# ETSI TS 136 101 V9.22.0 (2015-04)

**TECHNICAL SPECIFICATION**

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) radio transmission and reception
(3GPP TS 36.101 version 9.22.0 Release 9)

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# Contents

# Foreword

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# 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 $\beta/2$ of the total mean power of a given emission.

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

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

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

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

# 3.2     Symbols

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

| | |
|---|---|
| $BW_{Channel}$ | 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 |
| $L_{CRB}$ | The length of a contiguous resource block allocation |
| $N_{cp}$ | 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 interferer |
| P$_{PowerClass}$ | P$_{PowerClass}$ is the nominal UE power (i.e., no tolerance). |
| P$_{UMAX}$ | The measured configured maximum UE output power. |
| RB$_{start}$ | Indicates the lowest RB index of transmitted resource blocks |
| 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 36.521-1 Annex F defines Test Tolerances. These Test Tolerances are individually calculated for each test. The Test Tolerances are used to relax the Minimum Requirements in this specification to create Test Requirements.

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

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

## 4.2     Applicability of minimum requirements

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

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

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

d)  Note: Receiver sensitivity degradation may occur when:

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

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

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

## 4.3     (Void)

## 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 [8] 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[1] | 830 MHz | – | 840 MHz | 875 MHz | – | 885 MHz | FDD |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| 9 | 1749.9 MHz | – | 1784.9 MHz | 1844.9 MHz | – | 1879.9 MHz | FDD |
| 10 | 1710 MHz | – | 1770 MHz | 2110 MHz | – | 2170 MHz | FDD |
| 11 | 1427.9 MHz | – | 1447.9 MHz | 1475.9 MHz | – | 1495.9 MHz | FDD |
| 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | FDD |
| 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | FDD |
| 14 | 788 MHz | – | 798 MHz | 758 MHz | – | 768 MHz | FDD |
| 15 | Reserved | | | Reserved | | | FDD |
| 16 | Reserved | | | Reserved | | | FDD |
| 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | FDD |
| 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | FDD |
| 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | FDD |
| 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| 21 | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | FDD |
| ... | | | | | | | |
| 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 |
| NOTE 1: Band 6 is not applicable | | | | | | | |

# 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.
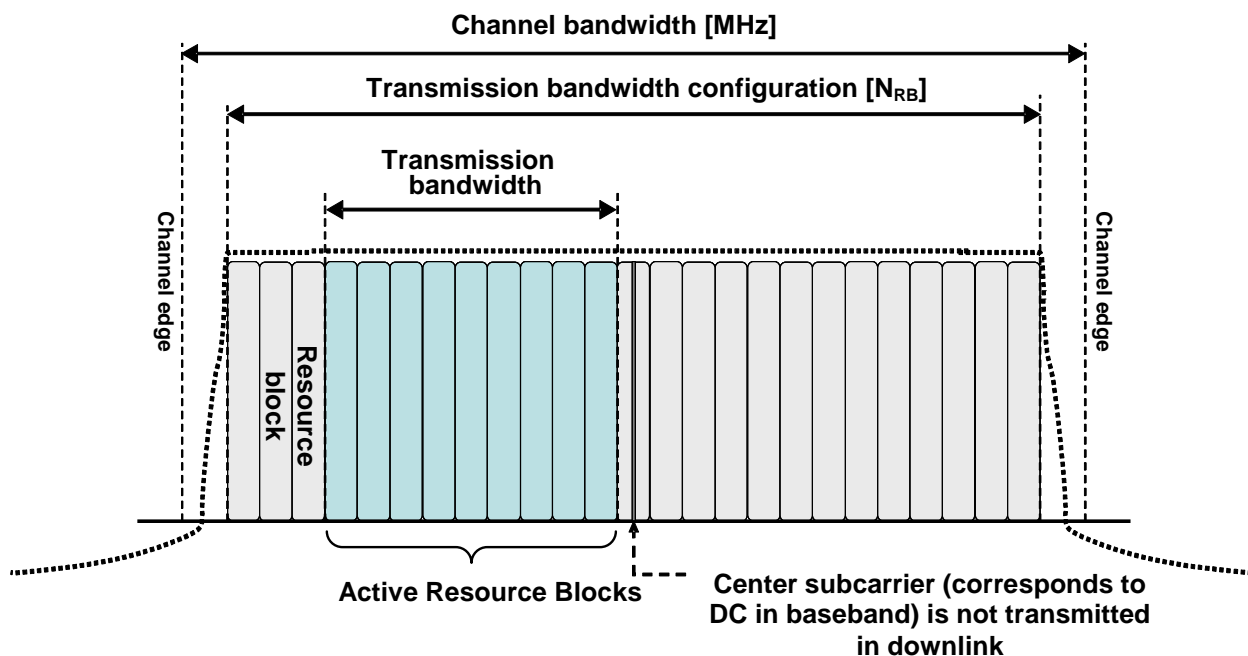


**Figure 5.6-1: Definition of channel bandwidth and transmission bandwidth configuration for one E-UTRA carrier**

## 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] | | |
| 18 | | | Yes | Yes[1] | Yes[1] | |
| 19 | | | Yes | Yes[1] | Yes[1] | |
| 20 | | | Yes | Yes[1] | Yes[1] | Yes[1] |
| 21 | | | Yes | 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: [1] refers to the bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (subClause 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:

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

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

## 5.7.2    Channel raster

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

## 5.7.3    Carrier frequency and EARFCN

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 - 65535. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where $F_{DL\_low}$ and $N_{Offs-DL}$ are given in Table 5.7.3-1 and $N_{DL}$ is the downlink EARFCN.

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

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

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

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

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

| E-UTRA Operating **Band** | **TX - RX**<br>**carrier centre frequency**<br>**separation** |
|---|---|
| 1 | 190 MHz |
| 2 | 80 MHz. |
| 3 | 95 MHz. |
| 4 | 400 MHz |
| 5 | 45 MHz |
| 6 | 45 MHz |
| 7 | 120 MHz |
| 8 | 45 MHz |
| 9 | 95 MHz |
| 10 | 400 MHz |
| 11 | 48 MHz |
| 12 | 30 MHz |
| 13 | -31 MHz |
| 14 | -30 MHz |
| 17 | 30 MHz |
| 18 | 45 MHz |
| 19 | 45 MHz |
| 20 | -41 MHz |
| 21 | 48 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 | | |
| 18 | | | | | 23 | ±2 | | |
| 19 | | | | | 23 | ±2 | | |
| 20 | | | | | 23 | ±2 | | |
| 21 | | | | | 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: [2] refers to transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or $F_{UL\_high}$ − 4 MHz and $F_{UL\_high}$, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB

NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.

Note 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance

## 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 ($N_{RB}$) | | | | | | 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 subclauses are specified in Table 6.2.4-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2.4.-1 and 6.2.4-2 are in addition to the allowed MPR requirements specified in subclause 6.2.3.

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

| Network Signalling value | Requirements (sub-clause) | E-UTRA Band | Channel bandwidth (MHz) | Resources Blocks ($N_{RB}$) | A-MPR (dB) |
|---|---|---|---|---|---|
| NS_01 | 6.6.2.1.1 | Table 5.5-1 | 1.4, 3, 5, 10, 15, 20 | Table 5.6-1 | NA |
| NS_03 | 6.6.2.2.1 | 2, 4,10, 35, 36 | 3 | >5 | ≤ 1 |
|  |  |  | 5 | >6 | ≤ 1 |
|  |  |  | 10 | >6 | ≤ 1 |
|  |  |  | 15 | >8 | ≤ 1 |
|  |  |  | 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 | Table 5.6-1 | n/a |
| NS_07 | 6.6.2.2.3    6.6.3.3.2 | 13 | 10 | Table 6.2.4-2 | Table 6.2.4-2 |
| NS_08 | 6.6.3.3.3 | 19 | 10, 15 | > 44 | ≤ 3 |
| NS_09 | 6.6.3.3.4 | 21 | 10, 15 | > 40 | ≤ 1 |
|  |  |  |  | > 55 | ≤ 2 |
| NS_10 |  | 20 | 15, 20 | Table 6.2.4-3 | Table 6.2.4-3 |
|  |  |  |  |  |  |
| .. |  |  |  |  |  |
| NS_32 | - | - | - | - | - |

**Table 6.2.4-2: A-MPR for 'NS_07'**

| Parameters | Region A | | Region B | | Region C |
|---|---|---|---|---|---|
| $RB_{start}$ | 0 - 12 | | 13 – 18 | 19 – 42 | 43 – 49 |
| $L_{CRB}$ [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   NOTE 2:    $L_{CRB}$ is the length of a contiguous resource block allocation   NOTE 3:    For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.   NOTE 4:    For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. | | | | | |

**Table 6.2.4-3: A-MPR for 'NS_10'**

| Channel BW | Parameters | Region A |
|------------|------------|----------|
| 15 | RB$_{start}$ | 0 – 10 |
| | L$_{CRB}$ [RBs] | 1 -20 |
| | A-MPR [dB] | ≤ 2 |
| 20 | RB$_{start}$ | 0 – 15 |
| | L$_{CRB}$ [RBs] | 1 -20 |
| | A-MPR [dB] | ≤ 5 |
| NOTE 1: RB$_{start}$ indicates the lowest RB index of transmitted resource blocks | | |
| NOTE 2: L$_{CRB}$ is the length of a contiguous resource block allocation | | |
| NOTE 3: For intra-subframe frequency hopping which intersects Region A, notes 1 and 2 apply on a per slot basis | | |
| NOTE 4: For intra-subframe frequency hopping which intersect Region A, the larger A-MPR value may be applied for both slots in the subframe | | |

For 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

- $P_{CMAX\_L} = MIN \{P_{EMAX} - \Delta T_C, \ P_{PowerClass} - MPR - A\text{-}MPR - \Delta T_C\}$

- $P_{CMAX\_H} = MIN \{P_{EMAX}, \ P_{PowerClass}\}$

- $P_{EMAX}$ 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

- MPR and A-MPR are specified in Section 6.2.3 and Section 6.2.4, respectively

- $\Delta T_C = 1.5$ dB when Note 2 in Table 6.2.2-1 applies

- $\Delta T_C = 0$ dB when Note 2 in Table 6.2.2-1 does not apply

The measured maximum output power $P_{UMAX}$ 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$_{CMAX}$<br>(dBm) | Tolerance T(P$_{CMAX}$)<br>(dB) |
|---|---|
| 21 ≤ P$_{CMAX}$ ≤ 23 | 2.0 |
| 20 ≤ P$_{CMAX}$ < 21 | 2.5 |
| 19 ≤ P$_{CMAX}$ < 20 | 3.5 |
| 18 ≤ P$_{CMAX}$ < 19 | 4.0 |
| 13 ≤ P$_{CMAX}$ < 18 | 5.0 |
| 8 ≤ P$_{CMAX}$ < 13 | 6.0 |
| -40 ≤ 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<br>MHz | 3.0<br>MHz | 5<br>MHz | 10<br>MHz | 15<br>MHz | 20<br>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 DTX and measurements gaps, the UE is not considered to be OFF.

### 6.3.3.1 Minimum requirement

The transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power shall not exceed the values specified in Table 6.3.3.1-1.

**Table 6.3.3.1-1: Transmit OFF power**

| | Channel bandwidth / Transmit OFF power / Measurement bandwidth | | | | | |
|---|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Transmit OFF power | -50 dBm | | | | | |
| Measurement bandwidth | 1.08 MHz | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

# 6.3.4 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 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 subclause 6.2.2 and subclause 6.6.2.3
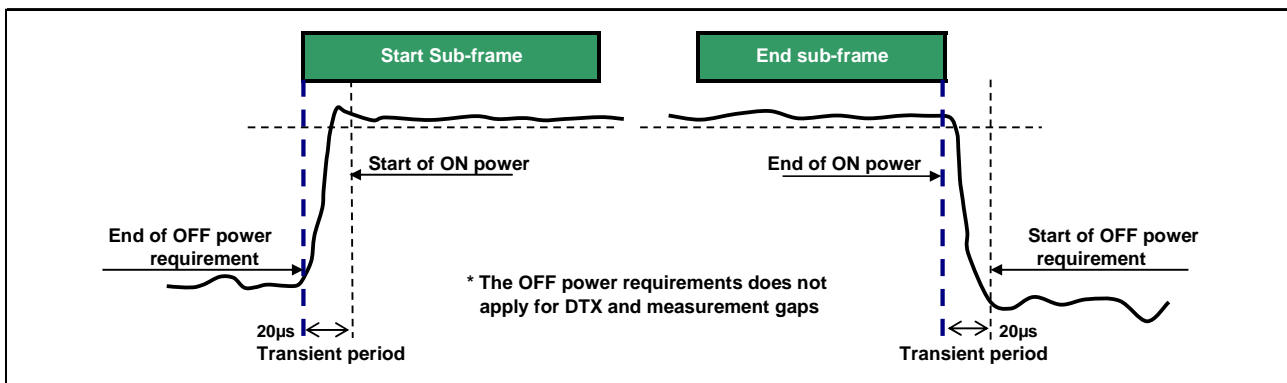


**Figure 6.3.4.1-1: General ON/OFF time mask**

## 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 subclause 6.2.2 and subclause 6.6.2.3

**Table 6.3.4.2-1: PRACH ON power measurement period**

| PRACH preamble format | Measurement period (ms) |
|---|---|
| 0 | 0.9031 |
| 1 | 1.4844 |
| 2 | 1.8031 |
| 3 | 2.2844 |
| 4 | 0.1479 |
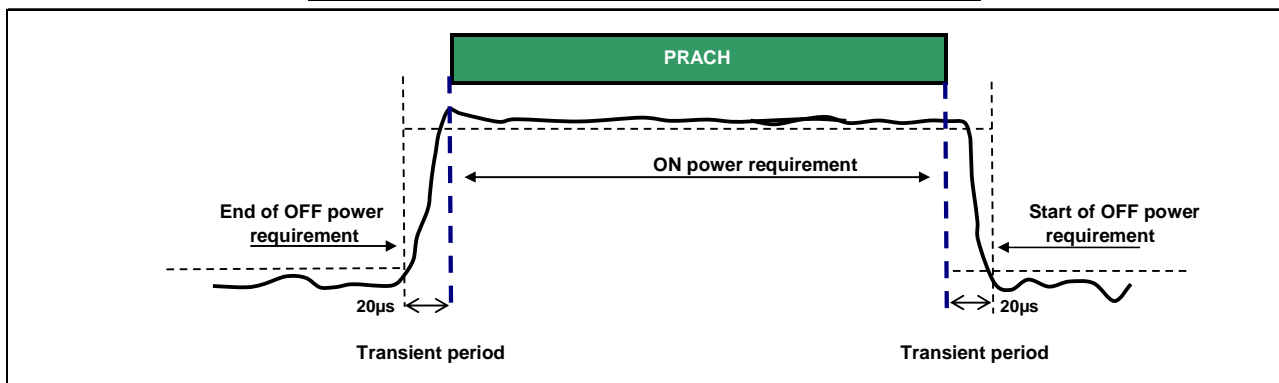


**Figure 6.3.4.2-1:  PRACH ON/OFF time mask**

6.3.4.2.2        SRS time mask

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

In the case a dual SRS transmission, the ON power is defined as the mean power for each symbol duration excluding any transient period. Figure 6.3.4.2.2-2

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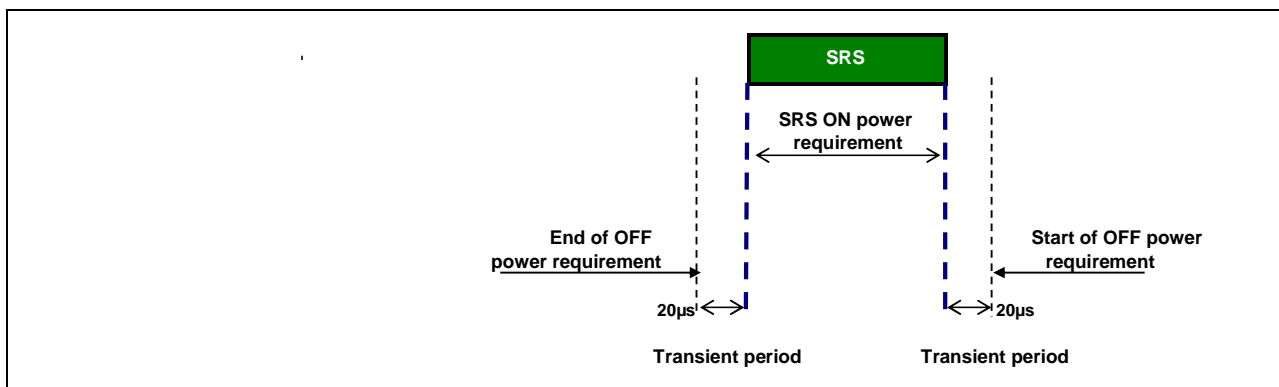


