24	1	1440	720	≥ 1
	3-20	6	12	QPSK	1/3	600	24	1	1728	864	≥ 1
	3-20	8	12	QPSK	1/3	808	24	1	2304	1152	≥ 1
	3-20	9	12	QPSK	1/3	776	24	1	2592	1296	≥ 1
	3-20	10	12	QPSK	1/3	872	24	1	2880	1440	≥ 1
	3-20	12	12	QPSK	1/3	1224	24	1	3456	1728	≥ 1
	5-20	15	12	QPSK	1/3	1320	24	1	4320	2160	≥ 1
	5-20	16	12	QPSK	1/3	1384	24	1	4608	2304	≥ 1
	5-20	18	12	QPSK	1/3	1864	24	1	5184	2592	≥ 1
	5-20	20	12	QPSK	1/3	1736	24	1	5760	2880	≥ 1
	5-20	24	12	QPSK	1/3	2472	24	1	6912	3456	≥ 1
	10-20	25	12	QPSK	1/3	2216	24	1	7200	3600	≥ 1
	10-20	27	12	QPSK	1/3	2792	24	1	7776	3888	≥ 1
	10-20	30	12	QPSK	1/3	2664	24	1	8640	4320	≥ 1
	10-20	32	12	QPSK	1/3	2792	24	1	9216	4608	≥ 1
	10-20	36	12	QPSK	1/3	3752	24	1	10368	5184	≥ 1
	10-20	40	12	QPSK	1/3	4136	24	1	11520	5760	≥ 1
	10-20	45	12	QPSK	1/3	4008	24	1	12960	6480	≥ 1
	10-20	48	12	QPSK	1/3	4264	24	1	13824	6912	≥ 1
	15 - 20	50	12	QPSK	1/3	5160	24	1	14400	7200	≥ 1
	15 - 20	54	12	QPSK	1/3	4776	24	1	15552	7776	≥ 1
	15 - 20	60	12	QPSK	1/4	4264	24	1	17280	8640	≥ 1
	15 - 20	64	12	QPSK	1/4	4584	24	1	18432	9216	≥ 1
	15 - 20	72	12	QPSK	1/4	5160	24	1	20736	10368	≥ 1
	20	75	12	QPSK	1/5	4392	24	1	21600	10800	≥ 1
	20	80	12	QPSK	1/5	4776	24	1	23040	11520	≥ 1
	20	81	12	QPSK	1/5	4776	24	1	23328	11664	≥ 1
	20	90	12	QPSK	1/6	4008	24	1	25920	12960	≥ 1
	20	96	12	QPSK	1/6	4264	24	1	27648	13824	≥ 1
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)											

A.2.2.2.2 16-QAM

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

Parameter	Ch BW	Allocated RBs	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size	Transport block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame	Total symbols per Sub-Frame	UE Category
Unit	MHz					Bits	Bits		Bits		
	1.4 - 20	1	12	16QAM	3/4	408	24	1	576	144	≥ 1
	1.4 - 20	2	12	16QAM	3/4	840	24	1	1152	288	≥ 1
	1.4 - 20	3	12	16QAM	3/4	1288	24	1	1728	432	≥ 1
	1.4 - 20	4	12	16QAM	3/4	1736	24	1	2304	576	≥ 1
	1.4 - 20	5	12	16QAM	3/4	2152	24	1	2880	720	≥ 1
	3-20	6	12	16QAM	3/4	2600	24	1	3456	864	≥ 1
	3-20	8	12	16QAM	3/4	3496	24	1	4608	1152	≥ 1
	3-20	9	12	16QAM	3/4	3880	24	1	5184	1296	≥ 1
	3-20	10	12	16QAM	3/4	4264	24	1	5760	1440	≥ 1
	3-20	12	12	16QAM	3/4	5160	24	1	6912	1728	≥ 1
	5-20	15	12	16QAM	1/2	4264	24	1	8640	2160	≥ 1
	5-20	16	12	16QAM	1/2	4584	24	1	9216	2304	≥ 1
	5-20	18	12	16QAM	1/3	5160	24	1	10368	2592	≥ 1
	5-20	20	12	16QAM	1/3	4008	24	1	11520	2880	≥ 1
	5-20	24	12	16QAM	1/3	4776	24	1	13824	3456	≥ 1
	10-20	25	12	16QAM	1/3	4968	24	1	14400	3600	≥ 1
	10-20	27	12	16QAM	1/3	4776	24	1	15552	3888	≥ 1
	10-20	30	12	16QAM	3/4	12960	24	3	17280	4320	≥ 2
	10-20	32	12	16QAM	3/4	13536	24	3	18432	4608	≥ 2
	10-20	36	12	16QAM	3/4	15264	24	3	20736	5184	≥ 2
	10-20	40	12	16QAM	3/4	16992	24	3	23040	5760	≥ 2
	10-20	45	12	16QAM	3/4	19080	24	4	25920	6480	≥ 2
	10-20	48	12	16QAM	3/4	20616	24	4	27648	6912	≥ 2
	15 - 20	50	12	16QAM	3/4	21384	24	4	28800	7200	≥ 2
	15 - 20	54	12	16QAM	3/4	22920	24	4	31104	7776	≥ 2
	15 - 20	60	12	16QAM	2/3	23688	24	4	34560	8640	≥ 2
	15 - 20	64	12	16QAM	2/3	25456	24	4	36864	9216	≥ 2
	15 - 20	72	12	16QAM	1/2	20616	24	4	41472	10368	≥ 2
	20	75	12	16QAM	1/2	21384	24	4	43200	10800	≥ 2
	20	80	12	16QAM	1/2	22920	24	4	46080	11520	≥ 2
	20	81	12	16QAM	1/2	22920	24	4	46656	11664	≥ 2
	20	90	12	16QAM	2/5	20616	24	4	51840	12960	≥ 2
	20	96	12	16QAM	2/5	22152	24	4	55296	13824	≥ 2
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)											

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	≥ 1	≥ 1	≥ 1	≥ 1	≥ 1
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 2: As per Table 4.2-2 in TS 36.211 [4]							

A.2.3.1.2 16-QAM

Table A.2.3.1.2-1 Reference Channels for 16-QAM with full RB allocation

Parameter	Unit	Value					
Channel bandwidth	MHz	1.4	3	5	10	15	20
Allocated resource blocks		6	15	25	50	75	100
Uplink-Downlink Configuration (Note 2)		1	1	1	1	1	1
DFT-OFDM Symbols per Sub-Frame		12	12	12	12	12	12
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding rate		3/4	1/2	1/3	3/4	1/2	1/3
Payload size							
For Sub-Frame 2,3,7,8	Bits	2600	4264	4968	21384	21384	19848
Transport block CRC	Bits	24	24	24	24	24	24
Number of code blocks per Sub-Frame (Note 1)							
For Sub-Frame 2,3,7,8		1	1	1	4	4	4
Total number of bits per Sub-Frame							
For Sub-Frame 2,3,7,8	Bits	3456	8640	14400	28800	43200	57600
Total symbols per Sub-Frame							
For Sub-Frame 2,3,7,8		864	2160	3600	7200	10800	14400
UE Category		≥ 1	≥ 1	≥ 1	≥ 2	≥ 2	≥ 2
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 2: As per Table 4.2-2 in TS 36.211 [4]							

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 QPSK with partial RB allocation

Parameter	Ch BW	Allocated RBs	UDL Configuration (Note 2)	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size for Sub-Frame 2, 3, 7, 8	Transport block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8	Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8	UE Category
Unit	MHz						Bits	Bits		Bits		
	1.4 - 20	1	1	12	QPSK	1/3	72	24	1	288	144	≥ 1
	1.4 - 20	2	1	12	QPSK	1/3	176	24	1	576	288	≥ 1
	1.4 - 20	3	1	12	QPSK	1/3	256	24	1	864	432	≥ 1
	1.4 - 20	4	1	12	QPSK	1/3	392	24	1	1152	576	≥ 1
	1.4 - 20	5	1	12	QPSK	1/3	424	24	1	1440	720	≥ 1
	3-20	6	1	12	QPSK	1/3	600	24	1	1728	864	≥ 1
	3-20	8	1	12	QPSK	1/3	808	24	1	2304	1152	≥ 1
	3-20	9	1	12	QPSK	1/3	776	24	1	2592	1296	≥ 1
	3-20	10	1	12	QPSK	1/3	872	24	1	2880	1440	≥ 1
	3-20	12	1	12	QPSK	1/3	1224	24	1	3456	1728	≥ 1
	5-20	15	1	12	QPSK	1/3	1320	24	1	4320	2160	≥ 1
	5-20	16	1	12	QPSK	1/3	1384	24	1	4608	2304	≥ 1
	5-20	18	1	12	QPSK	1/3	1864	24	1	5184	2592	≥ 1
	5-20	20	1	12	QPSK	1/3	1736	24	1	5760	2880	≥ 1
	5-20	24	1	12	QPSK	1/3	2472	24	1	6912	3456	≥ 1
	10-20	25	1	12	QPSK	1/3	2216	24	1	7200	3600	≥ 1
	10-20	27	1	12	QPSK	1/3	2792	24	1	7776	3888	≥ 1
	10-20	30	1	12	QPSK	1/3	2664	24	1	8640	4320	≥ 1
	10-20	32	1	12	QPSK	1/3	2792	24	1	9216	4608	≥ 1
	10-20	36	1	12	QPSK	1/3	3752	24	1	10368	5184	≥ 1
	10-20	40	1	12	QPSK	1/3	4136	24	1	11520	5760	≥ 1
	10-20	45	1	12	QPSK	1/3	4008	24	1	12960	6480	≥ 1
	10-20	48	1	12	QPSK	1/3	4264	24	1	13824	6912	≥ 1
	15 - 20	50	1	12	QPSK	1/3	5160	24	1	14400	7200	≥ 1
	15 - 20	54	1	12	QPSK	1/3	4776	24	1	15552	7776	≥ 1
	15 - 20	60	1	12	QPSK	1/4	4264	24	1	17280	8640	≥ 1
	15 - 20	64	1	12	QPSK	1/4	4584	24	1	18432	9216	≥ 1
	15 - 20	72	1	12	QPSK	1/4	5160	24	1	20736	10368	≥ 1
	20	75	1	12	QPSK	1/5	4392	24	1	21600	10800	≥ 1
	20	80	1	12	QPSK	1/5	4776	24	1	23040	11520	≥ 1
	20	81	1	12	QPSK	1/5	4776	24	1	23328	11664	≥ 1
	20	90	1	12	QPSK	1/6	4008	24	1	25920	12960	≥ 1
	20	96	1	12	QPSK	1/6	4264	24	1	27648	13824	≥ 1