**Figure 6.3.4.2.2-1:  Single SRS time mask**
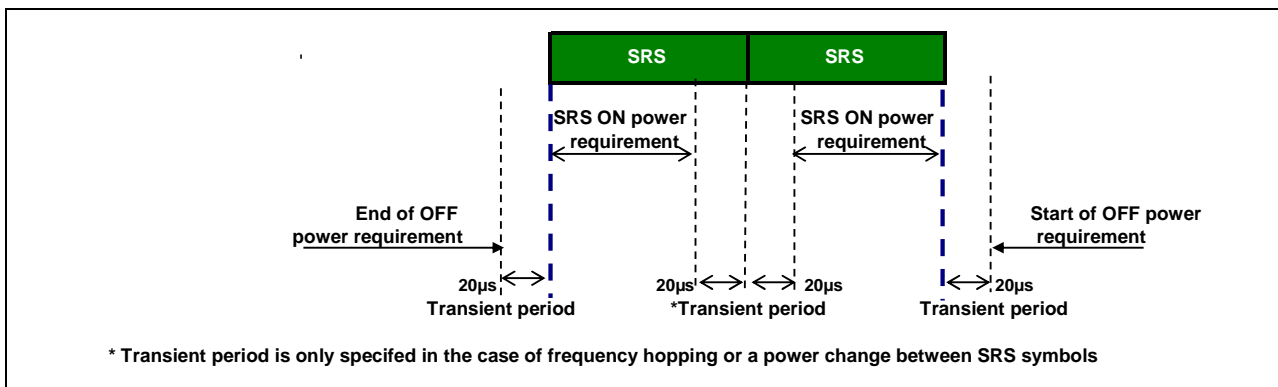
**Figure 6.3.4.2.2-2: Dual SRS time mask for the case of UpPTS transmissions**

## 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 subclause 6.2.2 and subclause 6.6.2.3
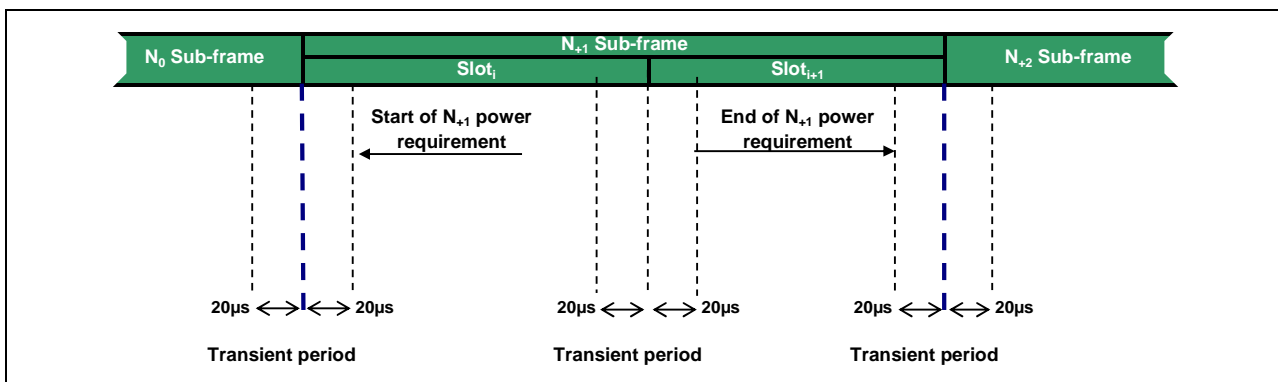


**Figure 6.3.4.3-1: Transmission power template**

## 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 subclause 6.2.2 and subclause 6.6.2.3
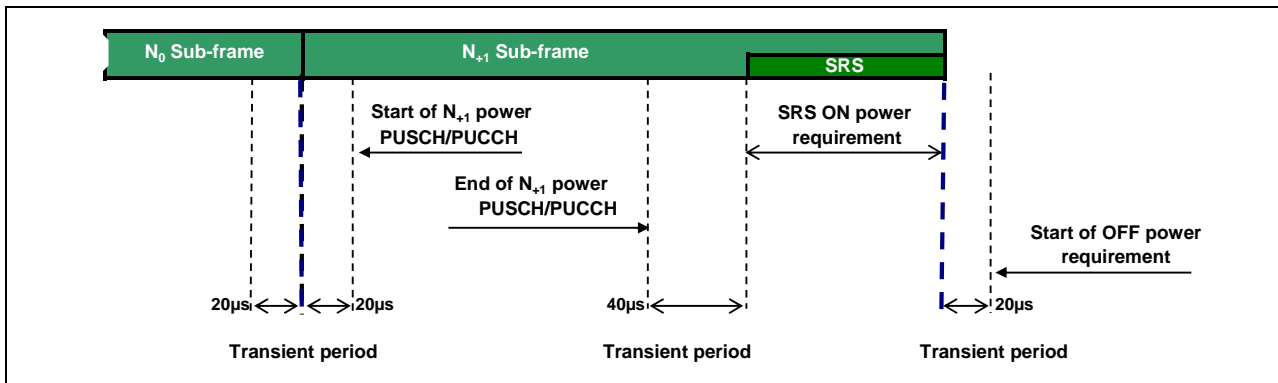
**Figure 6.3.4.4-1:  PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after**
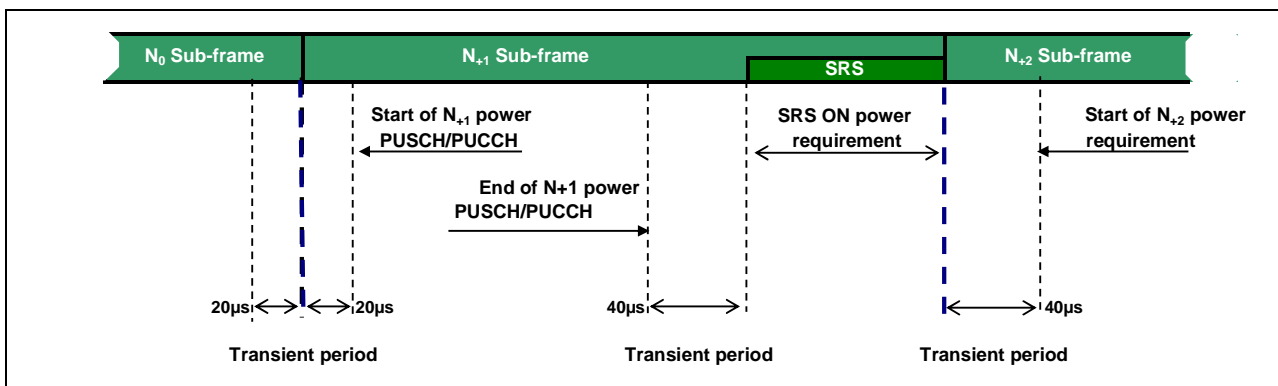


**Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS**
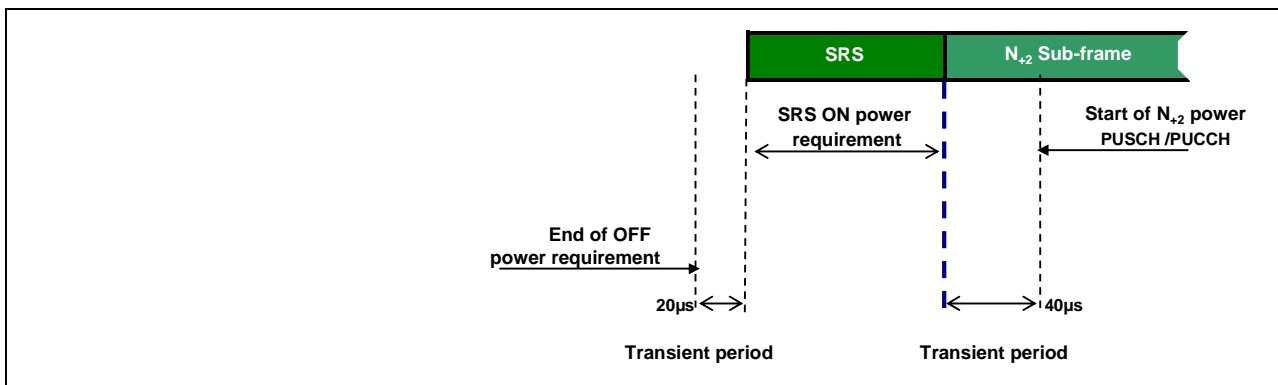


**Figure 6.3.4.4-3: PUCCH/PUSCH/SRS time mask when there is a transmission after SRS but not before**
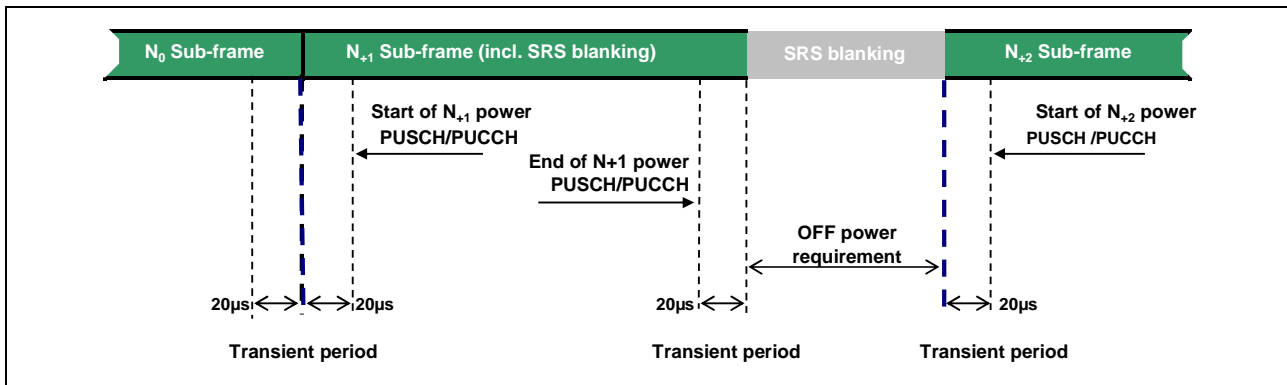
**Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking**

## 6.3.5 Power control

### 6.3.5.1 Absolute power tolerance

Absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 20ms. This tolerance includes the channel estimation error (the absolute RSRP accuracy requirement specified in subclause 9.1 of TS 36.133)

In the case of a PRACH transmission, the absolute tolerance is specified for the first preamble. The absolute power tolerance includes the channel estimation error (the absolute RSRP accuracy requirement specified in subclause 9.1 of TS 36.133).

#### 6.3.5.1.1 Minimum requirements

The minimum requirement for absolute power tolerance is given in Table 6.3.5.1.1-1 over the power range bounded by the Maximum output power as defined in subclause 6.2.2 and the Minimum output power as defined in subclause 6.3.2.

For operating bands under Note 2 in Table 6.2.2-1, the absolute power tolerance as specified in Table 6.3.5.1.1-1 is relaxed by reducing the lower limit by 1.5 dB when the transmission bandwidth is confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or $F_{UL\_high}$ − 4 MHz and $F_{UL\_high}$.

**Table 6.3.5.1.1-1: Absolute power tolerance**

| Conditions | Tolerance |
|---|---|
| Normal | ± 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 subclauses 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<br>NOTE 2: For operating bands under Note 2 in Table 6.2.2-1, the relative power tolerance is relaxed by increasing the upper limit by 1.5 dB if the transmission bandwidth of the reference sub-frames is confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or $F_{UL\_high}$ – 4 MHz and $F_{UL\_high}$ and the target sub-frame is not confined within any one of these frequency ranges; if the transmission bandwidth of the target sub-frame is confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or $F_{UL\_high}$ – 4 MHz and $F_{UL\_high}$ and the reference sub-frame is not confined within any one of these frequency ranges, then the tolerance is relaxed by reducing the lower limit by 1.5 dB.<br>NOTE 3: For PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods for TDD: for a power step 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 subclause 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 6.3.5.2.1-1.

For sub-frames not containing an SRS symbol, the power change is defined as the relative power difference between the mean power of the original reference sub-frame and the mean power of the target subframe not including transient durations. The mean power of successive sub-frames shall be calculated according to Figure 6.3.4.3-1 and Figure 6.3.4.1-1 if there is a transmission gap between the reference and target sub-frames.

If at least one of the sub-frames contains an SRS symbol, the power change is defined as the relative power difference between the mean power of the last transmission within the reference sub-frame and the mean power of the first transmission within the target sub-frame not including transient durations. A transmission is defined as PUSCH, PUCCH or an SRS symbol. The mean power of the reference and target sub-frames shall be calculated according to Figures 6.3.4.1-1, 6.3.4.2-1, 6.3.4.4-1, 6.3.4.4-2 and 6.3.4.4-3 for these cases.

### 6.3.5.3 Aggregate power control tolerance

Aggregate power control tolerance is the ability of a UE to maintain its power in non-contiguous transmission within 21 ms in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in TS 36.213 are constant.

### 6.3.5.3.1　　　Minimum requirement

The UE shall meet the requirements specified in Table 6.3.5.3.1-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3.2 and the maximum output power as defined in subclause 6.2.2.

**Table 6.3.5.3.1-1: Aggregate power control tolerance**

| TPC command | UL channel | Aggregate power tolerance within 21 ms |
|:-----------:|:----------:|:--------------------------------------:|
| 0 dB | PUCCH | ±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 subclause 6.5.2 are defined using the measurement methodology specified in Annex F.

### 6.5.2.1　　Error Vector Magnitude

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the 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 | $\max\left\{\ -25 - 10 \cdot \log_{10}(N_{RB}/L_{CRBs}),\right.$ $20 \cdot \log_{10} EVM\ -3 - 5 \cdot (\lvert\Delta_{RB}\rvert - 1)/L_{CRBs},$ $\left.-57\ dBm\ /180\,kHz - P_{RB}\right\}$ | | 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: $\Delta_{RB}$ is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth.

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

## 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:   $F_{UL\_Meas}$ refers to the sub-carrier frequency for which the equalizer coefficient is evaluated <br> 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 <br> NOTE 2:   $F_{UL\_Low}$ and $F_{UL\_High}$ refer to each E-UTRA frequency band specified in Table 5.5-1 | |
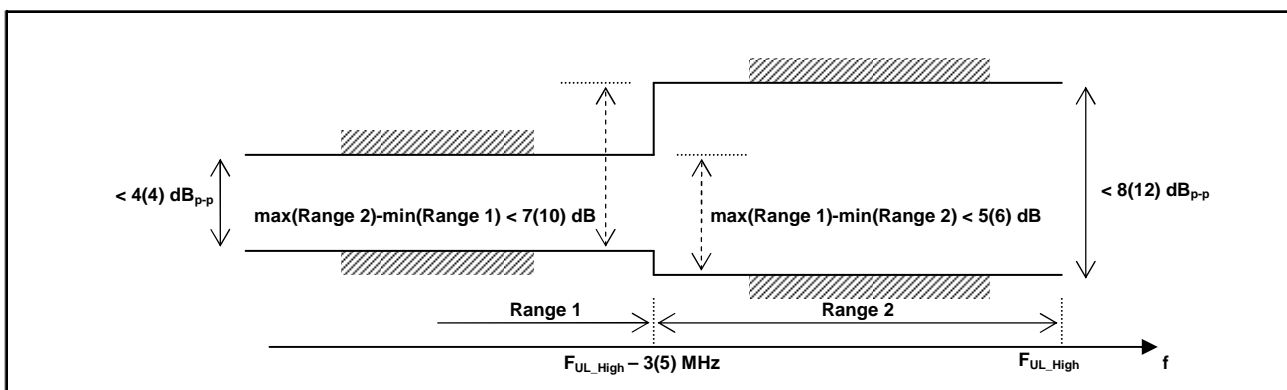


**Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).**

# 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.
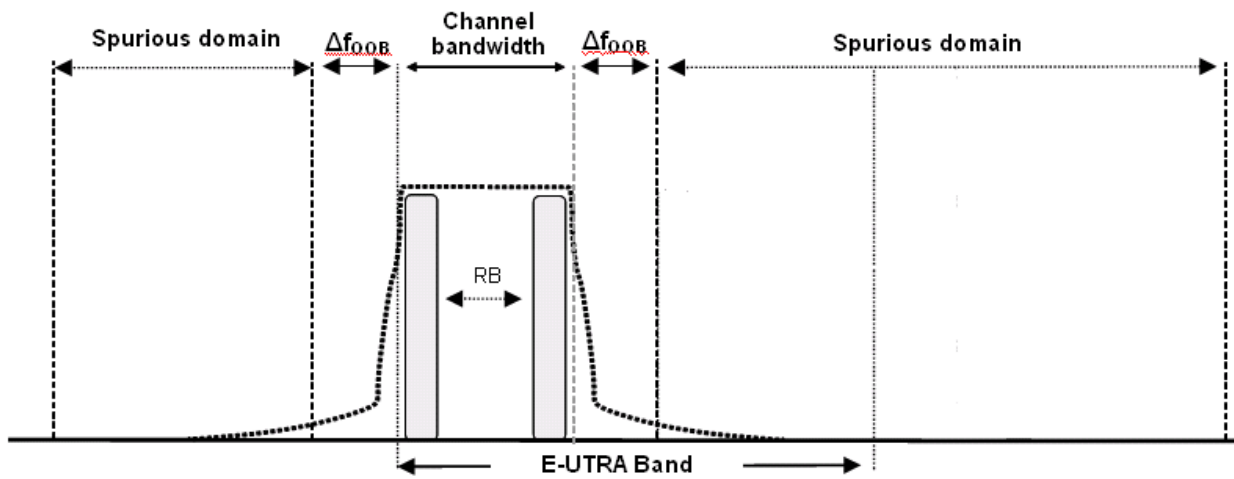
**Figure 6.6-1: Transmitter RF spectrum**

## 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 ($\Delta f_{OOB}$) starting from the ± edge of the assigned E-UTRA channel bandwidth.  For frequencies greater than ($\Delta f_{OOB}$) as specified in Table 6.6.2.1.1-1 the spurious requirements in subclause 6.6.3 are applicable.

### 6.6.2.1.1 Minimum requirement

The power of any UE emission shall not exceed the levels specified in Table 6.6.2.1.1-1 for the specified channel bandwidth.

**Table 6.6.2.1.1-1: General E-UTRA spectrum emission mask**

| | Spectrum emission limit (dBm)/ Channel bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|
| 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**

| Δf_OOB (MHz) | Spectrum emission limit (dBm)/ Channel bandwidth | | | | | | Measurement bandwidth |
|---|---|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | |
| ± 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**

| $\Delta f_{OOB}$ (MHz) | Spectrum emission limit (dBm)/ Channel bandwidth | | | | | | Measurement bandwidth |
|---|---|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | |
| ± 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**

| $\Delta f_{OOB}$ (MHz) | Spectrum emission limit (dBm)/ Channel bandwidth | | | | Measurement bandwidth |
|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | |
| ± 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.
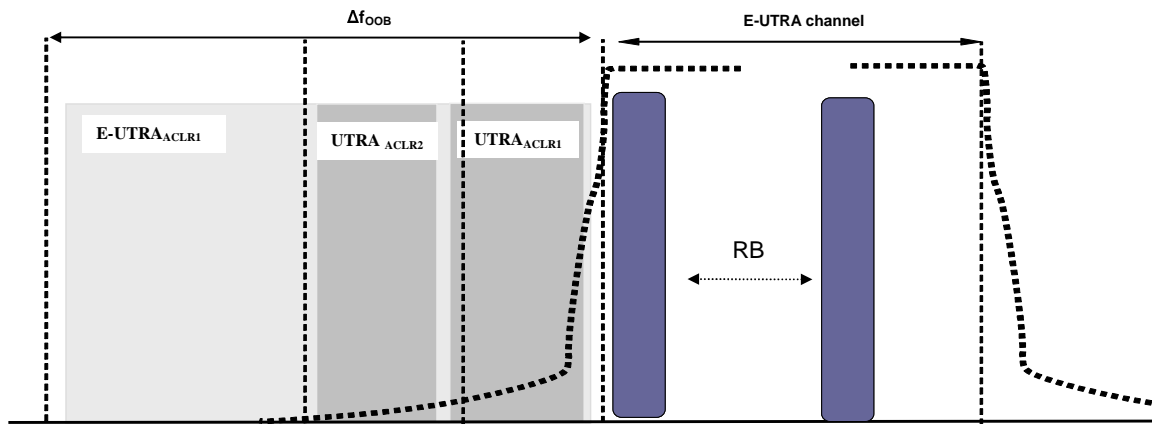


**Figure 6.6.2.3-1: Adjacent Channel Leakage requirements**

#### 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 |
| E-UTRA channel Measurement bandwidth | 1.08 MHz | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |
| Adjacent channel centre frequency offset [MHz] | +1.4 / -1.4 | +3.0 / -3.0 | +5 / -5 | +10 / -10 | +15 / -15 | +20 / -20 |

#### 6.6.2.3.2 Minimum requirements UTRA

UTRA Adjacent Channel Leakage power Ratio (UTRA$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned E-UTRA channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel (UTRA$_{ACLR1}$) and the 2$^{nd}$ UTRA adjacent channel (UTRA$_{ACLR2}$). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor $\alpha$ =0.22. The assigned E-UTRA channel power is measured with a rectangular filter with measurement bandwidth specified in Table 6.6.2.3.2-1. If the measured UTRA channel power is greater than –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 [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 [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 [Note 1] * | 3.84 MHz | 3.84 MHz | 3.84 MHz | 3.84 MHz | 3.84 MHz | 3.84 MHz |
| UTRA 1.6MHz channel measurement bandwidth [Note 2] | 1.28 MHz | 1.28 MHz | 1.28 MHz | 1.28MHz | 1.28MHz | 1.28MHz |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.<br>NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | | | | | | |

## 6.6.2.4 Void

### 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 (N$_{RB}$) 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 | Protected band | Frequency range (MHz) | | | Maximum level (dBm) | MBW (MHz) | NOTE |
|---|---|---|---|---|---|---|---|
| | | | | | Spurious emission | | |
| 1 | E-UTRA Band 1, 3, 7, 8, 11, 20, 21, 34, 38, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 895 | -50 | 1 | |
| | Frequency range | 1880 | - | 1895 | -40 | 1 | 14,18 |
| | Frequency range | 1839.9 | | 1879.9 | -50 | 1 | |
| | Frequency range | 1895 | - | 1915 | -15.5 | 5 | 14,18,19 |
| | Frequency range | 1915 | - | 1920 | +1.6 | 5 | 14,18,19 |
| 2 | E-UTRA Band 4, 5, 10, 12, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 2 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| 3 | E-UTRA Band 1, 7, 8, 20, 33, 34, 38 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| | E-UTRA Band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 13 |
| | Frequency range | 860 | - | 895 | -50 | 1 | 13 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |
| 4 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 5 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 6 | E-UTRA Band 1, 9, 11, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 875 | -37 | 1 | |
| | Frequency range | 875 | - | 895 | -50 | 1 | |
| | | 1884.5 | - | 1919.6 | -41 | 0.3 | 7 |
| | Frequency range | 1884.5 | - | 1915.7 | | | 8 |
| 7 | E-UTRA Band 1, 3, 7, 8, 20, 33, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 2570 | - | 2575 | -+1.6 | 5 | 14, 15, 19 |
| | | 2575 | - | 2595 | -15.5 | 5 | 14, 15, 19 |
| | | 2595 | - | 2620 | -40 | 1 | 14, 15 |
| 8 | E-UTRA Band 1, 20, 33, 34, 38, 39, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA band 7 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 8 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| | E-UTRA Band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 17 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 14, 17 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 17 |
| 9 | E-UTRA Band 1, 11, 21, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 895 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| 10 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 11 | E-UTRA Band 1, 9, 11, 21, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 895 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| 12 | E-UTRA Band 2, 5, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 4, 10 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| 13 | E-UTRA Band 2, 4, 5, 10, 12, 13, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 14 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 14 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 14 |
| 14 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 12, 14 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 12, 14 |
| 17 | E-UTRA Band 2, 5, 13, 14, 17 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | E-UTRA Band 4, 10 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| 18 | E-UTRA Band 1, 11, 21, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 895 | -40 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| 19 | E-UTRA Band 1, 11, 21, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| 20 | E-UTRA Band 1, 3, 7, 8, 33, 34, | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 20 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| | E-UTRA Band 38 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 21 | E-UTRA Band 1, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 895 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| … | | | | | | | |
| 33 | E-UTRA Band 1, 7, 8, 20, 34, 38, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 5 |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 14 |
| 34 | E-UTRA Band 1, 3, 7, 8, 11, 20, 21, 33, 38,39, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 5 |
| | Frequency range | 860 | - | 895 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| 35 | | | | | | | |
| 36 | | | | | | | |
| 37 | | | - | | | | |
| 38 | E-UTRA Band 1,3, 8, 20, 33, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 2620 | - | 2645 | -15.5 | 5 | 14, 16, 19 |
| | Frequency range | 2645 | | 2690 | -40 | 1 | 14, 16 |
| 39 | E-UTRA Band 34, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 40 | E-UTRA Band 1, 3, 33, 34, 39 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |

NOTE 1: FDL_low and FDL_high refer to each E-UTRA frequency band specified in Table 5.5-1

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 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).

NOTE 3: To meet these requirements some restriction will be needed for either the operating band or protected band

NOTE 4: N/A

NOTE 5: For non synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band

NOTE 6: N/A.

NOTE 7: Applicable when co-existence with PHS system operating in 1884.5 -1919.6MHz.

NOTE 8: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.

NOTE 9: N/A.

NOTE 10: N/A.

NOTE 11: Whether the applicable frequency range should be 793-805MHz instead of 799-805MHz is TBD

NOTE 12: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB

NOTE 13: Applicable when the assigned E-UTRA UL operating channel is ≥1744.9MHz and ≤ 1784.9MHz.

NOTE 14: These requirements also apply for the frequency ranges that are less than $\Delta f_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

NOTE 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.

NOTE 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*.

NOTE 17: For carriers of 5 MHz channel bandwidth with carrier center frequencies ($F_c$) in the range 902.5MHz ≤ $F_c$ < 907.5 MHz, the requirement applies for uplink transmission bandwidths less than or equal to 20 RB. No restrictions apply in the range 907.5 MHz ≤ $F_c$ ≤ 912.5 MHz. For carriers of 10 MHz channel bandwidth, the requirement only applies for $F_c$ = 910 MHz and uplink transmission bandwidths less than or equal to 32 RB with $RB_{start}$ > 3.

NOTE 18: 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.

NOTE 19: 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 18 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 $\Delta f_{OOB}$ (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 | Channel bandwidth / Spectrum emission limit (dBm) | | | | Measurement bandwidth | Note |
|---|---|---|---|---|---|---|
| (MHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | | |
| 1884.5 ≤ f ≤1915.7 | -41 | -41 | -41 | -41 | 300 KHz | 1 |
| NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in Subclause 5.6. 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 $\Delta f_{OOB}$ (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) 10 MHz | Measurement bandwidth |
|---|---|---|
| 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).

### 6.6.3.3.3 Minimum requirement (network signalled value 'NS_08')

When 'NS 08' is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.3-1. This requirement also applies for the frequency ranges that are less than $\Delta f_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.3-1: Additional requirement**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | | | Measurement bandwidth |
|---|---|---|---|---|
| | 5MHz | 10MHz | 15MHz | |
| 860 ≤ f ≤ 895 | -40 | -40 | -40 | 1 MHz |

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 (1 MHz).

### 6.6.3.3.4 Minimum requirement (network signalled value 'NS_09')

When 'NS 09' is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.4-1. This requirement also applies for the frequency ranges that are less than $\Delta f_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.4-1: Additional requirement**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | | | Measurement bandwidth |
|---|---|---|---|---|
| | **5MHz** | **10MHz** | **15MHz** | |
| 1475.9 ≤ f ≤ 1510.9 | -35 | -35 | -35 | 1 MHz |

NOTE 1: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus 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 (1 MHz).

NOTE 2: To improve measurement accuracy, A-MPR values for NS_09 specified in Table 6.2.4-1 in sub-clause 6.2.4 are derived based on both the above NOTE 1 and 100 kHz RBW.

# 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 subclause 7.3, the requirements shall be verified with the network signalling value NS_01 configured (Table 6.2.4-1).

All the parameters in clause 7 are defined using the UL reference measurement channels specified in Annexes A.2.2 and A.2.3, the DL reference measurement channels specified in Annex A.3.2 and using the set-up specified in Annex C.3.1

## 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 subclause 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 $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1 and table 7.3.1-2

**Table 7.3.1-1: Reference sensitivity QPSK P$_{REFSENS}$**

| | 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 |
| 18 | | | -100 | -97 | -95.2 | | FDD |
| 19 | | | -100 | -97 | -95.2 | | FDD |
| 20 | | | -97 | -94 | -91.2 | -90 | FDD |
| 21 | | | -100 | -97 | -95.2 | | 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 <br> 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 <br> NOTE 3: The signal power is specified per port <br> NOTE 4: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS. <br> NOTE 5: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS. | | | | | | | |

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.1-1 shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.1-2.

NOTE: Table 7.3.1-2 does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors.

**Table 7.3.1-2: 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 |
| 18 | | | 25 | $25^1$ | $25^1$ | | FDD |
| 19 | | | 25 | $25^1$ | $25^1$ | | FDD |
| 20 | | | 25 | $20^1$ | $20^3$ | $20^3$ | FDD |
| 21 | | | 25 | $25^1$ | $25^1$ | | 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: [1] refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). NOTE 2: For the UE which supports both Band 11 and Band 21 the uplink configuration for reference sensitivity is FFS. NOTE 3: [3] refers to Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at $RB_{start}$ 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at $RB_{start}$ 16 | | | | | | | |

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 |
| 19 | NS_08 |
| 21 | NS_09 |

## 7.3.2     Void

# 7.4     Maximum input level

This is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

## 7.4.1     Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4.1-1

**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 subclause 6.2.5. | | | | | | | |
| NOTE 2: Reference measurement channel is Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | |

# 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**

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

**Table 7.5.1-2: Test parameters for Adjacent Channel Selectivity, case 1**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + 14 dB | | | | | |
| $P_{Interferer}$ | dBm | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +42.5dB | REFSENS +39.5dB |
| $BW_{Interferer}$ | MHz | 1.4 | 3 | 5 | 5 | 5 | 5 |
| $F_{Interferer}$ (offset) | MHz | 1.4+0.0025 / -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 subclause 6.2.5. NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | | | | | | | |

**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 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 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 below P$_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with P$_{CMAX\_L}$ as defined in subclause 6.2.5. | |
| NOTE 2: | The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | |

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

| E-UTRA band | Parameter | Unit | Case 1 | Case 2 | Case 3 | Case 4 |
|---|---|---|---|---|---|---|
| | P$_{Interferer}$ | dBm | -56 | -44 | | |
| | 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$_{Ioffset,case\ 2}$ | Void | Void |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 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 - F$_{Ioffset,\ case\ 1}$ and
    b. the carrier frequency +BW/2 + F$_{Ioffset,\ case\ 1}$

## 7.6.2 Out-of-band blocking

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the UE receive band. For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5.1 and subclause 7.6.1 shall be applied.

### 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 5.6-1). For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to $\max\left(8,\ \lceil (N_{RB} + 2 \cdot L_{CRBs}) / 8 \rceil \right)$ 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 5.6-1) and $L_{CRBs}$ is the number of resource blocks allocated in the uplink. For these exceptions the requirements of subclause 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 | dBm | REFSENS + channel bandwidth specific value below | | | | | |
| | | 6 | 6 | 6 | 6 | 7 | 9 |

| Bandwidth Configuration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|

NOTE 1: The transmitter shall be set to 4dB below P$_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with P$_{CMAX\_L}$ as defined in subclause 6.2.5.
NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.

**Table 7.6.2.1-2: Out of band blocking**

| E-UTRA band | Parameter | Units | Frequency | | | |
|---|---|---|---|---|---|---|
| | | | **range 1** | **range 2** | **range 3** | **range 4** |
| | P$_{Interferer}$ | dBm | -44 | -30 | -15 | -15 |
| 1, 2, 3, 4, 5 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 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 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS. | | | | | | |

## 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 $\Delta f$ = 15 kHz) | MHz | 0.9075 | 1.7025 | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| F$_{uw}$ (offset for $\Delta f$ = 7.5 kHz) | MHz | | | | | | |
| NOTE 1: The transmitter shall be set to 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 subclause 6.2.5. NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | |

# 7.7 Spurious response

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in subclause 7.6.2 is not met.

## 7.7.1 Minimum requirements

The throughput shall be ≥ 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. | | | | | | | |
| NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | |

**Table 7.7.1-2: 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 |
| $P_{Interferer\ 1}$ (CW) | dBm | -46 | | | | | |
| $P_{Interferer\ 2}$ (Modulated) | dBm | -46 | | | | | |
| $BW_{Interferer\ 2}$ | | 1.4 | 3 | 5 | | | |
| $F_{Interferer\ 1}$ (Offset) | MHz | -BW/2 −2.1 / +BW/2+ 2.1 | -BW/2 −4.5 / +BW/2 + 4.5 | -BW/2 − 7.5 / +BW/2 + 7.5 | | | |
| $F_{Interferer\ 2}$ (Offset) | MHz | $2*F_{Interferer\ 1}$ | | | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX\_L}$ as defined in subclause 6.2.5. <br> NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. <br> NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 with set-up according to Annex C.3.1The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥5MHz | | | | | | | |

## 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<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix | | Normal |
| Cell_ID | | 0 |
| Note: | | |

## 8.2.1.1 Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.3 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS. The QPSK and 64QAM cases are also used to verify the performance for all bandwidths specified in Table 5.6.1-1.

### 8.2.1.1.1 Minimum Requirement

The requirements are specified in Table 8.2.1.1.1-2, with the addition of the parameters in Table 8.2.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.1.1-1: Test Parameters**

| Parameter | | Unit | Test 1- 5 | Test 6- 8 | Test 9- 15 | Test 16- 18 |
|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | 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 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | 1 |
| 7 | 10 MHz | R.3 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | 2-5 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | 1 |
| 8 | 10 MHz | R.3 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | 2-5 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | 1 |
| 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 |
| | 5 MHz | R.6-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.5 | 1 |
| 11 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | 2-5 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 12 | 10 MHz | R.7 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 19.0 | 2-5 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 18.1 | 1 |
| 13 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 19.1 | 2-5 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 17.8 | 1 |
| 14 | 15 MHz | R.8 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | 2-5 |
| | 15 MHz | R.8-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.8 | 1 |
| 15 | 20 MHz | R.9 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.6 | 3-5 |
| | 20 MHz | R.9-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.3 | 2 |
| | 20 MHz | R.9-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 16 | 3 MHz | R.0 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | 1-5 |
| 17 | 10 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | 1-5 |
| 18 | 20 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | 1-5 |

8.2.1.1.2     Void

8.2.1.1.3     Void

8.2.1.1.4     Minimum Requirement 1 PRB allocation in presence of MBSFN

The requirements are specified in Table 8.2.1.1.4-2, with the addition of the parameters in Table 8.2.1.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the single-antenna performance with a single PRB allocated at the lower band edge in presence of MBSFN.