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 2: As per Table 4.2-2 in TS 36.211 [4]

A.2.3.2.2 16-QAM

Table A.2.3.2.2-1 Reference Channels for 16QAM with partial RB allocation

Parameter	Ch BW	Allocated RBs	UDL Configuration (Note 2)	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size for Sub-Frame 2, 3, 7, 8	Transport block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8	Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8	UE Category
Unit	MHz						Bits	Bits		Bits		
	1.4 - 20	1	1	12	16QAM	3/4	408	24	1	576	144	≥ 1
	1.4 - 20	2	1	12	16QAM	3/4	840	24	1	1152	288	≥ 1
	1.4 - 20	3	1	12	16QAM	3/4	1288	24	1	1728	432	≥ 1
	1.4 - 20	4	1	12	16QAM	3/4	1736	24	1	2304	576	≥ 1
	1.4 - 20	5	1	12	16QAM	3/4	2152	24	1	2880	720	≥ 1
	3-20	6	1	12	16QAM	3/4	2600	24	1	3456	864	≥ 1
	3-20	8	1	12	16QAM	3/4	3496	24	1	4608	1152	≥ 1
	3-20	9	1	12	16QAM	3/4	3880	24	1	5184	1296	≥ 1
	3-20	10	1	12	16QAM	3/4	4264	24	1	5760	1440	≥ 1
	3-20	12	1	12	16QAM	3/4	5160	24	1	6912	1728	≥ 1
	5-20	15	1	12	16QAM	1/2	4264	24	1	8640	2160	≥ 1
	5-20	16	1	12	16QAM	1/2	4584	24	1	9216	2304	≥ 1
	5-20	18	1	12	16QAM	1/2	5160	24	1	10368	2592	≥ 1
	5-20	20	1	12	16QAM	1/3	4008	24	1	11520	2880	≥ 1
	5-20	24	1	12	16QAM	1/3	4776	24	1	13824	3456	≥ 1
	10-20	25	1	12	16QAM	1/3	4968	24	1	14400	3600	≥ 1
	10-20	27	1	12	16QAM	1/3	4776	24	1	15552	3888	≥ 1
	10-20	30	1	12	16QAM	3/4	12960	24	3	17280	4320	≥ 2
	10-20	32	1	12	16QAM	3/4	13536	24	3	18432	4608	≥ 2
	10-20	36	1	12	16QAM	3/4	15264	24	3	20736	5184	≥ 2
	10-20	40	1	12	16QAM	3/4	16992	24	3	23040	5760	≥ 2
	10-20	45	1	12	16QAM	3/4	19080	24	4	25920	6480	≥ 2
	10-20	48	1	12	16QAM	3/4	20616	24	4	27648	6912	≥ 2
	15 - 20	50	1	12	16QAM	3/4	21384	24	4	28800	7200	≥ 2
	15 - 20	54	1	12	16QAM	3/4	22920	24	4	31104	7776	≥ 2
	15 - 20	60	1	12	16QAM	2/3	23688	24	4	34560	8640	≥ 2
	15 - 20	64	1	12	16QAM	2/3	25456	24	4	36864	9216	≥ 2
	15 - 20	72	1	12	16QAM	1/2	20616	24	4	41472	10368	≥ 2
	20	75	1	12	16QAM	1/2	21384	24	4	43200	10800	≥ 2
	20	80	1	12	16QAM	1/2	22920	24	4	46080	11520	≥ 2
	20	81	1	12	16QAM	1/2	22920	24	4	46656	11664	≥ 2
	20	90	1	12	16QAM	2/5	20616	24	4	51840	12960	≥ 2
	20	96	1	12	16QAM	2/5	22152	24	4	55296	13824	≥ 2

Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 2: As per Table 4.2-2 in TS 36.211 [4]

A.2.3.2.3 64-QAM

[FFS]

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,

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

   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.3.1.1 Overview of DL reference measurement channels

In Table A.3.1.1-1 are listed the DL reference measurement channels specified in annexes A.3.2 to A.3.9 of this release of TS 36.101. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for requirements are annexes A.3.2 to A.3.7 as appropriate.

Table A.3.1.1-1: Overview of DL reference measurement channels

Duplex	Table	Name	BW	Mod	TCR	RB	RB Off set	UE Cat eg	Notes
FDD, Receiver requirements									
FDD	Table A.3.2-1		1.4	QPSK	1/3	6		≥ 1	
FDD	Table A.3.2-1		3	QPSK	1/3	15		≥ 1	
FDD	Table A.3.2-1		5	QPSK	1/3	25		≥ 1	
FDD	Table A.3.2-1		10	QPSK	1/3	50		≥ 1	
FDD	Table A.3.2-1		15	QPSK	1/3	75		≥ 1	
FDD	Table A.3.2-1		20	QPSK	1/3	100		≥ 1	
TDD, Receiver requirements									
TDD	Table A.3.2-2		1.4	QPSK	1/3	6		≥ 1	
TDD	Table A.3.2-2		3	QPSK	1/3	15		≥ 1	
TDD	Table A.3.2-2		5	QPSK	1/3	25		≥ 1	
TDD	Table A.3.2-2		10	QPSK	1/3	50		≥ 1	
TDD	Table A.3.2-2		15	QPSK	1/3	75		≥ 1	
TDD	Table A.3.2-2		20	QPSK	1/3	100		≥ 1	
FDD, Receiver requirements, Maximum input level for UE Categories 3-5									
FDD	Table A.3.2-3		1.4	64QAM	3/4	6		-	
FDD	Table A.3.2-3		3	64QAM	3/4	15		-	
FDD	Table A.3.2-3		5	64QAM	3/4	25		-	
FDD	Table A.3.2-3		10	64QAM	3/4	50		-	
FDD	Table A.3.2-3		15	64QAM	3/4	75		-	
FDD	Table A.3.2-3		20	64QAM	3/4	100		-	
FDD, Receiver requirements, Maximum input level for UE Categories 1									
FDD	Table A.3.2-3a		1.4	64QAM	3/4	6		-	
FDD	Table A.3.2-3a		3	64QAM	3/4	15		-	
FDD	Table A.3.2-3a		5	64QAM	3/4	18		-	
FDD	Table A.3.2-3a		10	64QAM	3/4	17		-	
FDD	Table A.3.2-3a		15	64QAM	3/4	17		-	
FDD	Table A.3.2-3a		20	64QAM	3/4	17		-	
FDD, Receiver requirements, Maximum input level for UE Categories 2									
FDD	Table A.3.2-3b		1.4	64QAM	3/4	6		-	
FDD	Table A.3.2-3b		3	64QAM	3/4	15		-	
FDD	Table A.3.2-3b		5	64QAM	3/4	25		-	
FDD	Table A.3.2-3b		10	64QAM	3/4	50		-	
FDD	Table A.3.2-3b		15	64QAM	3/4	75		-	
FDD	Table A.3.2-3b		20	64QAM	3/4	83		-	
TDD, Receiver requirements, Maximum input level for UE Categories 3-5									
TDD	Table A.3.2-4		1.4	64QAM	3/4	6		-	
TDD	Table A.3.2-4		3	64QAM	3/4	15		-	
TDD	Table A.3.2-4		5	64QAM	3/4	25		-	
TDD	Table A.3.2-4		10	64QAM	3/4	50		-	
TDD	Table A.3.2-4		15	64QAM	3/4	75		-	
TDD	Table A.3.2-4		20	64QAM	3/4	100		-	
TDD, Receiver requirements, Maximum input level for UE Categories 1									
TDD	Table A.3.2-4a		1.4	64QAM	3/4	6		-	
TDD	Table A.3.2-4a		3	64QAM	3/4	15		-	
TDD	Table A.3.2-4a		5	64QAM	3/4	18		-	

TDD	Table A.3.2-4a		10	64QAM	3/4	17		-	
TDD	Table A.3.2-4a		15	64QAM	3/4	17		-	
TDD	Table A.3.2-4a		20	64QAM	3/4	17		-	
TDD, Receiver requirements, Maximum input level for UE Categories 2									
TDD	Table A.3.2-4b		1.4	64QAM	3/4	6		-	
TDD	Table A.3.2-4b		3	64QAM	3/4	15		-	
TDD	Table A.3.2-4b		5	64QAM	3/4	25		-	
TDD	Table A.3.2-4b		10	64QAM	3/4	50		-	
TDD	Table A.3.2-4b		15	64QAM	3/4	75		-	
TDD	Table A.3.2-4b		20	64QAM	3/4	83		-	
FDD, PDSCH Performance, Single-antenna transmission (CRS)									
FDD	Table A.3.3.1-1	R.4 FDD	1.4	QPSK	1/3	6		≥ 1	
FDD	Table A.3.3.1-1	R.2 FDD	10	QPSK	1/3	50		≥ 1	
FDD	Table A.3.3.1-2	R.3 FDD	10	16QAM	1/2	50		≥ 2	
FDD	Table A.3.3.1-3	R.5 FDD	3	64QAM	3/4	15		≥ 1	
FDD	Table A.3.3.1-3	R.6 FDD	5	64QAM	3/4	25		≥ 2	
FDD	Table A.3.3.1-3	R.7 FDD	10	64QAM	3/4	50		≥ 2	
FDD	Table A.3.3.1-3	R.8 FDD	15	64QAM	3/4	75		≥ 2	
FDD	Table A.3.3.1-3	R.9 FDD	20	64QAM	3/4	100		≥ 3	
FDD, PDSCH Performance, Single-antenna transmission (CRS), Single PRB (Channel edge)									
FDD	Table A.3.3.1-4	R.0 FDD	3	16QAM	1/2	1		≥ 1	
FDD	Table A.3.3.1-4	R.1 FDD	10 / 20	16QAM	1/2	1		≥ 1	
FDD, PDSCH Performance, Single-antenna transmission (CRS), Single PRB (MBSFN Configuration)									
FDD	Table A.3.3.1-5	R.29 FDD	10	16QAM	1/2	1		≥ 1	
FDD, PDSCH Performance, Multi-antenna transmission (CRS), Two antenna ports									
FDD	Table A.3.3.2.1-1	R.10 FDD	10	QPSK	1/3	50		≥ 1	
FDD	Table A.3.3.2.1-1	R.11 FDD	10	16QAM	1/2	50		≥ 2	
FDD	Table A.3.3.2.1-1	R.30 FDD	20	16QAM	1/2	100		≥ 2	
FDD, PDSCH Performance, Multi-antenna transmission (CRS), Four antenna ports									
FDD	Table A.3.3.2.2-1	R.12 FDD	1.4	QPSK	1/3	6		≥ 1	
FDD	Table A.3.3.2.2-1	R.13 FDD	10	QPSK	1/3	50		≥ 1	
FDD	Table A.3.3.2.2-1	R.14 FDD	10	16QAM	1/2	50		≥ 2	
TDD, PDSCH Performance, Single-antenna transmission (CRS)									
TDD	Table A.3.4.1-1	R.4 TDD	1.4	QPSK	1/3	6		≥ 1	
TDD	Table A.3.4.1-1	R.2 TDD	10	QPSK	1/3	50		≥ 1	
TDD	Table A.3.4.1-2	R.3 TDD	10	16QAM	1/2	50		≥ 2	
TDD	Table A.3.4.1-3	R.5 TDD	3	64QAM	3/4	15		≥ 1	
TDD	Table A.3.4.1-3	R.6 TDD	5	64QAM	3/4	25		≥ 2	
TDD	Table A.3.4.1-3	R.7 TDD	10	64QAM	3/4	50		≥ 2	
TDD	Table A.3.4.1-3	R.8 TDD	15	64QAM	3/4	75		≥ 2	
TDD	Table A.3.4.1-3	R.9 TDD	20	64QAM	3/4	100		≥ 3	
TDD, PDSCH Performance, Single-antenna transmission (CRS), Single PRB (Channel edge)									
TDD	Table A.3.4.1-4	R.0 TDD	3	16QAM	1/2	1		≥ 1	
TDD	Table A.3.4.1-4	R.1 TDD	10 / 20	16QAM	1/2	1		≥ 1	
TDD, PDSCH Performance, Single-antenna transmission (CRS), Single PRB (MBSFN Configuration)									
TDD	Table A.3.4.1-5	R.29 TDD	10	16QAM	1/2	1		≥ 1	
TDD, PDSCH Performance, Multi-antenna transmission (CRS), Two antenna ports									

TDD	Table A.3.4.2.1-1	R.10 TDD	10	QPSK	1/3	50		≥ 1	
TDD	Table A.3.4.2.1-1	R.11 TDD	10	16QAM	1/2	50		≥ 2	
TDD	Table A.3.4.2.1-1	R.11-1 TDD	10	16QAM	1/2	50		≥ 2	
TDD	Table A.3.4.2.1-1	R.30 TDD	20	16QAM	1/2	100		≥ 2	
TDD, PDSCH Performance, Multi-antenna transmission (CRS), Four antenna ports									
TDD	Table A.3.4.2.2-1	R.12 TDD	1.4	QPSK	1/3	6		≥ 1	
TDD	Table A.3.4.2.2-1	R.13 TDD	10	QPSK	1/3	50		≥ 1	
TDD	Table A.3.4.2.2-1	R.14 TDD	10	16QAM	1/2	50		≥ 2	
TDD, PDSCH Performance, Single antenna port (DRS)									
TDD	Table A.3.4.3.1-1	R.25 TDD	10	QPSK	1/3	50		≥ 1	
TDD	Table A.3.4.3.1-1	R.26 TDD	10	16QAM	1/2	50		≥ 2	
TDD	Table A.3.4.3.1-1	R.27 TDD	10	64QAM	3/4	50		≥ 2	
TDD	Table A.3.4.3.1-1	R.28 TDD	10	16QAM	1/2	1		≥ 1	
FDD, PDCCH / PCFICH Performance									
FDD	Table A.3.5.1-1	R.15 FDD	10	PDCCH					
FDD	Table A.3.5.1-1	R.16 FDD	1.4	PDCCH					
FDD	Table A.3.5.1-1	R.17 FDD	10	PDCCH					
TDD, PDCCH / PCFICH Performance									
TDD	Table A.3.5.2-1	R.15 TDD	10	PDCCH					
TDD	Table A.3.5.2-1	R.16 TDD	1.4	PDCCH					
TDD	Table A.3.5.2-1	R.17 TDD	10	PDCCH					
FDD / TDD, PHICH Performance									
FDD / TDD	Table A.3.6-1	R.18	10	PHICH					
FDD / TDD	Table A.3.6-1	R.19A	1.4	PHICH					
FDD / TDD	Table A.3.6-1	R.20A	10	PHICH					
FDD / TDD	Table A.3.6-1	R.24	10	PHICH					
FDD / TDD, PBCH Performance									
FDD / TDD	Table A.3.7-1	R.21	1.4	QPSK	40/ 1920				
FDD / TDD	Table A.3.7-1	R.22	1.4	QPSK	40/ 1920				
FDD / TDD	Table A.3.7-1	R.23	1.4	QPSK	40/ 1920				

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					
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	1143.2	1952.8	3952.8	6040.8	7884
UE Category		≥ 1	≥ 1	≥ 1	≥ 1	≥ 1	≥ 1

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz

Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]

Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.3.2-2 Fixed Reference Channel for Receiver Requirements (TDD)

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 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	≥ 1	≥ 1	≥ 1	≥ 1	≥ 1

Note 1: For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs.
Note 2: For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance
Note 3: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: As per Table 4.2-2 in TS 36.211 [4]

Table A.3.2-3 Fixed Reference Channel for Maximum input level for UE Categories 3-5 (FDD)

Parameter	Unit	Value					
Channel bandwidth	MHz	1.4	3	5	10	15	20
Allocated resource blocks		6	15	25	50	75	100
Subcarriers per resource block		12	12	12	12	12	12
Allocated subframes per Radio Frame		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					
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					
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	51024
Transport block CRC	Bits	24	24	24	24	24	24
Number of Code Blocks per Sub-Frame (Note 3)							
For Sub-Frames 1,2,3,4,6,7,8,9		1	2	3	5	8	9
For Sub-Frame 5		n/a	n/a	n/a	n/a	n/a	n/a
For Sub-Frame 0		n/a	2	3	5	8	9
Binary Channel Bits Per Sub-Frame							
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	4104	11340	18900	41400	62100	68724
For Sub-Frame 5	Bits	n/a	n/a	n/a	n/a	n/a	n/a
For Sub-Frame 0	Bits	n/a	8820	16380	38880	59580	66204
Max. Throughput averaged over 1 frame	kbps	2387.2	7448.8	12547	27294	42046	45922
Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4] Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)							

Table A.3.2-4 Fixed Reference Channel for Maximum input level for UE Categories 3-5 (TDD)

Parameter	Unit	Value					
Channel bandwidth	MHz	1.4	3	5	10	15	20
Allocated resource blocks		6	15	25	50	75	100
Subcarriers per resource block		12	12	12	12	12	12
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	2	4	6	8
For Sub-Frame 5		n/a	n/a	n/a	n/a	n/a	n/a
For Sub-Frame 0		n/a	2	3	5	8	11
Binary Channel Bits per Sub-Frame							
For Sub-Frames 4,9	Bits	4104	11340	18900	41400	62100	82800
For Sub-Frames 1,6		n/a	9828	16668	33768	50868	67968
For Sub-Frame 5	Bits	n/a	n/a	n/a	n/a	n/a	n/a
For Sub-Frame 0	Bits	n/a	9252	16812	39312	60012	80712
Max. Throughput averaged over 1 frame	kbps	596.8	3791.2	6369.6	13910	20945	27877

Note 1: For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs.

Note 2: For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance

Note 3: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 5: As per Table 4.2-2 in TS 36.211 [4]

Table A.3.2-4a Fixed Reference Channel for Maximum input level for UE Category 1 (TDD)

Parameter	Unit	Value					
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					
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	9
Binary Channel Bits per Sub-Frame							
For Sub-Frames 4,9	Bits	4104	11340	18900	41400	62100	68724
For Sub-Frames 1,6		n/a	9828	16668	33768	50868	56340
For Sub-Frame 5	Bits	n/a	n/a	n/a	n/a	n/a	n/a
For Sub-Frame 0	Bits	n/a	9252	16380	39312	60012	66636
Max. Throughput averaged over 1 frame	kbps	596.8	3791.2	6369.6	13910	20945	23154

Note 1: For normal subframes(0,4,5,9), 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For special subframe (1&6), only 2 OFDM symbols are allocated to PDCCH for all BWs.

Note 2: For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance

Note 3: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4]

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Note 5: As per Table 4.2-2 in TS 36.211 [4]

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					
Reference channel		R.4 FDD			R.2 FDD		
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			≥ 1		
Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz 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					
Reference channel					R.3 FDD		
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		
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.3.3.1-3: Fixed Reference Channel 64QAM R=3/4

Parameter	Unit	Value					
Reference channel			R.5 FDD	R.6 FDD	R.7 FDD	R.8 FDD	R.9 FDD
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	≥ 2	≥ 2	≥ 2	≥ 3
Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz 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.3.3.1-4: Fixed Reference Channel Single PRB (Channel Edge)

Parameter	Unit	Value					
Reference channel			R.0 FDD		R.1 FDD		
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 (Note 3)							
For Sub-Frames 1,2,3,4,6,7,8,9			1		1		
For Sub-Frame 5			n/a		n/a		
For Sub-Frame 0			1		1		
Binary Channel Bits Per Sub-Frame							
For Sub-Frames 1,2,3,4,6,7,8,9	Bits		504		552		
For Sub-Frame 5	Bits		n/a		n/a		
For Sub-Frame 0	Bits		504		552		
Max. Throughput averaged over 1 frame	Mbps		0.202		0.230		
UE Category			≥ 1		≥ 1		

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 (Note 4)		111111
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
Note 1: 2 symbols allocated to PDCCH Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 4: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation		

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					
Reference channel			R.10 FDD	R.11 FDD			R.30 FDD
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 (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	≥ 2			≥ 2
Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)							

A.3.3.2.2 Four antenna ports

Table A.3.3.2.2-1: Fixed Reference Channel four antenna ports

Parameter	Unit	Value					
Reference channel		R.12 FDD	R.13 FDD	R.14 FDD			
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	≥ 1	≥ 2			
Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz 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					
Reference channel		R.4 TDD			R.2 TDD		
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			≥ 1		

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: For BW=1.4 MHz, the information bit payloads of special subframes are set to zero (no scheduling) to avoid problems with insufficient PDCCH performance at the test point.
Note 3: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 4: As per Table 4.2-2 in TS 36.211 [4]
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

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

Parameter	Unit	Value					
Reference channel					R.3 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		

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					
Reference channel			R.5 TDD	R.6 TDD	R.7 TDD	R.8 TDD	R.9 TDD
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	≥ 2	≥ 2	≥ 2	≥ 3

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3: As per Table 4.2-2 TS 36.211 [4]
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.3.4.1-4: Fixed Reference Channel Single PRB

Parameter	Unit	Value					
Reference channel			R.0 TDD		R.1 TDD		
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		≥ 1		

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3: As per Table 4.2-2 in TS 36.211 [4]
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.3.4.1-5: Fixed Reference Channel Single PRB (MBSFN Configuration)

Parameter	Unit	Value
Reference channel		R.29 TDD (MBSFN)
Channel bandwidth	MHz	10
Allocated resource blocks		1
MBSFN Configuration (Note 5)		[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) Note 5: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation		

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					
Reference channel			R.10 TDD	R.11 TDD	[R.11-1 TDD]		R.30 TDD
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	≥ 2	≥ 2		≥ 2

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: 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					
Reference channel		R.12 TDD	R.13 TDD	R.14 TDD			
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	≥ 1	≥ 2			

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: 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			
Reference channel		R.25 TDD	R.26 TDD	R.27 TDD	R.28 TDD
Channel bandwidth	MHz	10	10	10	10
Allocated resource blocks		50 [4]	50 [4]	50 [4]	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	≥ 2	≥ 2	≥ 1

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3: as per Table 4.2-2 in TS 36.211 [4]
Note 4: For R.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		
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		
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			
Reference channel		R.18	R.19A	R.20A	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]	[+3 0]
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). 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		
Reference channel		R.21	R.22	R.23
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 status information (Clause 9.2, 9.3 and 9.5).