**Table 8.2.1.1.4-1: Test Parameters for Testing 1 PRB allocation**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | 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 | $\rho_A$ | dB | -3 |
| | $\rho_B$ | 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 |
| | 5 MHz | R.11-2 FDD | OP.1 FDD | EVA5 | 2x2 Medium | 70 | 5.9 | 1 |
| 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 Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC-FSTD) with 4 transmitter antennas.

**Table 8.2.1.2.2-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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 |
| 2 | 10 MHz | R.13 FDD | OP.1 FDD | ETU70 | 4x2 Low | 70 | -0.9 | 1-5 |

## 8.2.1.3 Open-loop spatial multiplexing performance

### 8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.2.1.3.1-2, with the addition of the parameters in Table 8.2.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | $\sigma$ | 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 | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | $\sigma$ | 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 | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | $\sigma$ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 6 | 50 |
| PMI delay (Note 2) | | ms | 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 | $\rho_A$ | dB | -6 |
| | $\rho_B$ | 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 | | | 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 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| | | | |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 50 |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 1 |
| Reporting mode | | | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap | | | 110000 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$. | | | |
| Note 2: If the UE reports in an available uplink reporting instance at 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.35 FDD | OP.1 FDD | EPA5 | 2x2 Low | 70 | 18.9 | 2-5 |
| 2 | 10 MHz | R.11 FDD | OP.1 FDD | ETU70 | 2x2 Low | 70 | 14.3 | 2-5 |

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

The requirements are specified in Table 8.2.1.4.3-2, with the addition of the parameters in Table 8.2.1.4.3-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.1.4.3-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | $\sigma$ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 1 |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 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.36 FDD | OP.1 FDD | EPA5 | 4x2 Low | 70 | 14.7 | 2-5 |

### 8.2.1.5 MU-MIMO

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

## 8.2.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.2.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.2.2-1: Common Test Parameters (TDD)**

| Parameter | Unit | Value |
|---|---|---|
| Uplink downlink configuration (Note 1) | | 1 |
| Special subframe configuration (Note 2) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes | Processes | 7 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4] | | |

## 8.2.2.1    Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.4 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS. The QPSK and 64QAM cases are also used to verify the performance for all bandwidths specified in Table 5.6.1-1.

### 8.2.2.1.1    Minimum Requirement

The requirements are specified in Table 8.2.2.1.1-2, with the addition of the parameters in Table 8.2.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.1.1-1: Test Parameters**

| Parameter | | Unit | Test 1- 5 | Test 6- 8 | Test 9- 15 | Test 16- 18 |
|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | $\sigma$ | 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: $\quad P_B = 0$. | | | | | | |
| 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 Fraction of Maximum Throughput (%) | SNR (dB) | UE Category |
|---|---|---|---|---|---|---|---|---|
| 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 |
|  | 5 MHz | R.3-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 6.7 | 1 |
| 7 | 10 MHz | R.3 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 1.4 | 2-5 |
|  | 5 MHz | R.3-1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 1.4 | 1 |
| 8 | 10 MHz | R.3 TDD | OP.1 TDD | ETU300 | 1x2 High | 70 | 9.3 | 2-5 |
|  | 5 MHz | R.3-1 TDD | OP.1 TDD | ETU300 | 1x2 High | 70 | 9.3 | 1 |
| 9 | 3 MHz | R.5 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 1-5 |
| 10 | 5 MHz | R.6 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 2-5 |
|  | 5 MHz | R.6-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 1 |
| 11 | 10 MHz | R.7 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 2-5 |
|  | 10 MHz | R.7-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 1 |
| 12 | 10 MHz | R.7 TDD | OP.1 TDD | ETU70 | 1x2 Low | 70 | 19.1 | 2-5 |
|  | 10 MHz | R.7-1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 70 | 19.1 | 1 |
| 13 | 10 MHz | R.7 TDD | OP.1 TDD | EVA5 | 1x2 High | 70 | 19.1 | 2-5 |
|  | 10 MHz | R.7-1 TDD | OP.1 TDD | EVA5 | 1x2 High | 70 | 19.1 | 1 |
| 14 | 15 MHz | R.8 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.8 | 2-5 |
|  | 15 MHz | R.8-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.8 | 1 |
| 15 | 20 MHz | R.9 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | 3-5 |
|  | 20 MHz | R.9-2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | 2 |
|  | 20 MHz | R.9-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | 1 |
| 16 | 3 MHz | R.0 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1 | 1-5 |
| 17 | 10 MHz | R.1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.0 | 1-5 |
| 18 | 20 MHz | R.1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1 | 1-5 |

8.2.2.1.2          Void

8.2.2.1.3          Void

8.2.2.1.4          Minimum Requirement 1 PRB allocation in presence of MBSFN

The requirements are specified in Table 8.2.2.1.4-2, with the addition of the parameters in Table 8.2.2.1.1.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the single-antenna performance with a single PRB allocated at the lower band edge in presence of MBSFN.

**Table 8.2.2.1.4-1: Test Parameters for Testing 1 PRB allocation**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | $\sigma$ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Symbols for MBSFN portion of MBSFN subframes (Note 2) | | | OCNG (Note 3) |
| 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 | $\rho_A$ | dB | -3 |
| | $\rho_B$ | 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 |
| | 5 MHz | R.11-2 TDD | OP.1 TDD | EVA5 | 2x2 Medium | 70 | 6.8 | 1 |
| 2 | 10 MHz | R.10 TDD | OP.1 TDD | HST | 2x2 | 70 | -2.3 | 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 8.2.2.2.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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 | 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 TDD | OP.1 TDD | EPA5 | 4x2 Medium | 70 | 0.2 | 1-5 |
| 2 | 10 MHz | R.13 TDD | OP.1 TDD | ETU70 | 4x2 Low | 70 | -0.5 | 1-5 |

## 8.2.2.3 Open-loop spatial multiplexing performance

### 8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.3.1-2, with the addition of the parameters in Table 8.2.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | 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 | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | $\sigma$ | 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 Fraction of Maximum Throughput (%) | SNR (dB) | UE Category |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 MHz | R.14 TDD | OP.1 TDD | EVA70 | 4x2 Low | 70 | 14.2 | 2-5 |

## 8.2.2.4 Closed-loop spatial multiplexing performance

### 8.2.2.4.1 Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.1-2, with the addition of the parameters in Table 8.2.2.4.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.2.4.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | $\sigma$ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 6 | 50 |
| PMI delay (Note 2) | | ms | 10 or 11 | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap | | | 001111 | 001111 |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| PDSCH transmission mode | | | 4 | 4 |
| Note 1: $P_B = 1$. | | | | |
| Note 2: If the UE reports in an available uplink reporting instance at 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 | $\rho_A$ | dB | -6 |
| | $\rho_B$ | 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 | | | 000000000000000 000000000000000 000000000000000 000111111111111 1111 |
| 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 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 50 |
| PMI delay (Note 2) | | ms | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 3-1 |
| ACK/NACK feedback mode | | | Bundling |
| CodeBookSubsetRestriction bitmap | | | 110000 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$. | | | |
| Note 2: If the UE reports in an available uplink reporting instance at 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 | 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.35 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 19.5 | 2-5 |
| 2 | 10 MHz | R.11-1 TDD | OP.1 TDD | ETU70 | 2x2 Low | 70 | 13.9 | 2-5 |

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

The requirements are specified in Table 8.2.2.4.3-2, with the addition of the parameters in Table 8.2.2.4.3-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | 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 | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.36 TDD | OP.1 TDD | EPA5 | 4x2 Low | 70 | 15.7 | 2-5 |

### 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 User-specific Reference Symbols**

| Parameter | Unit | Value |
|---|---|---|
| Uplink downlink configuration (Note 1) | | 1 |
| Special subframe configuration (Note 2) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes | Processes | 7 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 2 |
| Beamforming Model | | As specified in Annex B.4 |
| Precoder update granularity | | Frequency domain: 1 PRB<br>Time domain: 1 ms |
| ACK/NACK feedback mode | | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. | | |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. | | |

## 8.3.2.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna port 5, the requirements are specified in Table 8.3.2.1-2, with the addition of the parameters in Table 8.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the demodulation performance using user-specific reference signals with full RB or single RB allocation.

**Table 8.3.2.1-1: Test Parameters for Testing DRS**

| parameter | | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | 0 | 0 | 0 | 0 |
| Cell-specific reference signals | | | Antenna port 0 | | | |
| Beamforming model | | | Annex B.4.1 | | | |
| $N_{oc}$ at antenna port | dB/15kHz | | -98 | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| PDSCH transmission mode | | | 7 | 7 | 7 | 7 |
| Note 1: $P_B = 0$. | | | | | | |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | | | |

**Table 8.3.2.1-2: Minimum performance DRS (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.25 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | -0.8 | 1-5 |
| 2 | 10 MHz 16QAM 1/2 | R.26 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 7.0 | 2-5 |
| | 5MHz 16QAM 1/2 | R.26-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 7.0 | 1 |
| 3 | 10 MHz 64QAM 3/4 | R.27 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.0 | 2-5 |
| | 10 MHz 64QAM 3/4 | R.27-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.0 | 1 |
| 4 | 10 MHz 16QAM 1/2 | R.28 TDD | OP.1 TDD | EPA5 | 2x2 Low | 30 | 1.7 | 1-5 |

For single-layer transmission on antenna ports 7 or 8, the requirements are specified in Table 8.3.2.1-4 and 8.3.2.1-5, with the addition of the parameters in Table 8.3.2.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port.

**Table 8.3.2.1-3: Test Parameters for Testing CDM-multiplexed DM RS (single layer)**

| parameter | | Unit | Test 1 | Test 2 | Test 3 | Test 4 | Test 5 |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | $\sigma$ | dB | -3 | -3 | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna port 0 and antenna port 1 | | | | |
| Beamforming model | | | Annex B.4.1 | | | | |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) |
| Simultaneous transmission | | | No | No | No | Yes (Note 3, 5) | Yes (Note 3, 5) |
| PDSCH transmission mode | | | 8 | 8 | 8 | 8 | 8 |
| Note 1: $P_B = 1$ | | | | | | | |
| Note 2: The modulation symbols of the signal under test is mapped onto antenna port 7 or 8. | | | | | | | |
| Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test. | | | | | | | |
| Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | | | | |
| Note 5: The two UEs" scrambling identities $n_{SCID}$ are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases. | | | | | | | |

**Table 8.3.2.1-4: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.31 TDD | OP.1 TDD | EVA5 | 2x2 Low | 70 | -1.0 | 1-5 |
| 2 | 10 MHz 16QAM 1/2 | R.32 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 7.7 | 2-5 |
| | 5MHz 16QAM 1/2 | R.32-1 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 7.7 | 1 |
| 3 | 10 MHz 64QAM 3/4 | R.33 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.7 | 2-5 |
| | 10 MHz 64QAM 3/4 | R.33-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.7 | 1 |

**Table 8.3.2.1-5: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 4 | 10 MHz 16QAM 1/2 | R.32 TDD (Note 1) | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 21.9 | 2-5 |
| 5 | 10 MHz 64QAM 1/2 | R.34 TDD (Note 1) | OP.1 TDD | EPA5 | 2x2 Low | 70 | 22.0 | 2-5 |
| Note 1: The reference channel applies to both the input signal under test and the interfering signal. | | | | | | | | |

## 8.3.2.2 Dual-Layer Spatial Multiplexing

For dual-layer transmission on antenna ports 7 and 8, the requirements are specified in Table 8.3.2.2-2, with the addition of the parameters in Table 8.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation.

**Table 8.3.2.2-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer)**

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | -3 | -3 |
| Cell-specific reference symbols | | | Antenna port 0 and antenna port 1 | |
| Beamforming model | | | Annex B.4.2 | |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) | OCNG (Note 2) |
| Number of allocated resource blocks | | PRB | 50 | 50 |
| PDSCH transmission mode | | | 8 | 8 |
| Note 1: $P_B = 1$. | | | | |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | |

**Table 8.3.2.2-2: Minimum performance for CDM-multiplexed DM RS (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.31 TDD | OP.1 TDD | EVA5 | 2x2 Low | 70 | 4.5 | 2-5 |
| 2 | 10 MHz 16QAM 1/2 | R.32 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 21.7 | 2-5 |

# 8.4 Demodulation of PDCCH/PCFICH

The receiver characteristics of the PDCCH/PCFICH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). PDCCH and PCFICH are tested jointly, i.e. a miss detection of PCFICH implies a miss detection of PDCCH.

## 8.4.1 FDD

**Table 8.4.1-1: Test Parameters for PDCCH/PCFICH**

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Number of PDCCH symbols | | symbols | 2 | 2 |
| Number of PHICH groups ($N_g$) | | | 1 | 1 |
| PHICH duration | | | Normal | Normal |
| 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 |

### 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 va | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SN |
| 1 | 10 MHz | 8 CCE | R.15 FDD | OP.1 FDD | ETU70 | 1x2 Low | 1 | |

### 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 va | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SN |
| 1 | 10 MHz | 4 CCE | R.16 FDD | OP.1 FDD | EVA70 | 2 x 2 Low | 1 | |

#### 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 va | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SN |
| 1 | 5 MHz | 2 CCE | R.17 FDD | OP.1 FDD | EPA5 | 4 x 2 Medium | 1 | |

## 8.4.2 TDD

**Table 8.4.2-1: Test Parameters for PDCCH/PCFICH**

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Uplink downlink configuration (Note 1) | | | 0 | 0 |
| Special subframe configuration (Note 2) | | | 4 | 4 |
| Number of PDCCH symbols | | symbols | 2 | 2 |
| Number of PHICH groups ($N_g$) | | | 1 | 1 |
| PHICH duration | | | Normal | Normal |
| 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_RA | dB | 0 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4] | | | | |
| Note 2: as specified in Table 4.2-1 in TS 36.211 [4] | | | | |

### 8.4.2.1 Single-antenna port performance

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

**Table 8.4.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | 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 va |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  | Pm-dsg (%) | SN |
| 1 | 10 MHz | 4 CCE | R.16 TDD | OP.1 TDD | EVA70 | 2 x 2 Low | 1 |  |

#### 8.4.2.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.4.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.2.2.2-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference va |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  | Pm-dsg (%) | SN |
| 1 | 5 MHz | 2 CCE | R.17 TDD | OP.1 TDD | EPA5 | 4 x 2 Medium | 1 |  |

# 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 delection).

## 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 |
| Number of PHICH groups (Note 1) | | | Ng = 1 | Ng = 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| Note 1: according to Clause 6.9 in TS 36.211 [4]. | | | | |

#### 8.5.1.1 Single-antenna port performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (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. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.5.1.2.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pm-an (%) | SNR (dB) |
| 1 | 10 MHz | R.19 | OP.1 FDD | EVA70 | 2 x 2 Low | 0.1 | 4.4 |

### 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 | 5 MHz | R.20 | OP.1 FDD | EPA5 | 4 x 2 Medium | 0.1 | 6.1 |

## 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 |
| Number of PHICH groups (Note 3) | | | Ng = 1 | Ng = 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]. Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. Note 3: according to Clause 6.9 in TS 36.211 [4]. | | | | |

### 8.5.2.1 Single-antenna port performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (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 | 10 MHz | R.19 | OP.1 TDD | EVA70 | 2 x 2 Low | 0.1 | 4.2 |

#### 8.5.2.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (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 | 5 MHz | R.20 | OP.1 TDD | EPA5 | 4 x 2 Medium | 0.1 | 6.2 |

## 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 |

# 8.7 Sustained downlink data rate provided by lower layers

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum number of DL-SCH transport block bits received within a TTI for the UE category indicated. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement. The size of the TB per TTI corresponds to the largest possible DL-SCH transport block for each UE category using the maximum number of layers for spatial multiplexing. Transmission modes 1 and 3 are used with radio conditions resembling a scenario where sustained maximum data rates are available.

## 8.7.1 FDD

The parameters specified in Table 8.7.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.7.1-1: Common Test Parameters (FDD)**

| Parameter | Unit | Value |
|---|---|---|
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 1 |

The requirements are specified in Table 8.7.1-3, with the addition of the parameters in Table 8.7.1-2 and the downlink physical channel setup according to Annex C.3.2. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.1-2: test parameters for sustained downlink data rate (FDD)**

| Parameter | | Unit | Test 1 | Test 2 | Test 3,4 | Test 3A | Test 3C,4B |
|---|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | 10 | 20 | 10 | 15 |
| Transmission mode | | | 1 | 3 | 3 | 3 | 3 |
| Antenna configuration | | | 1 x 2 | 2 x 2 | 2 x 2 | 2 x 2 | 2 x 2 |
| | | | | | | | |
| Propagation condition | | | Static propagation condition (Note 1) | | | | |
| CodeBookSubsetRestriction bitmap | | | n/a | 10 | 10 | 10 | 10 |
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 | -3 | **-3** |
| | $\rho_B$ | dB | 0 | -3 | -3 | -3 | **-3** |
| | σ | dB | 0 | 0 | 0 | 0 | 0 |
| $\hat{E}_s$ at antenna port | | dBm/15kHz | -85 | -85 | -85 | -85 | -85 |
| Symbols for unused PRBs | | | OP.6 FDD | OP.1 FDD | OP.1 FDD | OP.1 FDD | OP.1 FDD |
| | | | | | | | |
| Note 1: No external noise sources are applied. | | | | | | | |

**Table 8.7.1-3: Minimum requirement (FDD)**

| Test | UE Category | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value |
|------|-------------|-------------------------------------------------------------------|---------------------|-----------------|
| 1 | Category 1 | 10296 | R31-1 FDD | 95 |
| 2 | Category 2 | 25456 | R31-2 FDD | 95 |
| 3 | Category 3 (Note 1) | 51024 | R31-3 FDD | 95 |
| 3A | Category 3 (Note 2) | 36696 (Note 4) | R31-3A FDD | 85 |
| 3C | Category 3 | 51024 | R.31-3C FDD | [85] |
| 4 | Category 4 | 75376 (Note 5) | R31-4 FDD | 85 |
| 4B | Category 4 | 55056 (Note 7) | R.31-4B FDD | [85] |
| Note 1: | If the operating band under test does not support 20 MHz channel bandwidth, then test is executed according to Test 3A. | | | |
| Note 2: | Applicable to operating bands not supporting 20 MHz channel bandwidth. | | | |
| Note 3: | For 2 layer transmissions, 2 transport blocks are received within a TTI. | | | |
| Note 4: | 35160 bits for sub-frame 5. | | | |
| Note 5: | 71112 bits for sub-frame 5. | | | |
| Note 6: | The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. | | | |
| Note 7: | 52752 bits for sub-frame 5. | | | |

## 8.7.2   TDD

The parameters specified in Table 8.7.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.7.2-1: Common Test Parameters (TDD)**

| Parameter | Unit | Value |
|-----------|------|-------|
| Special subframe configuration (Note 1) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 1 |
| Note 1:    as specified in Table 4.2-1 in TS 36.211 [4]. | | |

The requirements are specified in Table 8.7.2-3, with the addition of the parameters in Table 8.7.2-2 and the downlink physical channel setup according to Annex C.3.2. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.2-2: test parameters for sustained downlink data rate (TDD)**

| Parameter | | Unit | Test 1 | Test 2 | Test 3 | Test 3B | Test 4 |
|---|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | 10 | 20 | 15 | 20 |
| Transmission mode | | | 1 | 3 | 3 | 3 | 3 |
| Antenna configuration | | | 1 x 2 | 2 x 2 | 2 x 2 | 2 x 2 | 2x2 |
| Propagation condition | | | Static propagation condition (Note 1) | | | | |
| CodeBookSubsetRestriction bitmap | | | n/a | 10 | 10 | 10 | 10 |
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 | -3 | -3 |
| | $\rho_B$ | dB | 0 | -3 | -3 | -3 | -3 |
| | σ | dB | 0 | 0 | 0 | 0 | 0 |
| $\hat{E}_s$ at antenna port | | dBm/15kHz | -85 | -85 | -85 | -85 | -85 |
| Symbols for unused PRBs | | | OP.6 TDD | OP.1 TDD | OP.1 TDD | OP.2 TDD | OP.1 TDD |
| ACK/NACK feedback mode | | | Bundling | Bundling | Bundling | Multiplexing | Multiplexing |
| Note 1:     No external noise sources are applied. | | | | | | | |

**Table 8.7.2-3: Minimum requirement (TDD)**

| Test | UE Category | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel | Reference value TB success rate [%] |
|---|---|---|---|---|
| 1 | Category 1 | 10296/0 | R31-1 TDD | 95 |
| 2 | Category 2 | 25456/0 | R31-2 TDD | 95 |
| 3 | Category 3 (Note 1) | 51024/0 | R31-3 TDD | 95 |
| 3B | Category 3 (Note 2) | 51024/0 | R31-3B TDD | 85 |
| 4 | Category 4 | 75376/0 (Note 4) | R31-4 TDD | 85 |
| Note 1:     If the operating band under test does not support 20 MHz channel bandwidth, then test is executed according to Test 3B. | | | | |
| Note 2:     Applicable to operating bands not supporting 20 MHz channel bandwidth. | | | | |
| Note 3:     For 2 layer transmissions, 2 transport blocks are received within a TTI. | | | | |
| Note 4:     71112 bits for sub-frame 5. | | | | |
| Note 5:     The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. | | | | |

# 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 1-5. 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 | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | 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 TDD 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 1-5. 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 | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | 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 | $\rho_A$ | dB | -3 | | | |
| | $\rho_B$ | 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 | $\rho_A$ | dB | -3 | | | |
| | $\rho_B$ | 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) a sub-band differential CQI offset level of 0 shall be reported at least $\alpha$ % of the time but less than $\beta$ % for each sub-band;

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

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 $\tau_d = 0.45\,\mu$s, $a = 1$, $f_D = 5$ Hz | | | |
| Antenna configuration | | | 1 x 2 | | | |
| 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 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| UE Category | 1-5 | 1-5 |

### 9.3.1.1.2 TDD

For the parameters specified in Table 9.3.1.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.2-2 and by the following

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

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

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 | | | |
| Antenna configuration | | | 1 x 2 | | | |
| 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 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| UE Category | 1-5 | 1-5 |

## 9.3.2 Frequency non-selective scheduling mode

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective fading conditions is determined by 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 $\alpha$ % of the time;

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 and antenna configuration | | | High (1 x 2) | | | |
| 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 for Category 2-5 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. | | | | | | |
| Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |
| Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3. | | | | | | |

**Table 9.3.2.1.1-2 Minimum requirement (FDD)**

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

## 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 $\alpha$ % of the time;

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | 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 and antenna configuration | | | High (1 x 2) | | | |
| 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 for Category 2-5 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. | | | | | | |
| Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |
| Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. | | | | | | |

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

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

## 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 $\alpha$ % for at least one of the sub-bands of full size at the channel edges;

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

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

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

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | 10 MHz |
| Transmission mode | | | 1 (port 0) | 1 (port 0) |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | 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 | |
| Reporting interval | | ms | 5 | |
| Antenna configuration | | | 1 x 2 | |
| CQI delay | | ms | 8 | |
| Reporting mode | | | PUSCH 3-0 | |
| Sub-band size | | RB | 6 (full size) | |
| Note 1:   If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) | | | | |
| Note 2:   Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. | | | | |

**Table 9.3.3.1.1-2 Minimum requirement (FDD)**

|  | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 60 | 60 |
| $\gamma$ | 1.6 | 1.6 |
| UE Category | 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 $\alpha$ % for at least one of the sub-bands of full size at the channel edges;

b)  the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be ≥ 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 | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | 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 | |
| Antenna configuration | | | 1 x 2 | |
| Reporting interval | | ms | 5 | |
| CQI delay | | ms | 10 or 11 | |
| Reporting mode | | | PUSCH 3-0 | |
| Sub-band size | | RB | 6 (full size) | |
| ACK/NACK feedback mode | | | Multiplexing | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) | | | | |
| Note 2: Reference measurement channel RC.3 TDD according to table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. | | | | |

**Table 9.3.3.1.2-2 Minimum requirement (TDD)**

|  | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 60 | 60 |
| $\gamma$ | 1.6 | 1.6 |
| UE Category | 1-5 | 1-5 |

# 9.3.4 UE-selected subband CQI

The accuracy of UE-selected subband channel quality indicator (CQI) reporting under frequency-selective fading conditions is determined by the relative increase of the throughput obtained when transmitting on the UE-selected subbands with the corresponding transport format compared to the case for which a fixed format is transmitted on any subband in set *S* of TS 36.213 [6]. The purpose is to verify that correct subbands are accurately reported for frequency-selective scheduling. To account for sensitivity of the input SNR the subband CQI reporting under frequency-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

## 9.3.4.1 Minimum requirement PUSCH 2-0

### 9.3.4.1.1 FDD

For the parameters specified in Table 9.3.4.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.1.1-2 and by the following

a) the ratio of the throughput obtained when transmitting on a randomly selected subband among the best M subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set *S* shall be $\geq \gamma$;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each TTI for FDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{PRB}$ entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.1.1-1 Subband test for single antenna transmission (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 $\tau_d = 0.45\,\mu$s, $a = 1$, $f_D = 5$ Hz | | | |
| Reporting interval | | ms | 5 | | | |
| CQI delay | | ms | 8 | | | |
| Reporting mode | | | PUSCH 2-0 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size ($k$) | | RBs | 3 (full size) | | | |
| Number of preferred subbands ($M$) | | | 5 | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4). Note 2: Reference measurement channel RC.5 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |

**Table 9.3.4.1.1-2 Minimum requirement (FDD)**

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

## 9.3.4.1.2 TDD

For the parameters specified in Table 9.3.4.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.1.2-2 and by the following

a) the ratio of the throughput obtained when transmitting on a randomly selected subband among the best M subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set *S* shall be ≥ γ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{PRB}$ entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.1.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 | | | |
| Reporting interval | | ms | 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| Reporting mode | | | PUSCH 2-0 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size (*k*) | | RBs | 3 (full size) | | | |
| Number of preferred subbands (*M*) | | | 5 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) <br> Note 2: Reference measurement channel RC.5 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. <br> Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |

**Table 9.3.4.1.2-2 Minimum requirement (TDD)**

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

## 9.3.4.2 Minimum requirement PUCCH 2-0

### 9.3.4.2.1 FDD

For the parameters specified in Table 9.3.4.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.2.1-2 and by the following

a) the ratio of the throughput obtained when transmitting on subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set *S* shall be ≥ γ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each TTI for FDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{\text{PRB}}$ entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.2.1-1 Subband test for single antenna transmission (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 8 | 9 | 13 | 14 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -90 | -89 | -85 | -84 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, $a = 1$, $f_D = 5$ Hz | | | |
| Reporting periodicity | | ms | $N_P = 2$ | | | |
| CQI delay | | ms | 8 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type for wideband CQI | | | 4 | | | |
| PUCCH Report Type for subband CQI | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size (*k*) | | RBs | 6 (full size) | | | |
| Number of bandwidth parts (*J*) | | | 3 | | | |
| K | | | 1 | | | |
| *cqi-pmi-ConfigIndex* | | | 1 | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) | | | | | | |
| Note 2: Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. | | | | | | |
| Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |
| Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3. | | | | | | |
| Note 5: CQI reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and data scheduling according to the most recent subband CQI report for bandwidth part with j=1. | | | | | | |
| Note 6: In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report. | | | | | | |

**Table 9.3.4.2.1-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma$ | 1.15 | 1.15 |
| UE Category | 1-5 | 1-5 |

### 9.3.4.2.2 TDD

For the parameters specified in Table 9.3.4.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.4.2.2-2 and by the following

a) the ratio of the throughput obtained when transmitting on subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set $S$ shall be $\geq \gamma$;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{PRB}$ entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

**Table 9.3.4.2.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| SNR (Note 3) | | dB | 8 | 9 | 13 | 14 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -90 | -89 | -85 | -84 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, $a = 1$, $f_D = 5$ Hz | | | |
| Reporting periodicity | | ms | $N_P = 5$ | | | |
| CQI delay | | ms | 10 or 11 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type for wideband CQI | | | 4 | | | |
| PUCCH Report Type for subband CQI | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size (*k*) | | RBs | 6 (full size) | | | |
| Number of bandwidth parts (*J*) | | | 3 | | | |
| K | | | 1 | | | |
| *cqi-pmi-ConfigIndex* | | | 3 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4) | | | | | | |
| Note 2: Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. | | | | | | |
| Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |
| Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2. | | | | | | |
| Note 5: CQI reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and data scheduling according to the most recent subband CQI report for bandwidth part with j=1. | | | | | | |
| Note 6: In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report. | | | | | | |

**Table 9.3.4.2.2-2 Minimum requirement (TDD)**

|  | Test 1 | Test 2 |
|---|---|---|
| $\gamma$ | 1.15 | 1.15 |
| UE Category | 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

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

In the definition of $\gamma$, for PUSCH 3-1 single PMI and PUSCH 1-2 multiple PMI requirements, $t_{rnd}$ is 60% of the maximum throughput obtained at $SNR_{rnd}$ using random precoding, and $t_{ue}$ the throughput measured at $SNR_{rnd}$ with precoders configured according to the UE reports;

For the PUCCH 2-1 single PMI requirement, $t_{rnd}$ is 60% of the maximum throughput obtained at $SNR_{rnd}$ using random precoding on a randomly selected full-size subband in set S subbands, and $t_{ue}$ the throughput measured at $SNR_{rnd}$ with both the precoder and the preferred full-size subband applied according to the UE reports;

For PUSCH 2-2 multiple PMI requirements, $t_{rnd}$ is 60% of the maximum throughput obtained at $SNR_{rnd}$ using random precoding on a randomly selected full-size subband in set S subbands, and $t_{ue}$ the throughput measured at $SNR_{rnd}$ with both the subband precoder and a randomly selected full-size subband (within the preferred subbands) applied according to the UE reports.

## 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 | $\rho_A$ | dB | -3 |
| | $\rho_B$ | 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 |
|---|---|
| $\gamma$ | 1.1 |
| UE Category | 1-5 |

### 9.4.1.1.2 TDD

For the parameters specified in Table 9.4.1.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.1.1.2-2.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | Low 2 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | 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 subframe SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4). | | | |

**Table 9.4.1.1.2-2 Minimum requirement (TDD)**

| Parameter | Test 1 |
|-----------|--------|
| $\gamma$ | 1.1 |
| UE Category | 1-5 |

## 9.4.1.2   Minimum requirement PUCCH 2-1

### 9.4.1.2.1      FDD

For the parameters specified in Table 9.4.1.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.2.1-2.

**Table 9.4.1.2.1-1 PMI test for single-layer (FDD)**

| Parameter | | Unit | Test 1 |
|-----------|---|------|--------|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | $\sigma$ | dB | 3 |

| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 |
|---|---|---|
| PMI delay | ms | 8 or 9 |
| Reporting mode | | PUCCH 2-1 (Note 6) |
| Reporting periodicity | ms | $N_P = 2$ |
| Physical channel for CQI reporting | | PUSCH (Note 3) |
| PUCCH Report Type for wideband CQI/PMI | | 2 |
| PUCCH Report Type for subband CQI | | 1 |
| Measurement channel | | R.14-1 FDD |
| OCNG Pattern | | OP.1/2 FDD |
| Precoding granularity | PRB | 6 (full size) |
| Number of bandwidth parts (*J*) | | 3 |
| K | | 1 |
| *cqi-pmi-ConfigIndex* | | 1 |
| Max number of HARQ transmissions | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} |
| Note 1: For random precoder selection, the precoder shall be updated every two TTI (2 ms granularity) <br><br> 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). <br> Note 3: To avoid collisions between HARQ-ACK and wideband CQI/PMI or subband CQI, it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3. <br> Note 4: Reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and instead data is to be transmitted on the most recently used subband for bandwidth part with j=1. <br> Note 5: In the case where wideband PMI is reported, data is to be transmitted on the most recently used subband. <br> Note 6: The bit field for PMI confirmation in DCI format 1B shall be mapped to '0' and TPMI information shall indicate the codebook index used in Table 6.3.4.2.3-2 of TS36.211 [4] according to the latest PMI report on PUCCH. | | |

**Table 9.4.1.2.1-2 Minimum requirement (FDD)**

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

### 9.4.1.2.2 TDD

For the parameters specified in Table 9.4.1.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.2.2-2.

**Table 9.4.1.2.2-1 PMI test for single-layer (TDD)**

| Parameter | Unit | Test 1 |
|---|---|---|
| Bandwidth | MHz | 10 |
| Transmission mode | | 6 |
| Uplink downlink configuration | | 1 |
| Special subframe configuration | | 4 |

| | | | |
|---|---|---|---|
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | σ | dB | 3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| PMI delay | | ms | 10 |
| Reporting mode | | | PUCCH 2-1 (Note 6) |
| Reporting periodicity | | ms | $N_P = 5$ |
| Physical channel for CQI reporting | | | PUSCH (Note 3) |
| PUCCH Report Type for wideband CQI/PMI | | | 2 |
| PUCCH Report Type for subband CQI | | | 1 |
| Measurement channel | | | R.14-1 TDD |
| OCNG Pattern | | | OP.1/2 TDD |
| Precoding granularity | | PRB | 6 (full size) |
| Number of bandwidth parts (*J*) | | | 3 |
| K | | | 1 |
| *cqi-pmi-ConfigIndex* | | | 4 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| Note 1: For random precoder selection, the precoder shall be updated in each available downlink transmission instance. Note 2: If the UE reports in an available uplink reporting instance at 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: To avoid collisions between HARQ-ACK and wideband CQI/PMI or subband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. Note 4: Reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and instead data is to be transmitted on the most recently used subband for bandwidth part with j=1. Note 5: In the case where wideband PMI is reported, data is to be transmitted on the most recently used subband. Note 6: The bit field for PMI confirmation in DCI format 1B shall be mapped to '0' and TPMI information shall indicate the codebook index used in Table 6.3.4.2.3-2 of TS36.211 [4] according to the latest PMI report on PUCCH. | | | |

**Table 9.4.1.2.2-2 Minimum requirement (TDD)**

| | Test 1 |
|---|---|
| $\gamma$ | 1.2 |
| UE Category | 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 | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EPA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Correlation and antenna configuration | | | Low 2 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | 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.11-3 FDD for UE Category 1, R.11 FDD for UE Category 2-5 |
| 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).<br><br>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).<br><br>Note 3: One/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2 shall be used. | | | |

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

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

### 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 | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EPA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Correlation and antenna configuration | | | Low 2 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | 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.11-3 TDD for UE Category 1 R.11 TDD for UE Category 2-5 |
| 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). | | | |
| Note 3: One/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2 shall be | | | |

| used. |
|---|

**Table 9.4.2.1.2-2 Minimum requirement (TDD)**

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

# 9.4.2.2   Minimum requirement PUSCH 2-2

## 9.4.2.2.1      FDD

For the parameters specified in Table 9.4.2.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.2.1-2.