In Table A.4-1 are specified the reference channels. Table A.4-7 specifies the mapping of CQI index to modulation coding scheme, which complies with the CQI definition specified in Section 7.2.3 of [6].

Table A.4-0: Void

Table A.4-1: CSI reference measurement channels

RMC Name	Duplex	CH-BW	Alloc. RB-s	UL/DL Config	Alloc. SF-s	MCS Scheme	Nr. HARQ Proc.	Max. nr HARQ Trans.	Notes
1 CRS Port									
RC.1 FDD	FDD	10	50	-		MCS.1	8	1	
RC.1 TDD	TDD	10	50	Note 3		MCS.1	10	1	
RC.3 FDD	FDD	10	6	-		MCS.10	8	1	
RC.3 TDD	TDD	10	6	Note 3		MCS.10	10	1	
2 CRS Ports									
RC.2 FDD	FDD	10	50	-		MCS.2	8	1	
RC.2 TDD	TDD	10	50	Note 3		MCS.2	10	1	
Note 1: 3 symbols allocated to PDCCH. Note 2: For FDD only subframes 1, 2, 3, 4, 6, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead. Note 3: TDD UL-DL configuration as specified in the individual tests. Note 4: For TDD when UL-DL configuration 1 is used only subframes 4 and 9 are allocated to avoide PBCH and synchronizaiton signal overhead. Note 5: For TDD when UL-DL configuration 2 is used only subframes 3, 4, 8, and 9 are allocated to avoid PBCH and synchronization signal overhead.									

Table A.4-2: Void

Table A.4-3: Void

Table A.4-3a: Void

Table A.4-4: Void

Table A.4-5: Void

Table A.4-6: Void

Table A.4-7: Mapping of CQI Index to Modulation coding scheme (MCS)

CQI Index			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Notes
Target Coding Rate			OOR	0.0762	0.1172	0.1885	0.3008	0.4385	0.5879	0.3691	0.4785	0.6016	0.4551	0.5537	0.6504	0.7539	0.8525	0.9258	
Modulation			OOR	QPSK						16QAM			64QAM						
MCS Scheme	**PRB**	**Available RE-s**	**Imcs**																
MCS.1	50	6300	DTX	0	0	2	4	6	8	11	13	16	18	21	23	25	27	27	
MCS.2	50	6000	DTX	0	0	2	4	6	8	11	13	15	18	20	22	24	26	27	
MCS.3	50	5700	DTX	0	0	2	4	6	8	10	13	15	17	19	21	23	25	26	
MCS.4	50	5600	DTX	0	0	2	4	6	7	10	12	14	17	19	21	23	25	26	
MCS.5	50	5400	DTX	0	0	2	3	5	7	10	12	14	17	19	21	23	24	25	
MCS.6	50	5300	DTX	0	0	1	3	5	7	10	12	14	17	19	21	22	24	25	
MCS.7	50	5200	DTX	0	0	1	3	5	7	10	12	14	17	18	20	22	24	25	
MCS.8	50	5000	DTX	0	0	1	3	5	7	10	12	13	17	18	20	22	23	24	
MCS.9	50	4800	DTX	0	0	1	3	5	7	10	12	13	17	18	20	22	23	24	
MCS.10	6	756	DTX	0	0	2	4	6	8	11	13	16	19	21	23	25	27	27	
MCS.11	6	684	DTX	0	0	2	4	6	8	11	13	14	17	20	21	23	25	27	
MCS.12	6	672	DTX	0	0	1	4	6	8	10	12	14	17	19	21	23	25	26	
MCS.13	6	648	DTX	0	0	2	4	6	8	11	13	15	18	20	22	24	26	27	
MCS.14	25	3150	DTX	0	0	2	4	6	8	11	13	16	18	21	23	25	27	27	
MCS.15	15	1890	DTX	0	0	2	4	6	8	11	13	16	18	21	23	25	27	27	
MCS.16	15	1800	DTX	0	0	2	4	6	8	11	13	15	18	20	22	24	26	27	
MCS.17	3	378	DTX	0	1	2	5	7	9	12	13	16	19	21	23	25	27	27	

Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6].
Note 2: 3 symbols allocated to PDCCH.
Note 3: Sub-frame#0 and #5 are not used for the corresponding requirement. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test). 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 (γ) 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 γ_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 γ 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 γ_{PRB} [dB]			**PDSCH Data**
Subframe			
0	5	1 – 4, 6 – 9	
Allocation			
First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	First unallocated PRB – 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 γ_{PRB} is used to scale the power of PDSCH. Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter γ_{PRB} applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.			

A.5.1.2 OCNG FDD pattern 2: Two sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB $N_{RB}-1$.

Table A.5.1.2-1: OP.2 FDD: Two sided dynamic OCNG FDD Pattern

Relative power level γ_{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 γ_{PRB} is used to scale the power of PDSCH.

Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter γ_{PRB} applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.

A.5.1.3 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 γ_{PRB} [dB]				PDSCH Data	PMCH Data
	Subframe					
	0	5	4, 9	1 – 3, 6 – 8		

1 – 49	0	0 (Allocation: all empty PRB-s)	0	N/A	Note 1	N/A
0 – 49	N/A	N/A	N/A	0	N/A	Note 2
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 γ_{PRB} is used to scale the power of PDSCH. 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 γ_{PRB} is used to scale the power of PMCH. Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. N/A: Not Applicable						

A.5.2 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 (γ) 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 γ_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 γ 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 γ_{PRB} [dB]				**PDSCH Data**
Subframe (only if available for DL)				
0	5	3, 4, 7, 8, 9 and 6 (as normal subframe) Note 2	1 and 6 (as special subframe) Note 2	
Allocation				
First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	
0	0	0	0	**Note 1**
Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter γ_{PRB} is used to scale the power of PDSCH. Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211 Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter γ_{PRB} applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.				

A.5.2.2 OCNG TDD pattern 2: Two sided dynamic OCNG TDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the subframes available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB $N_{RB}-1$.

Table A.5.2.2-1: OP.2 TDD: Two sided dynamic OCNG TDD Pattern

Relative power level γ_{PRB} [dB]				**PDSCH Data**
Subframe (only if available for DL)				
0	5	3, 4, 6, 7, 8, 9 (6 as normal subframe) Note 2	1,6 (6 as special subframe) Note 2	
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 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$)	
[0]	[0]	[0]	[0]	Note 1
Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter γ_{PRB} is used to scale the power of PDSCH. Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211 Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter γ_{PRB} applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.				

A.5.2.3 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 n_{PRB}	**Relative power level** γ_{PRB} **[dB]**				**PDSCH Data**	**PMCH Data**
	Subframe					
	0	5	4, 9[Note 2]	1, 6		
1 – 49	0	0 (Allocation: all empty PRB-s)	N/A	0	Note 1	**N/A**
0 – 49	N/A	N/A	0	N/A	N/A	**Note 3**

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 γ_{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

Annex B (normative): Propagation conditions

B.1 Static propagation condition

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

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

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum, that is characterized by a classical spectrum shape and a maximum Doppler frequency
- A set of correlation matrices defining the correlation between the UE and eNodeB antennas in case of multi-antenna systems.
- Additional multi-path models used for CQI (Channel Quality Indication) tests

B.2.1 Delay profiles

The delay profiles are selected to be representative of low, medium and high delay spread environments. The resulting model parameters are defined in Table B.2.1-1 and the tapped delay line models are defined in Tables B.2.1-2, B.2.1-3 and B.2.1-4.

Table B.2.1-1 Delay profiles for E-UTRA channel models

Model	Number of channel taps	Delay spread (r.m.s.)	Maximum excess tap delay (span)
Extended Pedestrian A (EPA)	7	43 ns	410 ns
Extended Vehicular A model (EVA)	9	357 ns	2510 ns
Extended Typical Urban model (ETU)	9	991 ns	5000 ns

Table B.2.1-2 Extended Pedestrian A model (EPA)

Excess tap delay [ns]	Relative power [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 [ns]	Relative power [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 [ns]	Relative power [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

eNode B Correlation	$R_{eNB} = 1$	$R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \mathbf{1} \end{pmatrix}$	$R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9^*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9^*} & \alpha^{1/9^*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9^*} & \alpha^{1/9^*} & 1 \end{pmatrix}$

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

Table B.2.3.1-3 defines the channel spatial correlation matrix R_{spat}. The parameters, α and β 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

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

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 α and β 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	
α	β	α	β	α	β
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:

$$\mathbf{R}_{high} = [\mathbf{R}_{spatial} + aI_n]/(1+a)$$

Where the value “a” is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 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

1x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$
2x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$
4x2 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8999 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$
4x4 case	$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

2 e	N/A
2 e	$R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$

2 e	$R_{medium} = \begin{pmatrix} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{pmatrix}$
4 e	$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

1x2 case	$R_{low} = \mathbf{I}_2$
2x2 case	$R_{low} = \mathbf{I}_4$
4x2 case	$R_{low} = \mathbf{I}_8$
4x4 case	$R_{low} = \mathbf{I}_{16}$

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,τ) representation, with τ_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

$$f_s(t) = f_d \cos\theta(t) \qquad \text{(B.3.1)}$$

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

$$\cos\theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}{}^2 + (D_s/2 - vt)^2}}\,,\ 0 \le t \le D_s/v \qquad \text{(B.3.2)}$$

$$\cos\theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}{}^2 + (-1.5D_s + vt)^2}}\,,\ D_s/v < t \le 2D_s/v \qquad \text{(B.3.3)}$$

$$\cos\theta(t) = \cos\theta(t \mod (2D_s/v))\,,\ t > 2D_s/v \qquad \text{(B.3.4)}$$

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.