**Table 9.4.2.2.1-1 PMI test for single-layer (FDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | σ | dB | 3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| PMI delay | | ms | 8 |
| Reporting mode | | | PUSCH 2-2 |
| Reporting interval | | ms | 1 |
| Measurement channel | | | R.14-2 FDD |
| OCNG Pattern | | | OP.1/2 FDD |
| Subband size (*k*) | | RBs | 3 (full size) |
| Number of preferred subbands (*M*) | | | 5 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| Note 1:    For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity) | | | |
| Note 2:    If the UE reports in an available uplink reporting instance at 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 9.4.2.2.1-2 Minimum requirement (FDD)**

|  | **Test 1** |
|---|---|
| $\gamma$ | 1.2 |
| UE Category | 1-5 |

## 9.4.2.2.2 TDD

For the parameters specified in Table 9.4.2.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.2.2.2-2.

**Table 9.4.2.2.2-1 PMI test for single-layer (TDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | σ | dB | 3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| PMI delay | | ms | 10 |
| Reporting mode | | | PUSCH 2-2 |
| Reporting interval | | ms | 1 |
| Measurement channel | | | R.14-2 TDD |
| OCNG Pattern | | | OP.1/2 FDD |
| Subband size (*k*) | | RBs | 3 (full size) |
| Number of preferred subbands (*M*) | | | 5 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| 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 9.4.2.2.2-2 Minimum requirement (TDD)**

|  | **Test 1** |
|---|---|
| $\gamma$ | 1.15 |
| UE Category | 1-5 |

## 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 | $\rho_A$ | dB | -3 | | |
| | $\rho_B$ | dB | -3 | | |
| | σ | dB | 0 | | |
| 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 | | | 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 |
|---|---|---|---|
| $\gamma_1$ | N/A | 1.05 | N/A |
| $\gamma_2$ | 1 | N/A | 1.1 |
| UE Category | 2-5 | 2-5 | 2-5 |

### 9.5.1.2 TDD

The minimum performance requirement in Table 9.5.1.2-2 is defined as

a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

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

**Table 9.5.1.2-1 RI Test (TDD)**

| Parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| PDSCH transmission mode | | | 4 | | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | |
| | $\rho_B$ | dB | -3 | | |
| | 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<br>010000 for fixed RI = 2<br>010011 for UE reported RI | | |
| Antenna correlation | | | Low | Low | High |
| RI configuration | | | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=2 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUSCH 3-1 (Note 3) | | |
| Reporting interval | | ms | 5 | | |
| PMI and CQI delay | | ms | 10 or 11 | | |
| ACK/NACK feedback mode | | | Bundling | | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 2: Reference measurement channel RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.
Note 3: Reported wideband CQI and PMI are used and sub-band CQI is discarded.

**Table 9.5.1.2-2 Minimum requirement (TDD)**

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

# 10　Performance requirement (MBMS)

## 10.1 FDD (Fixed Reference Channel)

The parameters specified in Table 10.1-1 are valid for all FDD tests unless otherwise stated. For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 0 dB as the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

**Table 10.1-1: Common Test Parameters (FDD)**

| Parameter | Unit | Value |
|---|---|---|
| Number of HARQ processes | Processes | None |
| Subcarrier spacing | kHz | 15 kHz |
| Allocated subframes per Radio Frame (Note 1) | | 6 subframes |
| Number of OFDM symbols for PDCCH (Note 2) | | 2 symbols in the case of 3 PHICH symbols or 4 RS Ports; 1 or 2 symbols for other scenarios. |
| Cyclic Prefix | | Extended |
| Note1: For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. Note2: 2 OFDM symbols are reserved for PDCCH in this subclause. | | |

## 10.1.1 Minimum requirement

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS.

For the parameters specified in Table 10.1-1 and Table 10.1.1-1 and Annex A.3.8.1, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.1.1-2.

**Table 10.1.1-1: Test Parameters for Testing**

| Parameter | | Unit | Test 1-4 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Note 1:　$P_B = 0$ | | | |

**Table 10.1.1-2: Minimum performance**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation condition | Correlation Matrix and antenna | Reference value BLER (%) | Reference value SNR(dB) | MBMS UE Category |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 MHz | R.37 FDD | OP.4 FDD | MBSFN channel model (Table B.2.6-1) | 1x2 low | 1 | 4.1 | 1-5 |
| 2 | 10 MHz | R.38 FDD | OP.4 FDD | | | | 11.0 | 1-5 |
| 3 | 10 MHz | R.39 FDD | OP.4 FDD | | | | 20.1 | 2-5 |
| | 5.0MHz | R.39-1 FDD | OP.4 FDD | | | | 20.5 | 1 |
| 4 | 1.4 MHz | R.40 FDD | OP.4 FDD | | | | 6.6 | 1-5 |

# 10.2 TDD (Fixed Reference Channel)

The parameters specified in Table 10.2-1 are valid for all TDD tests unless otherwise stated. For the requirements defined in this section, the difference between CRS EPRE and the MBSFN RS EPRE should be set to 0 dB as the UE demodulation performance might be different when this condition is not met (e.g. in scenarios where power offsets are present, such as scenarios when reserved cells are present).

**Table 10.2-1: Common Test Parameters (TDD)**

| Parameter | Unit | Value |
|---|---|---|
| Number of HARQ processes | Processes | None |
| Subcarrier spacing | kHz | 15 kHz |
| Allocated subframes per Radio Frame (Note 1) | | 5 subframes |
| Number of OFDM symbols for PDCCH (Note 2) | | 2 symbols in the case of 3 PHICH symbols or 4 RS Ports; 1 or 2 symbols for other scenarios. |
| Cyclic Prefix | | Extended |
| Note1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. Note2: 2 OFDM symbols are reserved for PDCCH in this subclause. | | |

## 10.2.1 Minimum requirement

The receive characteristic of MBMS is determined by the BLER. The requirement is valid for all RRC states for which the UE has capabilities for MBMS.

For the parameters specified in Table 10.2-1 and Table 10.2.1-1 and Annex A.3.8.2, the average downlink SNR shall be below the specified value for the BLER shown in Table 10.2.1-2.

**Table 10.2.1-1: Test Parameters for Testing**

| Parameter | | Unit | Test 1-4 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Note 1: $P_B = 0$. | | | |

**Table 10.2.1-2: Minimum performance**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation condition | Correlation Matrix and antenna | Reference value BLER (%) | SNR(dB) | MBMS UE Category |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 MHz | R.37 TDD | OP.4 TDD | MBSFN channel model (Table B.2.6-1) | 1x2 low | 1 | 3.4 | 1-5 |
| 2 | 10 MHz | R.38 TDD | OP.4 TDD | | | | 11.1 | 1-5 |
| 3 | 10 MHz | R.39 TDD | OP.4 TDD | | | | 20.1 | 2-5 |
| | 5MHz | R.39-1 TDD | OP.4 TDD | | | | 20.5 | 1 |
| 4 | 1.4 MHz | R.40 TDD | OP.4 TDD | | | | 5.8 | 1-5 |

# 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 Cat eg | 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**

| Param eter | Ch BW | Alloca ted RBs | DFT-OFDM Symb ols per Sub-Frame | Mod"n | Target Codin g rate | Payloa d size | Trans port block CRC | Numb er of code blocks per Sub-Frame (Note 1) | Total numbe r of bits per Sub-Frame | Total symbo ls per Sub-Frame | UE Categ ory |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.2.2.3  Void

**Table A.2.2.3-1: Void**

# 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**

| Para mete r | Ch BW | Alloc ated RBs | UDL Confi gurati on (Note 2) | DFT-OFDM Symb ols per Sub-Fram e | Mod" n | Targ et Codi ng rate | Paylo ad size for Sub-Fram e 2, 3, 7, 8 | Trans port block CRC | Numb er of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symb ols per Sub-Fram e for Sub-Fram e 2, 3, 7, 8 | UE Cate gory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.2.3.3  Void

**Table A.2.3.3-1: Void**

# 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.3.9 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.3-1 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.1-2 | R.3 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.5 FDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.1-3 | R.6 FDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.7 FDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.8 FDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.9 FDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| FDD | Table A.3.3.1-3a | R.6-1 FDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.7-1 FDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.8-1 FDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-1 FDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-2 FDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| **FDD, 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.11-2 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-1 | R.11-3 FDD | 10 | 16QAM | 1/2 | 40 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-1 | R.30 FDD | 20 | 16QAM | 1/2 | 100 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.35 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 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 | |
| FDD | Table A.3.3.2.2-1 | R.14-1 FDD | 10 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| FDD | Table A.3.3.2.2-1 | R.14-2 FDD | 10 | 16QAM | 1/2 | 3 | | ≥ 1 | |
| FDD | Table A.3.3.2.2-1 | R.36 FDD | 10 | 64QAM | 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.3-1 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.1-2 | R.3 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.5 TDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.1-3 | R.6 TDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.7 TDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.8 TDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.9 TDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| TDD | Table A.3.4.1-3a | R.6-1 TDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.7-1 TDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.8-1 TDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-1 TDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-2 TDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| **TDD, 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.11-2 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-1 | R.11-3 TDD | 10 | 16QAM | 1/2 | 40 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-1 | R.30 TDD | 20 | 16QAM | 1/2 | 100 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-1 | R.35 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 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 | Table A.3.4.2.2-1 | R.14-1 TDD | 10 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| TDD | Table A.3.4.2.2-1 | R.14-2 TDD | 10 | 16QAM | 1/2 | 3 | | ≥ 1 | |
| TDD | Table A.3.4.2.2-1 | R.36 TDD | 10 | 64QAM | 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.26-1 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.3.1-1 | R.27 TDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.1-1 | R.27-1 TDD | 10 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| TDD | Table A.3.4.3.1-1 | R.28 TDD | 10 | 16QAM | 1/2 | 1 | | ≥ 1 | |
| **TDD, PDSCH Performance, Two antenna ports (DRS)** | | | | | | | | | |
| TDD | Table A.3.4.3.2-1 | R.31 TDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.3.2-1 | R.32 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.2-1 | R.32-1 TDD | 5 | 16QAM | 1/2 | [25] | | ≥ 1 | |
| TDD | Table A.3.4.3.2-1 | R.33 TDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.2-1 | R.33-1 TDD | 10 | 64QAM | 3/4 | [18] | | ≥ 1 | |
| TDD | Table A.3.4.3.2-1 | R.34 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| **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 | 1.410 | PDCCH | | | | | |
| FDD | Table A.3.5.1-1 | R.17 FDD | 5 | 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 | 1.410 | PDCCH | | | | | |
| TDD | Table A.3.5.2-1 | R.17 TDD | 5 | PDCCH | | | | | |
| **FDD / TDD, PHICH Performance** | | | | | | | | | |
| FDD / TDD | Table A.3.6-1 | R.18 | 10 | PHICH | | | | | |
| FDD / TDD | Table A.3.6-1 | R.19 | 10 | PHICH | | | | | |
| FDD / TDD | Table A.3.6-1 | R.20 | 5 | 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 | | | | |
| **FDD, PMCH Performance** | | | | | | | | | |
| FDD | Table A.3.8.1-1 | R.40 FDD | 1.4 | QPSK | 1/3 | 6 | | ≥ 1 | |
| FDD | Table A.3.8.1-1 | R.37 FDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| FDD | Table A.3.8.1-2 | R.38 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 1 | |
| FDD | Table A.3.8.1-3 | R.39-1 FDD | 5 | 64QAM | 2/3 | 25 | | ≥ 1 | |
| FDD | Table A.3.8.1-3 | R.39 FDD | 10 | 64QAM | 2/3 | 50 | | ≥ 2 | |
| **TDD, PMCH Performance** | | | | | | | | | |
| TDD | Table A.3.8.2-1 | R.40 TDD | 1.4 | QPSK | 1/3 | 6 | | ≥ 1 | |
| TDD | Table A.3.8.2-1 | R.37 TDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| TDD | Table A.3.8.2-2 | R.38 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 1 | |
| TDD | Table A.3.8.2-3 | R.39-1 TDD | 5 | 64QAM | 2/3 | 25 | | ≥ 1 | |
| TDD | Table A.3.8.2-3 | R.39 TDD | 10 | 64QAM | 2/3 | 50 | | ≥ 2 | |
| **FDD, Sustained data rate** | | | | | | | | | |
| FDD | Table A.3.9.1-1 | R.31-1 FDD | 10 | 64QAM | 0.40 | | | ≥ 1 | |
| FDD | Table A.3.9.1-1 | R.31-2 FDD | 10 | 64QAM | 0.59-0.64 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31-3 FDD | 20 | 64QAM | 0.59-0.62 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31-3A FDD | 10 | 64QAM | 0.85-0.90 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31-3C FDD | 15 | 64QAM | 0.87-0.91 | | | ≥ 3 | |
| FDD | Table A.3.9.1-1 | R.31-4 FDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |
| FDD | Table A.3.9.1-1 | R.31-4B FDD | 15 | 64QAM | 0.85-0.88 | | | ≥ 4 | |
| **TDD, Sustained data rate** | | | | | | | | | |
| TDD | Table A.3.9.2-1 | R.31-1 TDD | 10 | 64QAM | 0.40 | | | ≥ 1 | |
| TDD | Table A.3.9.2-1 | R.31-2 TDD | 10 | 64QAM | 0.59-0.64 | | | ≥ 2 | |
| TDD | Table A.3.9.2-1 | R.31-3 TDD | 20 | 64QAM | 0.59-0.62 | | | ≥ 2 | |
| TDD | Table A.3.9.2-1 | R.31-3B TDD | 15 | 64QAM | 0.87-0.90 | | | ≥ 2 | |
| TDD | Table A.3.9.2-1 | R.31-4 TDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |

## 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, A.3.2-3a, A.3.2-3b, A.3.2-4, A.3.2-4a and A.3.2-4b 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 5) | | 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. <br> Note 2:   For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance <br> Note 3:   Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4] <br> 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). <br> 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 4) | | | | | | | |
| 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 4) | | | | | | | |
|   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 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 | 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. <br> Note 2:   For 1.4MHz, no data shall be scheduled on special subframes(1&6) to avoid problems with insufficient PDCCH performance <br> Note 3:   Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4] <br> 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) <br> 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 <br> Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] <br> Note 3:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | | R.3-1 FDD | R.3 FDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| 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 | | | 6456 | 14112 | | |
|   For Sub-Frame 5 | Bits | | | n/a | n/a | | |
|   For Sub-Frame 0 | Bits | | | 5736 | 12960 | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
|   For Sub-Frames 1,2,3,4,6,7,8,9 | | | | 2 | 3 | | |
|   For Sub-Frame 5 | | | | n/a | n/a | | |
|   For Sub-Frame 0 | | | | 1 | 3 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
|   For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 12600 | 27600 | | |
|   For Sub-Frame 5 | Bits | | | n/a | n/a | | |
|   For Sub-Frame 0 | Bits | | | 10920 | 25920 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | 5.738 | 12.586 | | |
| UE Category | | | | ≥ 1 | ≥ 2 | | |
| Note 1:   2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz <br> Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] <br> Note 3:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

**Table A.3.3.1-3: 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 <br> Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] <br> Note 3:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

**Table A.3.3.1-3a: Fixed Reference Channel 64QAM R=3/4**

| Parameter | Unit | Value | | | | |
|---|---|---|---|---|---|---|
| Reference channel | | R.6-1 FDD | R.7-1 FDD | R.8-1 FDD | R.9-1 FDD | R.9-2 FDD |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 20 |
| Allocated resource blocks (Note 3) | | 18 | 17 | 17 | 17 | 83 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 10296 | 10296 | 10296 | 10296 | 51024 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 8248 | 10296 | 10296 | 10296 | 51024 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 2 | 2 | 2 | 2 | 9 |
| For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | | 2 | 2 | 2 | 2 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 13608 | 14076 | 14076 | 14076 | 68724 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 11088 | 14076 | 14076 | 14076 | 66204 |
| Max. Throughput averaged over 1 frame | Mbps | 9.062 | 9.266 | 9.266 | 9.266 | 45.922 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 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: Localized allocation started from RB #0 is applied. | | | | | | |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | |

**Table A.3.3.1-4: 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<br>Note 2:   Reference signal, synchronization signals and  PBCH allocated as per TS 36.211 [4]<br>Note 3:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 4:   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.11-2 FDD | R.11-3 FDD | R.30 FDD | R.35 FDD |
| Channel bandwidth | MHz | 10 | 10 | 5 | 10 | 20 | 10 |
| Allocated resource blocks | | 50 | 50 | 25 | 40 | 100 | 50 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 | 10 |
| Modulation | | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4392 | 12960 | 5736 | 10296 | 25456 | 19848 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 4392 | 12960 | 4968 | 10296 | 25456 | 18336 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 3 | 1 | 2 | 5 | 4 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 1 | 3 | 1 | 2 | 5 | 3 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 13200 | 26400 | 12000 | 21120 | 52800 | 39600 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 12384 | 24768 | 10368 | 19488 | 51168 | 37152 |
| Max. Throughput averaged over 1 frame | Mbps | 3.953 | 11.664 | 5.086 | 9.266 | 22.910 | 17.712 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz | | | | | | | |
| Note 2: Reference signal, synchronization signals and  PBCH allocated as per TS 36.211 [4] | | | | | | | |
| Note 3: If more 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 | R.14-1 FDD | R.14-2 FDD | R.36 FDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 10 |
| Allocated resource blocks | | 6 | 50 | 50 | 6 | 3 | 50 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 | 10 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | | | | |
|   For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | 18336 |
|   For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | Bits | 152 | 3624 | 11448 | n/a | n/a | 18336 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
|   For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 1 | 3 | 1 | 1 | 3 |
|   For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | | 1 | 1 | 2 | n/a | n/a | 3 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
|   For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 38400 |
|   For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | Bits | 480 | 12032 | 24064 | n/a | n/a | 36096 |
| Max. Throughput averaged over 1 frame | Mbps | 0.342 | 3.876 | 11.513 | 1.235 | 0.595 | 16.502 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 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<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

## A.3.3.3 [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.3-1 TDD | R.3 TDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| Uplink-Downlink Configuration (Note 3) | | | | 1 | 1 | | |
| Allocated subframes per Radio Frame (D+S) | | | | 4+2 | 4+2 | | |
| Modulation | | | | 16QAM | 16QAM | | |
| Target Coding Rate | | | | 1/2 | 1/2 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | 6456 | 14112 | | |
| For Sub-Frames 1,6 | Bits | | | 5160 | 11448 | | |
| For Sub-Frame 5 | Bits | | | n/a | n/a | | |
| For Sub-Frame 0 | Bits | | | 5736 | 12960 | | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | | | 2 | 3 | | |
| For Sub-Frames 1,6 | | | | 1 | 2 | | |
| For Sub-Frame 5 | | | | n/a | n/a | | |
| For Sub-Frame 0 | | | | 1 | 3 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | 12600 | 27600 | | |
| For Sub-Frames 1,6 | Bits | | | 11112 | 22512 | | |
| For Sub-Frame 5 | Bits | | | n/a | n/a | | |
| For Sub-Frame 0 | Bits | | | 11208 | 26208 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | 2.897 | 6.408 | | |
| UE Category | | | | ≥ 1 | ≥ 2 | | |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. | | | | | | | |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] | | | | | | | |
| Note 3: As per Table 4.2-2 in TS 36.211 [4] | | | | | | | |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

**Table A.3.4.1-3: Fixed Reference Channel 64QAM R=3/4**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| | | | R.5 TDD | R.6 TDD | R.7 TDD | R.8 TDD | R.9 TDD |
| Reference channel | | | 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.3.4.1-3a: Fixed Reference Channel 64QAM R=3/4**

| Parameter | Unit | | Value | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | R.6-1 TDD | R.7-1 TDD | R.8-1 TDD | R.9-1 TDD | R.9-2 TDD |
| Channel bandwidth | MHz | | 5 | 10 | 15 | 20 | 20 |
| Allocated resource blocks (Note 3) | | | 18 | 17 | 17 | 17 | 83 |
| Uplink-Downlink Configuration (Note 4) | | | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 |
| Modulation | | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | | |
|   For Sub-Frames 4,9 | Bits | | 10296 | 10296 | 10296 | 10296 | 51024 |
|   For Sub-Frames 1,6 | Bits | | 8248 | 7480 | 7480 | 7480 | 39232 |
|   For Sub-Frame 5 | Bits | | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | Bits | | 8248 | 10296 | 10296 | 10296 | 51024 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
|   For Sub-Frames 4,9 | | | 2 | 2 | 2 | 2 | 9 |
|   For Sub-Frames 1,6 | | | 2 | 2 | 2 | 2 | 7 |
|   For Sub-Frame 5 | | | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | | | 2 | 2 | 2 | 2 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
|   For Sub-Frames 4,9 | Bits | | 13608 | 14076 | 14076 | 14076 | 68724 |
|   For Sub-Frames 1,6 | Bits | | 11880 | 11628 | 11628 | 11628 | 56340 |
|   For Sub-Frame 5 | Bits | | n/a | n/a | n/a | n/a | n/a |
|   For Sub-Frame 0 | Bits | | 11520 | 14076 | 14076 | 14076 | 66636 |
| Max. Throughput averaged over 1 frame | Mbps | | 4.534 | 4.585 | 4.585 | 4.585 | 23.154 |
| UE Category | | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 |
| Note 1:   2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. | | | | | | | |
| Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] | | | | | | | |
| Note 3:   Localized allocation started from RB #0 is applied. | | | | | | | |
| Note 4:   As per Table 4.2-2 TS 36.211 [4] | | | | | | | |
| Note 5:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | |

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| 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. <br> Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] <br> Note 3:   As per Table 4.2-2 in TS 36.211 [4] <br> Note 4:   If more 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) | | 010010 |
| 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 |
| Note 1:   2 symbols allocated to PDCCH<br>Note 2:   Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3:   as per Table 4.2-2 in TS 36.211 [4]<br>Note 4:   If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 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.11-2 TDD | R.11-3 TDD | R.30 TDD | **R.35 TDD** |
| Channel bandwidth | MHz | 10 | 10 | 10 | 5 | 10 | 20 | 10 |
| Allocated resource blocks | | 50 | 50 | 50 | 25 | 40 | 100 | 50 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 |
| Modulation | | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 64 QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4392 | 12960 | 12960 | 5736 | 10296 | 25456 | 19848 |
| For Sub-Frames 1,6 | | 3240 | 9528 | 9528 | 5160 | 9144 | 22920 | 15840 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | | n/a | n/a |
| For Sub-Frame 0 | Bits | 4392 | 12960 | n/a | 4968 | 10296 | 25456 | n/a |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 3 | 3 | 1 | 2 | 5 | 4 |
| For Sub-Frames 1,6 | | 1 | 2 | 2 | 1 | 2 | 4 | 3 |
| For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | | 1 | 3 | n/a | 1 | 2 | 5 | n/a |
| Binary Channel Bits Per Sub-Frame | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 13200 | 26400 | 26400 | 12000 | 21120 | 52800 | 39600 |
| For Sub-Frames 1,6 | | 10656 | 21312 | 21312 | 10512 | 16992 | 42912 | 31968 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 12528 | 25056 | n/a | 10656 | 19776 | 51456 | n/a |
| Max. Throughput averaged over 1 frame | Mbps | 1.966 | 5.794 | 4.498 | 2.676 | 4.918 | 12.221 | 7.138 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. 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 | R.14-1 TDD | R.14-2 TDD | R.36 TDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 10 |
| Allocated resource blocks | | 6 | 50 | 50 | 6 | 3 | 50 |
| Uplink-Downlink Configuration (Note 4) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | 18336 |
| For Sub-Frames 1,6 | Bits | n/a | 3240 | 9528 | n/a | n/a | 15840 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 208 | 4392 | n/a | n/a | n/a | n/a |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 1 | 3 | 1 | 1 | 3 |
| For Sub-Frames 1,6 | | n/a | 1 | 2 | n/a | n/a | 3 |
| For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | | 1 | 1 | n/a | n/a | n/a | n/a |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 38400 |
| For Sub-Frames 1,6 | | n/a | 10256 | 20512 | n/a | n/a | 30768 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 624 | 12176 | n/a | n/a | n/a | n/a |
| Max. Throughput averaged over 1 frame | Mbps | 0.102 | 1.966 | 4.498 | 0.309 | 0.149 | 6.835 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 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 Reference Measurement Channels for UE-Specific Reference Symbols

### A.3.4.3.1 Single antenna port (Cell Specific)

The reference measurement channels in Table A.3.4.3.1-1 apply for verifying demodulation performance for UE-specific reference symbols with one cell-specific antenna port.

**Table A.3.4.3.1-1: Fixed Reference Channel for DRS**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.25 TDD | R.26 TDD | R.26-1 TDD | R.27 TDD | R.27-1 TDD | R.28 TDD |
| Channel bandwidth | MHz | 10 | 10 | 5 | 10 | 10 | 10 |
| Allocated resource blocks | | 50 [4] | 50 [4] | 25 [4] | 50 [4] | 18 [6] | 1 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 |
| Modulation | | QPSK | 16QAM | 16QAM | 64QAM | 64QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 3/4 | 3/4 | 1/2 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4392 | 12960 | 5736 | 28336 | 10296 | 224 |
| For Sub-Frames 1,6 | Bits | 3240 | 9528 | 4584 | 22920 | 8248 | 176 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 2984 | 9528 | 3880 | 22152 | 10296 | 224 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 3 | 1 | 5 | 2 | 1 |
| For Sub-Frames 1,6 | | 1 | 2 | 1 | 4 | 2 | 1 |
| For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | | 1 | 2 | 1 | 4 | 2 | 1 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 12600 | 25200 | 11400 | 37800 | 13608 | 504 |
| For Sub-Frames 1,6 | Bits | 10356 | 20712 | 10212 | 31068 | 11340 | 420 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 10332 | 20664 | 7752 | 30996 | 13608 | 504 |
| Max. Throughput averaged over 1 frame | Mbps | 1.825 | 5.450 | 2.452 | 12.466 | 4.738 | 0.102 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 |

Note 1:  2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2:  Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3:  as per Table 4.2-2 in TS 36.211 [4]
Note 4:  For R.25, R.26 and R.27, 50 resource blocks are allocated in sub-frames 1–9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.  For R.26-1, 25 resource blocks are allocated in sub-frames 1–9 and 17 resource blocks (RB0–RB7 and RB16–RB24) are allocated in sub-frame 0.
Note 5:  If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6:  Localized allocation started from RB #0 is applied.

## A.3.4.3.2 Two antenna ports (Cell Specific)

The reference measurement channels in Table A.3.4.3.2-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports.

**Table A.3.4.3.2-1: Fixed Reference Channel for CDM-multiplexed DM RS**

| Reference channel | | R.31 TDD | R.32 TDD | R.32-1 TDD | R.33 TDD | R.33-1 TDD | R.34 TDD | |
|---|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 10 | 10 | 5 | 10 | 10 | 10 | |
| Allocated resource blocks | | 50 [4] | 50 [4] | 25 [4] | 50 [4] | 18 [6] | 50 [4] | |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | 1 | 1 | 1 | |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | 4+2 | |
| Modulation | | QPSK | 16QAM | 16QAM | 64QAM | 64QAM | 64QAM | |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 3/4 | 3/4 | 1/2 | |
| Information Bit Payload | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 3624 | 11448 | 5736 | 27376 | 9528 | 18336 | |
| For Sub-Frames 1,6 | | 2664 | 7736 | 3112 | 16992 | 7480 | 11832 | |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a | |
| For Sub-Frame 0 | Bits | 2984 | 9528 | 3496 | 22152 | 9528 | 14688 | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 1 | 5 | 2 | 3 | |
| For Sub-Frames 1,6 | | 1 | 2 | 1 | 3 | 2 | 2 | |
| For Sub-Frame 5 | | n/a | n/a | n/a | n/a | n/a | n/a | |
| For Sub-Frame 0 | | 1 | 2 | 1 | 4 | 2 | 3 | |
| Binary Channel Bits Per Sub-Frame | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 12000 | 24000 | 10800 | 36000 | 12960 | 36000 | |
| For Sub-Frames 1,6 | | 7872 | 15744 | 6528 | 23616 | 10368 | 23616 | |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a | n/a | n/a | n/a | |
| For Sub-Frame 0 | Bits | 9840 | 19680 | 7344 | 29520 | 12960 | 29520 | |
| Max. Throughput averaged over 1 frame | Mbps | 1.556 | 4.79 | 2.119 | 11.089 | 4.354 | 7.502 | |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 2 | |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. | | | | | | | | |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] | | | | | | | | |
| Note 3: as per Table 4.2-2 in TS 36.211 [4] | | | | | | | | |
| Note 4: For R.31, R.32, R.33and R.34, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.32-1, 25 resource blocks are allocated in sub-frames 4,9 and 17 resource blocks (RB0–RB7 and RB16–RB24) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1, 6. | | | | | | | | |
| Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | | |
| Note 6: Localized allocation started from RB #0 is applied. | | | | | | | | |

## 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 | 10 | 5 |
| Number of OFDM symbols for PDCCH | symbols | 2 | 2 | 2 |
| Aggregation level | CCE | 8 | 4 | 2 |
| DCI Format | | Format 1 | Format 2 | Format 2 |
| Cell ID | | 0 | 0 | 0 |
| Payload (without CRC) | Bits | 31 | 43 | 42 |

### 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 | 10 | 5 |
| Number of OFDM symbols for PDCCH | symbols | 2 | 2 | 2 |
| Aggregation level | CCE | 8 | 4 | 2 |
| DCI Format | | Format 1 | Format 2 | Format 2 |
| Cell ID | | 0 | 0 | 0 |
| Payload (without CRC) | Bits | 34 | 46 | 45 |

## 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.19 | R.20 | R.24 |
| Number of transmitter antennas | | 1 | 2 | 4 | 1 |
| Channel bandwidth | MHz | 10 | 10 | 5 | 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.<br>Note 2: The resource allocation per user is given as (N_group_PHICH, N_seq_PHICH).<br>Note 3: The power offsets (per user) represent the difference of the power of BPSK modulated symbol per PHICH relative to the first interfering user.<br>Note 4: A=fixed ACK, R=random ACK/NACK. | | | | | |

# A.3.7 Reference measurement channels for PBCH performance requirements

**Table A.3.7-1: Reference Channel FDD/TDD**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| 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.3.8 Reference measurement channels for MBMS performance requirements

## A.3.8.1 FDD

**Table A.3.8.1-1: Fixed Reference Channel QPSK R=1/3**

| Parameter | PMCH |
|---|---|

| | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.40 FDD | | | R.37 FDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | | | 50 | | |
| Allocated subframes per Radio Frame (Note 1) | | 6 | | | 6 | | |
| Modulation | | QPSK | | | QPSK | | |
| Target Coding Rate | | 1/3 | | | 1/3 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | 408 | | | 3624 | | |
| For Sub-Frames 0,4,5,9 | Bits | n/a | | | n/a | | |
| Number of Code Blocks per Subframe (Note 3) | | 1 | | | 1 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | 1224 | | | 10200 | | |
| For Sub-Frames 0,4,5,9 | Bits | n/a | | | n/a | | |
| MBMS UE Category | | ≥ 1 | | | ≥ 1 | | |
| Note 1: For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. | | | | | | | |
| Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211. | | | | | | | |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.1-2: Fixed Reference Channel 16QAM R=1/2**

| Parameter | PMCH | | | | | | |
|---|---|---|---|---|---|---|---|
| | Unit | Value | | | | | |
| Reference channel | | | | | R.38 FDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | | 50 | | |
| Allocated subframes per Radio Frame (Note 1) | | | | | 6 | | |
| Modulation | | | | | 16QAM | | |
| Target Coding Rate | | | | | 1/2 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | | | | 9912 | | |
| For Sub-Frames 0,4,5,9 | Bits | | | | n/a | | |
| Number of Code Blocks per Subframe (Note 3) | | | | | 2 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | | | | 20400 | | |
| For Sub-Frames 0,4,5,9 | Bits | | | | n/a | | |
| MBMS UE Category | | | | | ≥ 1 | | |
| Note 1: For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. | | | | | | | |
| Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211. | | | | | | | |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.1-3: Fixed Reference Channel 64QAM R=2/3**

| Parameter | PMCH |
|---|---|

| | Unit | | | Value | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | | R.39-1 FDD | R.39 FDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| Allocated subframes per Radio Frame(Note1) | | | | 6 | 6 | | |
| Modulation | | | | 64QAM | 64QAM | | |
| Target Coding Rate | | | | 2/3 | 2/3 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | | | 9912 | 19848 | | |
| For Sub-Frames 0,4,5,9 | Bits | | | n/a | n/a | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | 2 | 4 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 1,2,3,6,7,8 | Bits | | | 15300 | 30600 | | |
| For Sub-Frames 0,4,5,9 | Bits | | | n/a | n/a | | |
| MBMS UE Category | | | | ≥ 1 | ≥ 2 | | |
| Note 1: : For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. | | | | | | | |
| Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211. | | | | | | | |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