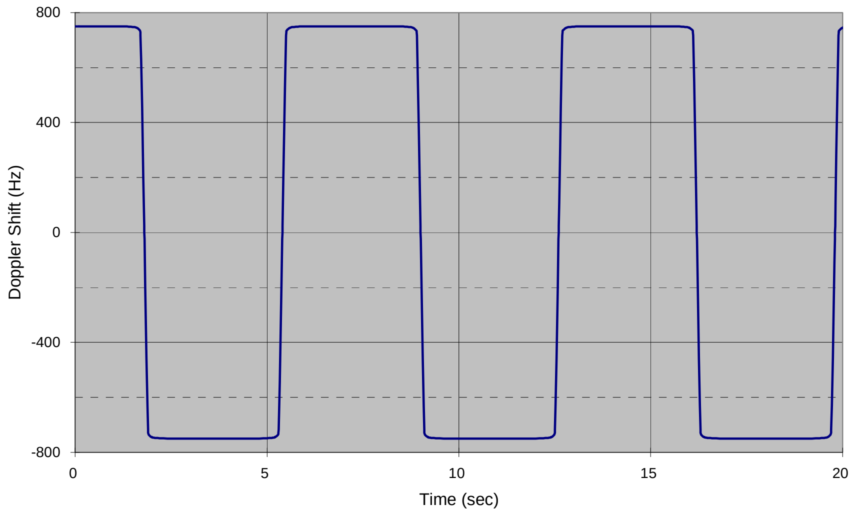

Figure B.3-1: Doppler shift trajectory

For 1x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx.

For 2x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx with phase shift according to $\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}$.

B.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 2×1 randomly selected from Table 6.3.4.2.3-1 in [4] as the beamforming weight. This precoder takes as an input the signal $y^{(p)}(i)$, $i = 0,1,...,M_{\mathrm{symb}}^{\mathrm{ap}} - 1$, for antenna port $p = 5$, with $M_{\mathrm{symb}}^{\mathrm{ap}}$ the number of modulation symbols including the user-specific reference symbols (DRS), and generates a block of signals $y_{bf}(i) = \begin{bmatrix} y_{bf}(i) & \tilde{y}_{bf}(i) \end{bmatrix}^T$ 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 = $\rho_A + \sigma$
	PBCH_RB = $\rho_B + \sigma$
PSS	PSS_RA = 0 dB (Note 2)
SSS	SSS_RA = 0 dB (Note 2)
PCFICH	PCFICH_RB = $\rho_B + \sigma$
PDCCH	PDCCH_RA = $\rho_A + \sigma$
	PDCCH_RB = $\rho_B + \sigma$
PDSCH	PDSCH_RA = ρ_A
	PDSCH_RB = ρ_B
OCNG	OCNG_RA = $\rho_A + \sigma$
	OCNG_RB = $\rho_B + \sigma$

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

NOTE 2: Assuming PSS and SSS transmitted on a single antenna port.

NOTE 3: ρ_A, ρ_B and σ are test specific.

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*

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**
$BW_{Interferer}$	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 Lithium Mercury/nickel & cadmium	 0,85 * nominal 0,95 * nominal 0,90 * nominal	 Nominal 1,1 * Nominal	 Nominal 1,1 * 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

Frequency	ASD (Acceleration Spectral Density) random vibration
5 Hz to 20 Hz	0,96 m^2/s^3
20 Hz to 500 Hz	0,96 m^2/s^3 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).

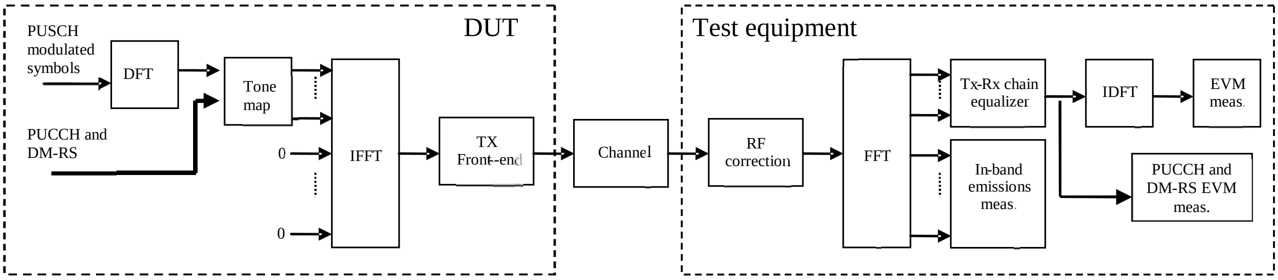

Figure F.1-1: EVM measurement points

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)

$$EVM = \sqrt{\frac{\sum_{v \in T_m} \left| z'(v) - i(v) \right|^2}{|T_m| \cdot P_0}},$$

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

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

where

T_s is a set of $|T_s|$ SC-FDMA symbols with the considered modulation scheme being active within the measurement period,

Δ_{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

$$Emissions_{relative}(\Delta_{RB}) = \frac{Emissions_{absolute}(\Delta_{RB})}{\dfrac{1}{|T_s| \cdot N_{RB}} \sum_{t \in T_s} \sum_{f_l}^{f_l + (12\cdot N_{RB}-1)\Delta f} |Y(t,f)|^2}$$

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::

$$Z'(t,f) = IDFT\left\{\frac{FFT\left\{z(v-\Delta\tilde{t})\cdot e^{-j2\pi\Delta\tilde{f}v}\right\}\cdot e^{j2\pi f\Delta\tilde{t}}}{\tilde{a}(t,f)\cdot e^{j\tilde{\varphi}(t,f)}}\right\}$$

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:

$$Z'(t,f) = \frac{FFT\left\{z(v-\Delta\tilde{t})\cdot e^{-j2\pi\Delta\tilde{f}v}\right\}\cdot e^{j2\pi f\Delta\tilde{t}}}{\tilde{a}(t,f)\cdot e^{j\tilde{\varphi}(t,f)}}$$

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 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 seleted 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 coefficient 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 $\mathrm{EVM_l}$ with $\Delta\tilde{t}$ set to $\Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$,

- calculate $\mathrm{EVM_h}$ 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[1] N_{cp} for symbol 0	Cyclic prefix length[1] 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 [2]
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[1] N_{cp}	Nominal FFT size	Cyclic prefix in FFT samples	EVM window length *W* in FFT samples	Ratio of *W* to CP [2]
1.4	512	128	32	28	87.5
3		256	64	58	90.6
5		512	128	124	96.9
10		1024	256	250	97.4
15		1536	384	374	97.4
20		2048	512	504	98.4
Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed. Note 2: These percentages are informative					

F.5. 5 Window length for PRACH

The table below specifies the EVM window length for PRACH preamble formats 0-4.

Table F.5.5-1 EVM window length for PRACH

Preamble format	Cyclic prefix length[1] N_{cp}	Nominal FFT size[2]	EVM window length *W* in FFT samples	Ratio of *W* to CP*
0	3168	24576	3072	96.7%
1	21024	24576	20928	99.5%
2	6240	49152	6144	98.5%
3	21024	49152	20928	99.5%
4	448	4096	432	96.4%
Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed Note 2: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied Note 3: These percentages are informative				

F.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 $\overline{\mathrm{EVM}}_{\mathrm{l}}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_l$ in the expressions above and $\overline{\mathrm{EVM}}_{\mathrm{h}}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_h$.

Thus we get:

$$EVM = \max(\overline{\mathrm{EVM}}_{\mathrm{l}}, \overline{\mathrm{EVM}}_h)$$

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 $\overline{\mathrm{EVM}}_{\mathrm{l}} > \overline{\mathrm{EVM}}_{\mathrm{h}}$, and it is set to $\Delta\tilde{t} = \Delta\tilde{t}_h$ otherwise, where $\overline{\mathrm{EVM}}_{\mathrm{l}}$ and $\overline{\mathrm{EVM}}_{\mathrm{h}}$ 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 $\overline{\mathrm{EVM}}_{\mathrm{PRACH,l}}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_l$ and $\overline{\mathrm{EVM}}_{\mathrm{PRACH,h}}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_h$.

Thus we get:

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

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	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	8.0.0
03-2008	RP#39	RP-080123	3			TS36.101 - Combined updates of E-UTRA UE requirements	8.1.0
05-2008	RP#40	RP-080325	4			TS36.101 - Combined updates of E-UTRA UE requirements	8.2.0
09-2008	RP#41	RP-080638	5r1			Addition of Ref Sens figures for 1.4MHz and 3MHz Channel bandwiidths	8.3.0
09-2008	RP#41	RP-080638	7r1			Transmitter intermodulation requirements	8.3.0
09-2008	RP#41	RP-080638	10			CR for clarification of additional spurious emission requirement	8.3.0
09-2008	RP#41	RP-080638	15			Correction of In-band Blocking Requirement	8.3.0
09-2008	RP#41	RP-080638	18r1			TS36.101: CR for section 6: NS_06	8.3.0
09-2008	RP#41	RP-080638	19r1			TS36.101: CR for section 6: Tx modulation	8.3.0
09-2008	RP#41	RP-080638	20r1			TS36.101: CR for UE minimum power	8.3.0
09-2008	RP#41	RP-080638	21r1			TS36.101: CR for UE OFF power	8.3.0
09-2008	RP#41	RP-080638	24r1			TS36.101: CR for section 7: Band 13 Rx sensitivity	8.3.0
09-2008	RP#41	RP-080638	26			UE EVM Windowing	8.3.0
09-2008	RP#41	RP-080638	29			Absolute ACLR limit	8.3.0
09-2008	RP#41	RP-080731	23r2			TS36.101: CR for section 6: UE to UE co-existence	8.3.0
09-2008	RP#41	RP-080731	30			Removal of [ ] for UE Ref Sens figures	8.3.0
09-2008	RP#41	RP-080731	31			Correction of PA, PB definition to align with RAN1 specification	8.3.0
09-2008	RP#41	RP-080731	37r2			UE Spurious emission band UE co-existence	8.3.0
09-2008	RP#41	RP-080731	44			Definition of specified bandwidths	8.3.0
09-2008	RP#41	RP-080731	48r3			Addition of Band 17	8.3.0
09-2008	RP#41	RP-080731	50			Alignment of the UE ACS requirement	8.3.0
09-2008	RP#41	RP-080731	52r1			Frequency range for Band 12	8.3.0
09-2008	RP#41	RP-080731	54r1			Absolute power tolerance for LTE UE power control	8.3.0
09-2008	RP#41	RP-080731	55			TS36.101 section 6: Tx modulation	8.3.0
09-2008	RP#41	RP-080732	6r2			DL FRC definition for UE Receiver tests	8.3.0
09-2008	RP#41	RP-080732	46			Additional UE demodulation test cases	8.3.0
09-2008	RP#41	RP-080732	47			Updated descriptions of FRC	8.3.0
09-2008	RP#41	RP-080732	49			Definition of UE transmission gap	8.3.0
09-2008	RP#41	RP-080732	51			Clarification on High Speed train model in 36.101	8.3.0
09-2008	RP#41	RP-080732	53			Update of symbol and definitions	8.3.0
09-2008	RP#41	RP-080743	56			Addition of MIMO (4x2) and (4x4) Correlation Matrices	8.3.0
12-2008	RP#42	RP-080908	94r2			CR TX RX channel frequency separation	8.4.0
12-2008	RP#42	RP-080909	105r1			UE Maximum output power for Band 13	8.4.0
12-2008	RP#42	RP-080909	60			UL EVM equalizer definition	8.4.0
12-2008	RP#42	RP-080909	63			Correction of UE spurious emissions	8.4.0
12-2008	RP#42	RP-080909	66			Clarification for UE additional spurious emissions	8.4.0
12-2008	RP#42	RP-080909	72			Introducing ACLR requirement for coexistance with UTRA 1.6MHZ channel from 36.803	8.4.0
12-2008	RP#42	RP-080909	75			Removal of [] from Section 6 transmitter characteristcs	8.4.0
12-2008	RP#42	RP-080909	81			Clarification for PHS band protection	8.4.0
12-2008	RP#42	RP-080909	101			Alignement for the measurement interval for transmit signal quality	8.4.0
12-2008	RP#42	RP-080909	98r1			Maximum power	8.4.0
12-2008	RP#42	RP-080909	57r1			CR UE spectrum flatness	8.4.0
12-2008	RP#42	RP-080909	71r1			UE in-band emission	8.4.0
12-2008	RP#42	RP-080909	58r1			CR Number of TX exceptions	8.4.0
12-2008	RP#42	RP-080951	99r2			CR UE output power dynamic	8.4.0
12-2008	RP#42	RP-080951	79r1			LTE UE transmitter intermodulation	8.4.0
12-2008	RP#42	RP-080910	91			Update of Clause 8	8.4.0
12-2008	RP#42	RP-080950	106r1			Structure of Clause 9 including CSI requirements for PUCCH mode 1-0	8.4.0
12-2008	RP#42	RP-080911	59			CR UE ACS test frequency offset	8.4.0
12-2008	RP#42	RP-080911	65			Correction of spurious response parameters	8.4.0
12-2008	RP#42	RP-080911	80			Removal of LTE UE narrowband intermodulation	8.4.0
12-2008	RP#42	RP-080911	90r1			Introduction of Maximum Sensitivity Degradation	8.4.0
12-2008	RP#42	RP-080911	103			Removal of [] from Section 7 Receiver characteristic	8.4.0
12-2008	RP#42	RP-080912	62			Alignement of TB size n Ref Meas channel for RX characteristics	8.4.0
12-2008	RP#42	RP-080912	78			TDD Reference Measurement channel for RX characterisctics	8.4.0
12-2008	RP#42	RP-080912	73r1			Addition of 64QAM DL referenbce measurement channel	8.4.0
12-2008	RP#42	RP-080912	74r1			Addition of UL Reference Measurement Channels	8.4.0
12-2008	RP#42	RP-080912	104			Reference measurement channels for PDSCH performance requirements (TDD)	8.4.0
12-2008	RP#42	RP-080913	68			MIMO Correlation Matrix Corrections	8.4.0

12-2008	RP#42	RP-080915	67			Correction to the figure with the Transmission Bandwidth configuration	8.4.0
12-2008	RP#42	RP-080916	77			Modification to EARFCN	8.4.0
12-2008	RP#42	RP-080917	85r1			New Clause 5 outline	8.4.0
12-2008	RP#42	RP-080919	102			Introduction of Bands 12 and 17 in 36.101	8.4.0
12-2008	RP#42	RP-080927	84r1			Clarification of HST propagation conditions	8.4.0
03-2009	RP#43	RP-090170	156r2			A-MPR table for NS_07	8.5.0
03-2009	RP#43	RP-090170	170			Corrections of references (References to tables and figures)	8.5.0
03-2009	RP#43	RP-090170	108			Removal of [ ] from Transmitter Intermodulation	8.5.0
03-2009	RP#43	RP-090170	155			E-UTRA ACLR for below 5 MHz bandwidths	8.5.0
03-2009	RP#43	RP-090170	116			Clarification of PHS band including the future plan	8.5.0
03-2009	RP#43	RP-090170	119			Spectrum emission mask for 1.4 MHz and 3 MHz bandwidhts	8.5.0
03-2009	RP#43	RP-090170	120			Removal of “Out-of-synchronization handling of output power” heading	8.5.0
03-2009	RP#43	RP-090170	126			UE uplink power control	8.5.0
03-2009	RP#43	RP-090170	128			Transmission BW Configuration	8.5.0
03-2009	RP#43	RP-090170	130			Spectrum flatness	8.5.0
03-2009	RP#43	RP-090170	132r2			PUCCH EVM	8.5.0
03-2009	RP#43	RP-090170	134			UL DM-RS EVM	8.5.0
03-2009	RP#43	RP-090170	140			Removal of ACLR2bis requirements	8.5.0
03-2009	RP#43	RP-090171	113			In-band blocking	8.5.0
03-2009	RP#43	RP-090171	127			In-band blocking and sensitivity requirement for band 17	8.5.0
03-2009	RP#43	RP-090171	137r1			Wide band intermodulation	8.5.0
03-2009	RP#43	RP-090171	141			Correction of reference sensitivity power level of Band 9	8.5.0
03-2009	RP#43	RP-090172	109			AWGN level for UE DL demodulation performance tests	8.5.0
03-2009	RP#43	RP-090172	124			Update of Clause 8: additional test cases	8.5.0
03-2009	RP#43	RP-090172	139r1			Performance requirement structure for TDD PDSCH	8.5.0
03-2009	RP#43	RP-090172	142r1			Performance requirements and reference measurement channels for TDD PDSCH demodulation with UE-specific reference symbols	8.5.0
03-2009	RP#43	RP-090172	145			Number of information bits in DwPTS	8.5.0
03-2009	RP#43	RP-090172	160r1			MBSFN-Unicast demodulation test case	8.5.0
03-2009	RP#43	RP-090172	163r1			MBSFN-Unicast demodulation test case for TDD	8.5.0
03-2009	RP#43	RP-090173	162			Clarification of EARFCN for 36.101	8.5.0
03-2009	RP#43	RP-090369	110			Correction to UL Reference Measurement Channel	8.5.0
03-2009	RP#43	RP-090369	114			Addition of MIMO (4x4, medium) Correlation Matrix	8.5.0
03-2009	RP#43	RP-090369	121			Correction of 36.101 DL RMC table notes	8.5.0
03-2009	RP#43	RP-090369	125			Update of Clause 9	8.5.0
03-2009	RP#43	RP-090369	138r1			Clarification on OCNG	8.5.0
03-2009	RP#43	RP-090369	161			CQI reference measurement channels	8.5.0
03-2009	RP#43	RP-090369	164			PUCCH 1-1 Static Test Case	8.5.0
03-2009	RP#43	RP-090369	111			Reference Measurement Channel for TDD	8.5.0
03-2009	RP#44					Editorial correction in Table 6.2.4-1	8.5.1
05-2009	RP#44	RP-090540	167			Boundary between E-UTRA fOOB and spurious emission domain for 1.4 MHz and 3 MHz bandwiths. (Technically Endorsed CR in R4-50bis - R4-091205)	8.6.0
05-2009	RP#44	RP-090540	168			EARFCN correction for TDD DL bands. (Technically Endorsed CR in R4-50bis - R4-091206)	8.6.0
05-2009	RP#44	RP-090540	169			Editorial correction to in-band blocking table. (Technically Endorsed CR in R4-50bis - R4-091238)	8.6.0
05-2009	RP#44	RP-090540	171			CR PRACH EVM. (Technically Endorsed CR in R4-50bis - R4-091308)	8.6.0
05-2009	RP#44	RP-090540	172			CR EVM correction. (Technically Endorsed CR in R4-50bis - R4-091309)	8.6.0
05-2009	RP#44	RP-090540	177			CR power control accuracy. (Technically Endorsed CR in R4-50bis - R4-091418)	8.6.0
05-2009	RP#44	RP-090540	179			Correction of SRS requirements. (Technically Endorsed CR in R4-50bis - R4-091426)	8.6.0
05-2009	RP#44	RP-090540	186			Clarification for EVM. (Technically Endorsed CR in R4-50bis - R4-091512)	8.6.0

05-2009	RP#44	RP-090540	187			Removal of [ ] from band 17 Refsens values and ACS offset frequencies	8.6.0
05-2009	RP#44	RP-090540	191			Completion of band17 requirements	8.6.0
05-2009	RP#44	RP-090540	192			Removal of 1.4 MHz and 3 MHz bandwidths from bands 13, 14 and 17.	8.6.0
05-2009	RP#44	RP-090540	223			CR: 64 QAM EVM	8.6.0
05-2009	RP#44	RP-090540	201			CR In-band emissions	8.6.0
05-2009	RP#44	RP-090540	203			CR EVM exclusion period	8.6.0
05-2009	RP#44	RP-090540	204			CR In-band emissions timing	8.6.0
05-2009	RP#44	RP-090540	206			CR Minimum Rx exceptions	8.6.0
05-2009	RP#44	RP-090540	207			CR UL DM-RS EVM	8.6.0
05-2009	RP#44	RP-090540	218r1			A-MPR table for NS_07	8.6.0
05-2009	RP#44	RP-090540	205r1			CR In-band emissions in shortened subframes	8.6.0
05-2009	RP#44	RP-090540	200r1			CR PUCCH EVM	8.6.0
05-2009	RP#44	RP-090540	178r2			No additional emission mask indication. (Technically Endorsed CR in R4-50bis - R4-091421)	8.6.0
05-2009	RP#44	RP-090540	220r1			Spectrum emission requirements for band 13	8.6.0
05-2009	RP#44	RP-090540	197r2			CR on aggregate power tolerance	8.6.0
05-2009	RP#44	RP-090540	196r2			CR: Rx IP2 performance	8.6.0
05-2009	RP#44	RP-090541	198r1			Maximum output power relaxation	8.6.0
05-2009	RP#44	RP-090542	166			Update of performance requirement for TDD PDSCH with MBSFN configuration. (Technically Endorsed CR in R4-50bis - R4-091180)	8.6.0
05-2009	RP#44	RP-090542	175			Adding AWGN levels for some TDD DL performance requirements. (Technically Endorsed CR in R4-50bis - R4-091406)	8.6.0
05-2009	RP#44	RP-090542	182			OCNG Patterns for Single Resource Block FRC Requirements. (Technically Endorsed CR in R4-50bis - R4-091504)	8.6.0
05-2009	RP#44	RP-090542	170r1			Update of Clause 8: PHICH and PMI delay. (Technically Endorsed CR in R4-50bis - R4-091275)	8.6.0
05-2009	RP#44	RP-090543	183			Requirements for frequency-selective fading test. (Technically Endorsed CR in R4-50bis - R4-091505)	8.6.0
05-2009	RP#44	RP-090543	199			CQI requirements under AWGN conditions	8.6.0
05-2009	RP#44	RP-090543	188r1			Adaptation of UL-RMC-s for supporting more UE categories	8.6.0
05-2009	RP#44	RP-090543	193r1			Correction of the LTE UE downlink reference measurement channels	8.6.0
05-2009	RP#44	RP-090543	184r1			Requirements for frequency non-selective fading tests. (Technically Endorsed CR in R4-50bis - R4-091506)	8.6.0
05-2009	RP#44	RP-090543	185r1			Requirements for PMI reporting. (Technically Endorsed CR in R4-50bis - R4-091510)	8.6.0
05-2009	RP#44	RP-090543	221r1			Correction to DL RMC-s for Maximum input level for supporting more UE-Categories	8.6.0
05-2009	RP#44	RP-090543	216			Addition of 15 MHz and 20 MHz bandwidths into band 38	8.6.0
09-2009	RP#45	RP-090822	224			LTE UTRA ACLR1 centre frequency definition for 1.4 and 3 MHz BW	8.7.0
09-2009	RP#45	RP-090822	226			Harmonization of text for LTE Carrier leakage	8.7.0
09-2009	RP#45	RP-090822	228			Sensitivity requirements for Band 38 15 MHz and 20 MHz bandwidths	8.7.0
09-2009	RP#45	RP-090822	237			Addition of 5MHz channel bandwidth for Band 40	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	8.7.0
09-2009	RP#45	RP-090877	260			Correction of LTE UE ACS test parameter	8.7.0
09-2009	RP#45	RP-090877	262			Correction of LTE UE ACLR test parameter	8.7.0
09-2009	RP#45	RP-090877	285			Uplink power and RB allocation for receiver tests	8.7.0
09-2009	RP#45	RP-090877	301			CR 64QAM MPR	8.7.0
09-2009	RP#45	RP-090877	319			CR Sensitivity relaxation for small BW	8.7.0
09-2009	RP#45	RP-090877	323			Correction of Band 3 spurious emission band UE co-existence	8.7.0
09-2009	RP#45	RP-090877	248R1			CR Pcmax definition (working assumption)	8.7.0
09-2009	RP#45	RP-090877	329			Spectrum flatness clarification	8.7.0
09-2009	RP#45	RP-090877	331			Additional SRS relative power requirement and update of measurement definition	8.7.0
09-2009	RP#45	RP-090877	281R1			Additional SRS relative power requirement and update of measurement definition	8.7.0
09-2009	RP#45	RP-090877	283R1			Power range applicable for relative tolerance	8.7.0
09-2009	RP#45	RP-090878	232			TDD UL/DL configurations for CQI reporting	8.7.0
09-2009	RP#45	RP-090878	234			Further clarification on CQI test configurations	8.7.0
09-2009	RP#45	RP-090878	242			Corrections to UL- and DL-RMC-s	8.7.0
09-2009	RP#45	RP-090878	246			Reference measurement channel for multiple PMI requirements	8.7.0
09-2009	RP#45	RP-090878	289			CQI reporting test for a scenario with frequency-selective interference	8.7.0
09-2009	RP#45	RP-090878	264R2			CQI reference measurement channels	8.7.0
09-2009	RP#45	RP-090878	304R2			CR RI Test	8.7.0

09-2009	RP#45	RP-090875	230			Correction of parameters for demodulation performance requirement	8.7.0
09-2009	RP#45	RP-090875	240R1			UE categories for performance tests and correction to RMC references	8.7.0
09-2009	RP#45	RP-090875	277			Clarification of Ês definition in the demodulation requirement	8.7.0
09-2009	RP#45	RP-090875	325			Editorial corrections and updates to PHICH PBCH test cases	8.7.0
09-2009	RP#45	RP-090875	258R2			Test case numbering in section 8 Performance tests	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)	8.8.0
12-2009	RP#46	RP-091261	336			Adding beamforming model for user-specfic reference signal (Technically endorsed at RAN 4 52bis in R4-093524)	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)	8.8.0
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)	8.8.0
12-2009	RP#46	RP-091261	342			Correction to the modulated E-UTRA interferer (Technically endorsed at RAN 4 52bis in R4-093661)	8.8.0
12-2009	RP#46	RP-091264	344R1			OCNG: Patterns and present use in tests (Technically endorsed at RAN 4 52bis in R4-093663)	8.8.0
12-2009	RP#46	RP-091264	346			OCNG: Use in receiver and performance tests (Technically endorsed at RAN 4 52bis in R4-093665)	8.8.0
12-2009	RP#46	RP-091263	348			Miscellaneous corrections on CSI requirements (Technically endorsed at RAN 4 52bis in R4-093676)	8.8.0
12-2009	RP#46	RP-091261	350			Removal of RLC modes (Technically endorsed at RAN 4 52bis in R4-093677)	8.8.0
12-2009	RP#46	RP-091261	352			CR Rx diversity requirement (Technically endorsed at RAN 4 52bis in R4-093703)	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)	8.8.0
12-2009	RP#46	RP-091263	358			Single- and multi-PMI requirements (Technically endorsed at RAN 4 52bis in R4-093846)	8.8.0
12-2009	RP#46	RP-091263	362			CQI reference measurement channel (Technically endorsed at RAN 4 52bis in R4-093970)	8.8.0
12-2009	RP#46	RP-091264	366			Numbering of PDSCH (User-Specific Reference Symbols) Demodulation Tests	8.8.0
12-2009	RP#46	RP-091264	368			Numbering of PDCCH/PCFICH, PHICH, PBCH Demod Tests	8.8.0
12-2009	RP#46	RP-091261	370			Remove [ ] from Reference Measurement Channels in Annex A	8.8.0
12-2009	RP#46	RP-091264	372R1			Corrections to RMC-s for Maximum input level test for low UE categories	8.8.0
12-2009	RP#46	RP-091261	376			Correction of UE-category for R.30	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	8.8.0
12-2009	RP#46	RP-091262	385R3			Clarification of measurement conditions of spurious emission requirements at the edge of spurious domain	8.8.0
12-2009	RP#46	RP-091262	389			Spurious emission table correction for TDD bands 33 and 38.	8.8.0
12-2009	RP#46	RP-091262	391R2			36.101 Symbols and abreviations for Pcmax	8.8.0
12-2009	RP#46	RP-091262	393			UTRAACLR1 requirement definition for 1.4 and 3 MHz BW completed	8.8.0
12-2009	RP#46	RP-091263	395			Introduction of the ACK/NACK feedback modes for TDD requirements	8.8.0
12-2009	RP#46	RP-091262	403R2			CR Power control exception R8	8.8.0
12-2009	RP#46	RP-091262	415R1			Relative power tolerance: special case for receiver tests	8.8.0
12-2009	RP#46	RP-091263	419R1			CSI reporting: test configuration for CQI fading requirements	8.8.0
12-2009	RP#46	RP-091264	424			Editorial corrections and updates to Clause 8.2.1 FDD demodulation test cases	8.8.0
12-2009	RP#46	RP-091262	426			CR: time mask	8.8.0
12-2009	RP#46	RP-091264	429			Correction of the payload size for PDCCH/PCFICH performance requirements	8.8.0
12-2009	RP#46	RP-091263	431			Transport format and test point updates to RI reporting test cases	8.8.0
12-2009	RP#46	RP-091263	433			Transport format and test setup updates to frequency-selective interference CQI tests	8.8.0
12-2009	RP#46	RP-091263	435			CR RI reporting configuration in PUCCH 1-1 test	8.8.0
12-2009	RP#46	RP-091261	437			Addition of R.11-1 TDD references	8.8.0
12-2009	RP#46	RP-091287	440			Correction of Band 11 requirements for TS36.101 Rel-8	8.8.0
12-2009	RP#46	RP-091262	441			In Band Emissions Requirements Correction CR	8.8.0
12-2009	RP#46	RP-091262	443R1			PCMAX definition	8.8.0

03-2010	RP#47	RP-100246	461r1			UTRA ACLR measurement bandwidths for 1.4 and 3 MHz	8.9.0
03-2010	RP#47	RP-100246	492			Band 8 Coexistence Requirement Table Correction	8.9.0
03-2010	RP#47	RP-100246	488r1			Rel 8 CR for Band 14	8.9.0
03-2010	RP#47	RP-100246	484r1			CR Band 1- PHS coexistence	8.9.0
03-2010	RP#47	RP-100247	500			Fading CQI requirements for FDD mode	8.9.0
03-2010	RP#47	RP-100247	498			CR correction to RI test	8.9.0
03-2010	RP#47	RP-100249	450			Reporting mode, Reporting Interval and Editorial corrections for demodulation	8.9.0
03-2010	RP#47	RP-100249	463r1			Corrections to 1PRB PDSCH performance test in presence of MBSFN.	8.9.0
03-2010	RP#47	RP-100249	457r1			OCNG corrections	8.9.0
03-2010	RP#47	RP-100249	466			Addition of OCNG configuration in DRS performance test	8.9.0
03-2010	RP#47	RP-100250	459r1			Use of OCNG in CSI tests	8.9.0
03-2010	RP#47	RP-100250	490r1			Corrections to CQI test configurations	8.9.0
03-2010	RP#47	RP-100250	468r1			Corrections of some CSI test parameters	8.9.0
03-2010	RP#47	RP-100251	455r1			TBS correction for RMC UL TDD 16QAM full allocation BW 1.4 MHz	8.9.0
03-2010	RP#47	RP-100264	447			RF requirements for UE in later releases	8.9.0
03-2010	RP#47	RP-100238	477r4			Modification of the spectral flatness requirement and some editorial corrections	8.9.0
06-2010	RP-48	RP-100619	527r1			Corrections on the definition of PCMAX	8.10.0
06-2010	RP-48	RP-100619	556r2			CR on UE coexistence requirement	8.10.0
06-2010	RP-48	RP-100619	537			Correction of transient time definition for EVM requirements	8.10.0
06-2010	RP-48	RP-100619	535			CR: Corrections on MIMO demodulation performance requirements	8.10.0
06-2010	RP-48	RP-100619	546r1			Correction of antenna configuration and beam-forming model for DRS	8.10.0
06-2010	RP-48	RP-100619	558r1			Corrections of tables for Additional Spectrum Emission Mask	8.10.0
06-2010	RP-48	RP-100619	567			Relaxation of the PDSCH demodulation requirements due to control channel errors	8.10.0
06-2010	RP-48	RP-100619	565			Correction of the UE output power definition for RX tests	8.10.0
06-2010	RP-48	RP-100620	520			Correction to FRC for CQI index 0	8.10.0
06-2010	RP-48	RP-100620	504r1			Fading CQI requirements for TDD mode	8.10.0
06-2010	RP-48	RP-100620	515r1			Correction to CQI test configuration	8.10.0
06-2010	RP-48	RP-100620	525r1			UE Categories for CSI reporting test	8.10.0
06-2010	RP-48	RP-100620	531			Correction of CQI and PMI delay configuration description for TDD	8.10.0
06-2010	RP-48	RP-100620	570			Minimum requirements for Rank indicator reporting	8.10.0
06-2010	RP-48	RP-100620	573			Correction to FDD and TDD CSI test configurations	8.10.0
09-2010	RP-49	RP-100914	604			Reference sensitivity requirements for the 1.4 and 3 MHz bandwidths	8.11.0
09-2010	RP-49	RP-100914	612			Band 13 and Band 14 spurious emission corrections	8.11.0
09-2010	RP-49	RP-100914	587			Missing note in Additional spurious emission test with NS_07	8.11.0
09-2010	RP-49	RP-100914	589r1			Downlink power for receiver tests	8.11.0
09-2010	RP-49	RP-100916	598			Correction of PDCCH content for PHICH test	8.11.0
09-2010	RP-49	RP-100916	580r1			Test configuration corrections to CQI reporting in AWGN	8.11.0
09-2010	RP-49	RP-100916	592			Throughput for multi-datastreams transmissions	8.11.0
09-2010	RP-49	RP-100916	594			Corrections to RF OCNG Pattern OP.1 and 2	8.11.0
12-2010	RP-50	RP-101324	671			Correction on the statement of TB size and subband selection in CSI tests	8.12.0
12-2010	RP-50	RP-101327	650			Correction to Band 12 frequency range	8.12.0
12-2010	RP-50	RP-101329	628			Removal of [ ] from TDD Rank Indicator requirements	8.12.0
12-2010	RP-50	RP-101329	633r1			Test configuration corrections to CQI TDD reporting in AWGN (Rel-8)	8.12.0
12-2010	RP-50	RP-101329	661r2			Correction of the PMI reporting in Multi-Layer Spatial Multiplexing performance test	8.12.0
12-2010	RP-50	RP-101330	643			EVM window length for PRACH	8.12.0
12-2010	RP-50	RP-101330	647			Removal of NS signalling from TDD REFSENS tests	8.12.0
12-2010	RP-50	RP-101330	640r1			Correction of Note 4 In Table 7.3.1-1: Reference sensitivity QPSK PREFSENS	8.12.0
03-2011	RP-51	RP-110337	697			PDCCH and PHICH performance: OCNG and power settings	8.13.0
03-2011	RP-51	RP-110336	704r1			Spurious emissions measurement uncertainty	8.13.0
03-2011	RP-51	RP-110338	708			PMI performance: Power settings and precoding granularity	8.13.0
03-2011	RP-51	RP-110337	760r1			Clarification to LTE relative power tolerance table	8.13.0
04-2011						Editorial: Spec Title correction, removal of “Draft”	8.13.1
06-2011	RP-52	RP-110788	770			CR: Corrections for UE to UE co-existence requirements of Band 3	8.14.0
06-2011	RP-52	RP-110787	812			Correction on CQI mapping index of RI test	8.14.0

06-2011	RP-52	RP-110787	776r1			Minor corrections to DL-RMC-s for Maximum input level	8.14.0
09-2011	RP-53	RP-111248	860r1			Removal of unnecessary channel bandwidths from REFSENS tables	8.15.0
09-2011	RP-53	RP-111248	867r1			Clarification on BS precoding information field for the RI FDD test	8.15.0
09-2011	RP-53	RP-111248	870 r1			CR for B14Rx requirement Rel 8	8.15.0
09-2011	RP-53	RP-111248	888 r1			CR to TS36.101: Correction on the accuracy test of CQI.	8.15.0
09-2011	RP-53	RP-111248	891			CR to TS36.101: Correction on CQI mapping index of TDD RI test	8.15.0
09-2011	RP-53	RP-111248	902			Correction of code block numbers for some RMCs	8.15.0
09-2011	RP-53	RP-111248	905			Correction to UL RMC for FDD and TDD	8.15.0
09-2011	RP-53	RP-111248	912 r1			Adding codebook subset restriction for single layer closed-loop spatial multiplexing test:	8.15.0
12-2011	RP-53	RP-111680	951			Clarification on applying CSI reports during rank switching in RI FDD test - Rel-8	8.16.0
12-2011	RP-53	RP-111680	954			UE spurious emissions	8.16.0
12-2011	RP-53	RP-111681	957r1			FDD-TDD co-existence REL-8	8.16.0
12-2011	RP-53	RP-111680	964			General review of the reference measurement channels	8.16.0
03-2012	RP-55	RP-120291	1012			RF: Updates and corrections to the RMC-s related annexes (Rel-8)	8.17.0
03-2012	RP-55	RP-120292	1043r 1			UE spurious emissions for Band 7 and Band 38 coexistence CR is only partially implemented as it is based on on the wrong version of the spec.	8.17.0
06-2012	RP-56	RP-120767	1197			FDD TDD co-existence requirement correction	8.18.0
06-2012	RP-56	RP-120764	1209			Correction of PHS protection requirements for TS 36.101	8.18.0
09-2012	RP-57	RP-121294	1227			Correct Transport Block size in 9RB 16QAM Uplink Reference Measurement Channel	8.19.0
09-2012	RP-57	RP-121295	1345			Random precoding granularity in PMI tests	8.19.0
12-2012	RP-58	RP-121849	1379			Correction of PCFICH power parameter setting	8.20.0
12-2012	RP-58	RP-121852	1432r 1			Band 1 to Band 33 and Band 39 UE coexistence requirements	8.20.0
12-2012	RP-58	RP-121849	1491r 2			Low-channel Band 1 coexistence with PHS	8.20.0
12-2012	RP-58	RP-121862	1501r 1			Clean up CR for Rel-8	8.20.0
12-2012	RP-58	RP-121852	1506r 1			UE-UE coexistence between bands with small frequency separation	8.20.0
03-2013	RP-59	RP-130258	1525			Corrections to CQI reporting	8.21.0
03-2013	RP-59	RP-130265	1540			Correction related to SNR definition for Rel-8	8.21.0
03-2013	RP-59	RP-130258	1576			UE-UE co-existence between Band 1 and Band 33/39	8.21.0
09-2013	RP-61	RP-131279	1768r 1			Correlation matrix for high speed train demodulation scenarios (Rel-8)	8.22.0
12-2013	RP-62	RP-131924	1848r 1			Clean-up of uplink reference measurement channels (Rel-8)	8.23.0
12-2013	RP-62	RP-131924	2010			P-max for Band 38 to Band 7 coexistence	8.23.0
12-2013	RP-62	RP-131924	2061			Simplification of Band 12/17 in-band blocking test cases	8.23.0
06-2014	RP-64	RP-140909	2265			In-band blocking case nubering re-establisment	8.24.0
06-2014	RP-64	RP-140909	2298			RF: Corrections to spurious emission requirements with NS different than NS_01 (Rel-8)	8.24.0
09-2014	RP-65	RP-141525	2450			Correction of downlink power allocation parameter for TDD single-antenna tests (Rel-8)	8.25.0
09-2014	RP-65	RP-141525	2474			CQI reporting under fading: CQI indices in set	8.25.0
09-2014	RP-65	RP-141525	2500			Perf: Cleanup and better description of DL-RMC-s with dynamic coding rate for CSI requirements (Rel-8)	8.25.0
09-2014	RP-65	RP-141525	2561			Corrections to UE coex table	8.25.0
12-2014	RP-66	RP-142142	2583r 1			CR for 1 PRB allocation performance in presence of MBSFN (rel-8)	8.26.0
12-2014	RP-66	RP-142142	2616r 1			CQI reporting in AWGN: CQI indices in set	8.26.0
03/2016	RP-71	RP-160486	3468		D	CR of editorial change on PHICH group and Ng in Rel-8	8.27.0
09/2017	RP-77	RP-171964	4591	1	F	Correction for EPA delay profiles of r.m.s delay spread (Rel-8)	8.28.0
12/2017	RP-78	RP-172604	4797		D	CR to resolve RMC name conflict in PHICH demodulation test	8.29.0

History

Document history		
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
V8.11.0	October 2010	Publication
V8.12.0	January 2011	Publication
V8.13.1	May 2011	Publication
V8.14.0	June 2011	Publication
V8.15.0	November 2011	Publication
V8.16.0	January 2012	Publication
V8.17.0	March 2012	Publication
V8.18.0	July 2012	Publication
V8.19.0	October 2012	Publication
V8.20.0	February 2013	Publication
V8.21.0	April 2013	Publication
V8.22.0	October 2013	Publication
V8.23.0	January 2014	Publication
V8.24.0	July 2014	Publication
V8.25.0	October 2014	Publication
V8.26.0	February 2015	Publication
V8.27.0	May 2016	Publication
V8.28.0	October 2017	Publication
V8.29.0	January 2018	Publication