## A.3.8.2 TDD

**Table A.3.8.2-1: Fixed Reference Channel QPSK R=1/3**

| Parameter | PMCH | | | | | |
|---|---|---|---|---|---|---|
| | Unit | Value | | | | |
| Reference channel | | R.40 TDD | | | R.37 TDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | | | 50 | | |
| Uplink-Downlink Configuration(Note 1) | | 5 | | | 5 | | |
| Allocated subframes per Radio Frame | | 5 | | | 5 | | |
| Modulation | | QPSK | | | QPSK | | |
| Target Coding Rate | | 1/3 | | | 1/3 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | 408 | | | 3624 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | n/a | | | n/a | | |
| Number of Code Blocks per Subframe (Note 3) | | 1 | | | 1 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | 1224 | | | 10200 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | n/a | | | n/a | | |
| MBMS UE Category | | ≥ 1 | | | ≥ 1 | | |
| Note 1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. | | | | | | | |
| Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211. | | | | | | | |
| Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.2-2: Fixed Reference Channel 16QAM R=1/2**

| Parameter | | PMCH | | | | | |
|---|---|---|---|---|---|---|---|
| | Unit | | | | Value | | |
| Reference channel | | | | | R.38 TDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | | 50 | | |
| Uplink-Downlink Configuration(Note 1) | | | | | 5 | | |
| Allocated subframes per Radio Frame | | | | | 5 | | |
| Modulation | | | | | 16QAM | | |
| Target Coding Rate | | | | | 1/2 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | | | | 9912 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | | | | n/a | | |
| Number of Code Blocks per Subframe (Note 3) | | | | | 2 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | | | | 20400 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | | | | n/a | | |
| MBMS UE Category | | | | | ≥ 1 | | |
| Note 1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211. Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.2-3: Fixed Reference Channel 64QAM R=2/3**

| Parameter | | PMCH | | | | | |
|---|---|---|---|---|---|---|---|
| | Unit | | | Value | | | |
| Reference channel | | | | R.39-1TDD | R.39 TDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| Uplink-Downlink Configuration(Note 1) | | | | 5 | 5 | | |
| Allocated subframes per Radio Frame | | | | 5 | 5 | | |
| Modulation | | | | 64QAM | 64QAM | | |
| Target Coding Rate | | | | 2/3 | 2/3 | | |
| Information Bit Payload (Note 2) | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | | | 9912 | 19848 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | | | n/a | n/a | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | 2 | 4 | | |
| Binary Channel Bits Per Subframe | | | | | | | |
| For Sub-Frames 3,4,7,8,9 | Bits | | | 15300 | 30600 | | |
| For Sub-Frames 0,1,2,5,6 | Bits | | | n/a | n/a | | |
| MBMS UE Category | | | | ≥ 1 | ≥ 2 | | |
| Note 1: For TDD mode, in line with TS 36.331, Uplink-Downlink Configuration 5 is proposed, up to 5 subframes (#3/4/7/8/9) are available for MBMS. Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211. Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

## A.3.9 Reference measurement channels for sustained downlink data rate provided by lower layers

### A.3.9.1 FDD

**Table A.3.9.1-1: Fixed Reference Channel for sustained data-rate test (FDD)**

| Parameter | Unit | Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.31-1 FDD | R.31-2 FDD | R.31-3 FDD | R.31-3A FDD | R.31-3C FDD | R.31-4 FDD | R.31-4B FDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 10 | 15 | 20 | 15 |
| Allocated resource blocks | | Note 5 | Note 6 | Note 7 | Note 6 | Note 8 | Note 7 | Note 9 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.40 | 0.59 | 0.59 | 0.85 | 0.87 | 0.88 | 0.85 |
| For Sub-Frame 5 | | 0.40 | 0.64 | 0.62 | 0.89 | 0.88 | 0.87 | 0.87 |
| For Sub-Frame 0 | | 0.40 | 0.63 | 0.61 | 0.90 | 0.91 | 0.90 | 0.88 |
| Information Bit Payload | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 35160 | 51024 | 71112 | 52752 |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 |
| For Sub-Frame 5 | Bits | 2 | 5 | 9 | 6 | 9 | 12 | 9 |
| For Sub-Frame 0 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 26100 | 43200 | 86400 | 43200 | 58752 | 86400 | 64800 |
| For Sub-Frame 5 | Bits | 26100 | 39744 | 82080 | 39744 | 57888 | 82080 | 60480 |
| For Sub-Frame 0 | Bits | 26100 | 40752 | 83952 | 40752 | 56304 | 83952 | 62352 |
| Number of layers | | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame | Mbps | 10.296 | 25.456 | 51.024 | 36.542 | 51.024 | 74.950 | 54.826 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 | ≥ 3 | ≥ 4 |
| | Note 1: 1 symbol allocated to PDCCH for all tests<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 4: Resource blocks $n_{PRB}$ = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths<br>Note 5: Resource blocks $n_{PRB}$ = 6..14,30..49 are allocated for the user data in all sub-frames<br>Note 6: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9<br>Note 7: Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9<br>Note 8: Resource blocks $n_{PRB}$ = 4..71 are allocated for the user data in sub-frames 0,1,2,3,4,5,6,7,8,9.<br>Note 9: Resource blocks $n_{PRB}$ = 4..74 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9. | | | | | | | |

## A.3.9.2 TDD

**Table A.3.9.2-1: Fixed Reference Channel for sustained data-rate test (TDD)**

| Parameter | Unit | Value | | | | |
|---|---|---|---|---|---|---|
| Reference channel | | R.31-1 TDD | R.31-2 TDD | R.31-3 TDD | R.31-3B TDD | R.31-4 TDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | Note 8 |
| Uplink-Downlink Configuration (Note 3) | | 5 | 5 | 5 | 1 | 1 |
| Number of HARQ Processes per component carrier | Processes | 15 | 15 | 15 | 7 | 7 |
| Allocated subframes per Radio Frame (D+S) | | 8+1 | 8+1 | 8+1 | 4+2 | 4+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | | | | |
| For Sub-Frames 4,9 | | 0.40 | 0.59 | 0.59 | 0.87 | 0.88 |
| For Sub-Frames 3,7,8 | | 0.40 | 0.59 | 0.59 | n/a | n/a |
| For Sub-Frames 1 | | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frames 5 | | 0.40 | 0.64 | 0.62 | 0.88 | 0.87 |
| For Sub-Frames 6 | | 0.40 | 0.60 | 0.60 | n/a | n/a |
| For Sub-Frames 0 | | 0.40 | 0.62 | 0.61 | 0.90 | 0.90 |
| Information Bit Payload | | | | | | |
| For Sub-Frames 4,9 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 |
| For Sub-Frame 3,7,8 | Bits | 10296 | 25456 | 51024 | 0 | 0 |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 51024 | 71112 |
| For Sub-Frame 6 | Bits | 10296 | 25456 | 51024 | 0 | 0 |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | |
| For Sub-Frames 4,9 | | 2 | 5 | 9 | 9 | 13 |
| For Sub-Frame 3,7,8 | Bits | 2 | 5 | 9 | n/a | n/a |
| For Sub-Frame 1 | | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 5 | | 2 | 5 | 9 | 9 | 12 |
| For Sub-Frame 6 | Bits | 2 | 5 | 9 | n/a | n/a |
| For Sub-Frame 0 | | 2 | 5 | 9 | 9 | 13 |
| Binary Channel Bits Per Sub-Frame | | | | | | |
| For Sub-Frames 4,9 | Bits | 26100 | 43200 | 86400 | 58752 | 86400 |
| For Sub-Frame 3,7,8 | Bits | 26100 | 43200 | 86400 | n/a | n/a |
| For Sub-Frame 1 | Bits | n/a | n/a | n/a | n/a | n/a |
| For Sub-Frame 5 | Bits | 26100 | 40176 | 82512 | 58320 | 82512 |
| For Sub-Frame 6 | Bits | 26100 | 42768 | 85968 | n/a | n/a |
| For Sub-Frame 0 | Bits | 26100 | 41184 | 84384 | 56736 | 84384 |
| Number of layers | | 1 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame | Mbps | 8.237 | 20.365 | 40.819 | 20.409 | 29.724 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 |
| Note 1: 1 symbol allocated to PDCCH for all tests | | | | | | |
| Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4] | | | | | | |
| Note 3: As per Table 4.2-2 in TS 36.211 [4] | | | | | | |
| Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | |
| Note 5: Resource blocks $n_{PRB}$ = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths | | | | | | |
| Note 6: Resource blocks $n_{PRB}$ = 6..14,30..49 are allocated for the user data in all subframes | | | | | | |
| Note 7: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in sub-frames 0,3,4,6,7,8,9 | | | | | | |
| Note 8: Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in sub-frames 0,3,4,6,7,8,9 | | | | | | |
| Note 9: Resource blocks $n_{PRB}$ = 4..71 are allocated for the user data in all sub-frames | | | | | | |

# A.4 CSI reference measurement channels

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

In Table A.4-1 are specified the reference channels. Table A.4-13 specifies the mapping of CQI index to modulation coding scheme, which complies with the CQI definition specified in Section 7.2.3 of [6].

**Table A.4-0: Void**

**Table A.4-1: CSI reference measurement channels**

| RMC Name | Duplex | CH-BW | Alloc. RB-s | UL/DL Config | Alloc. SF-s | MCS Scheme | Nr. HARQ Proc. | Max. nr HARQ Trans. | Notes |
|---|---|---|---|---|---|---|---|---|---|
| **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 | |
| RC.4 FDD | FDD | 10 | 15 | - | | MCS.15 | 8 | 1 | Note 6 |
| RC.4 TDD | TDD | 10 | 15 | Note 3 | | MCS.15 | 10 | 1 | Note 6 |
| RC.5 FDD | FDD | 10 | 3 | - | | MCS.17 | 8 | 1 | |
| RC.5 TDD | TDD | 10 | 3 | Note 3 | | MCS.17 | 10 | 1 | |
| **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. <br> Note 2: For FDD only subframes 1, 2, 3, 4, 6, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead. <br> Note 3: TDD UL-DL configuration as specified in the individual tests. <br> 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. <br> 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. <br> Note 6: Centered within the Transmission Bandwidth Configuration (Figure 5.6-1). | | | | | | | | | |

**Table A.4-2: Void**

**Table A.4-3: Void**

**Table A.4-3a: Void**

**Table A.4-4: Void**

**Table A.4-6: Void**

**Table A.4-7: Void**

**Table A.4-8: Void**

**Table A.4-9: Void**

**Table A.4-10: Void**

**Table A.4-11: Void**

**Table A.4-12: Void**

### Table A.4-13: Mapping of CQI Index to Modulation coding scheme (MCS)

| CQI Index | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 |
| **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 |
| MCS.2 | 50 | 6000 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 18 | 20 | 22 | 24 |
| MCS.3 | 50 | 5700 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 10 | 13 | 15 | 17 | 19 | 21 | 23 |
| MCS.4 | 50 | 5600 | DTX | 0 | 0 | 2 | 4 | 6 | 7 | 10 | 12 | 14 | 17 | 19 | 21 | 23 |
| MCS.5 | 50 | 5400 | DTX | 0 | 0 | 2 | 3 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 21 | 23 |
| MCS.6 | 50 | 5300 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 21 | 22 |
| MCS.7 | 50 | 5200 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 17 | 18 | 20 | 22 |
| MCS.8 | 50 | 5000 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 13 | 17 | 18 | 20 | 22 |
| MCS.9 | 50 | 4800 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 13 | 17 | 18 | 20 | 22 |
| MCS.10 | 6 | 756 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 19 | 21 | 23 | 25 |
| MCS.11 | 6 | 684 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 14 | 17 | 20 | 21 | 23 |
| MCS.12 | 6 | 672 | DTX | 0 | 0 | 1 | 4 | 6 | 8 | 10 | 12 | 14 | 17 | 19 | 21 | 23 |
| MCS.13 | 6 | 648 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 18 | 20 | 22 | 24 |
| MCS.14 | 25 | 3150 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 18 | 21 | 23 | 25 |
| MCS.15 | 15 | 1890 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 18 | 21 | 23 | 25 |
| MCS.16 | 15 | 1800 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 18 | 20 | 22 | 24 |
| MCS.17 | 3 | 378 | DTX | 0 | 1 | 2 | 5 | 7 | 9 | 12 | 13 | 16 | 19 | 21 | 23 | 25 |

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 b
retransmissions.

# A.5    OFDMA Channel Noise Generator (OCNG)

## A.5.1    OCNG Patterns for FDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test) and/or allocations used for MBSFN. The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG_RA and OCNG_RB which together with a relative power level ( $\gamma$ ) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA/OCNG\_RA = PDSCH_i\_RB/OCNG\_RB,$$

where $\gamma_i$ denotes the relative power level of the *i:th* virtual UE. The parameter settings of OCNG_RA, OCNG_RB, and the set of relative power levels $\gamma$ are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a constant transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover the OCNG pattern is accompanied by a PCFICH/PDCCH/PHICH reference channel which specifies the control region. For any aggregation and PHICH allocation, the PDCCH and any unused PHICH groups are padded with resource element groups with a power level given respectively by PDCCH_RA/RB and PHICH_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

### A.5.1.1   OCNG FDD pattern 1: One sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.1.1-1: OP.1 FDD: One sided dynamic OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | $1-4, 6-9$ | |
| **Allocation** | | | |
| First unallocated PRB – 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 $\gamma_{PRB}$ is used to scale the power of PDSCH. <br> Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | |

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

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

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

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | $1-4, 6-9$ | |
| **Allocation** | | | |
| 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB} - 1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB} - 1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB} - 1$) | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH. <br> Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | |

## A.5.1.3   OCNG FDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz

**Table A.5.1.3-1: OP.3 FDD: OCNG FDD Pattern 3**

| Allocation $n_{PRB}$ | Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data | PMCH Data |
|---|---|---|---|---|---|---|
| | Subframe | | | | | |
| | 0 | 5 | 4, 9 | 1 – 3, 6 – 8 | | |
| 1 – 49 | 0 | 0 (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 $\gamma_{PRB}$ 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 $\gamma_{PRB}$ is used to scale the power of PMCH. | | | | | | |
| Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | | | | |
| N/A:     Not Applicable | | | | | | |

## A.5.1.4   OCNG FDD pattern 4: One sided dynamic OCNG FDD pattern for MBMS transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided) and MBMS performance is tested.

**Table A.5.1.4-1: OP.4 FDD: One sided dynamic OCNG FDD Pattern for MBMS transmission**

| Allocation $n_{PRB}$ | Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data | PMCH Data |
| | Subframe | | | | |
| | 0, 4, 9 | 5 | 1 – 3, 6 – 8 | | |
|---|---|---|---|---|---|
| First unallocated PRB – Last unallocated PRB | 0 | 0 (Allocation: all empty PRB-s) | N/A | Note 1 | N/A |
| First unallocated PRB – Last unallocated PRB | N/A | N/A | N/A | N/A | 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 $\gamma_{PRB}$ 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 $\gamma_{PRB}$ is used to scale the power of PMCH. | | | | | |
| Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | | | |
| N/A: Not Applicable | | | | | |

## A.5.1.5   Void

## A.5.1.6   OCNG FDD pattern 6: dynamic OCNG FDD pattern when user data is in 2 non-contiguous blocks

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

**Table A.5.1.6-1: OP.6 FDD: OCNG FDD Pattern when user data is in 2 non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH. <br> Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | |

# A.5.2 OCNG Patterns for TDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG_RA and OCNG_RB which together with a relative power level ($\gamma$) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA/OCNG\_RA = PDSCH_i\_RB/OCNG\_RB,$$

where $\gamma_i$ denotes the relative power level of the *i:th* virtual UE. The parameter settings of OCNG_RA, OCNG_RB, and the set of relative power levels $\gamma$ are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover the OCNG pattern is accompanied by a PCFICH/PDCCH/PHICH reference channel which specifies the control region. For any aggregation and PHICH allocation, the PDCCH and any unused PHICH groups are padded with resource element groups with a power level given respectively by PDCCH_RA/RB and PHICH_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

## A.5.2.1 OCNG TDD pattern 1: One sided dynamic OCNG TDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the subframes available for DL transmission (depending on TDD UL/DL configuration), when the unallocated area is continuous in frequency domain (one sided).

**Table A.5.2.1-1: OP.1 TDD: One sided dynamic OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data |
|---|---|---|---|---|
| Subframe (only if available for DL) | | | | |
| 0 | 5 | 3, 4, 7, 8, 9 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 $\gamma_{PRB}$ is used to scale the power of PDSCH. <br> Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211 <br> Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | | |

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

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

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

| Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data |
|---|---|---|---|---|
| Subframe (only if available for DL) | | | | |
| 0 | 5 | 3, 4, 6, 7, 8, 9 (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 $\gamma_{PRB}$ is used to scale the power of PDSCH. <br> Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211 <br> Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | | |

## A.5.2.3 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 $\gamma_{PRB}$ [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 $\gamma_{PRB}$ is used to scale the power of PDSCH.

Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211.

Note 3: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.

Note 4: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.

N/A: Not Applicable

## A.5.2.4 OCNG TDD pattern 4: One sided dynamic OCNG TDD pattern for MBMS transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided) and MBMS performance is tested.

**Table A.5.2.4-1: OP.4 TDD: One sided dynamic OCNG TDD Pattern for MBMS transmission**

| Allocation $n_{PRB}$ | Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data | PMCH Data |
|---|---|---|---|---|---|---|
| | Subframe (only for DL) | | | | | |
| | 0 and 6 (as normal subframe) | 1 (as special subframe) | 5 | 3, 4, 7 – 9 | | |

| First unallocated PRB – Last unallocated PRB | 0 | 0 (Allocation: all empty PRB-s of DwPTS) | 0 (Allocation: all empty PRB-s) | N/A | Note 1 | N/A |
|---|---|---|---|---|---|---|
| First unallocated PRB – Last unallocated PRB | N/A | N/A | N/A | N/A | N/A | Note2 |

Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.

Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.

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.5.2.5 Void

## A.5.2.6 OCNG TDD pattern 6: dynamic OCNG TDD pattern when user data is in 2 non-contiguous blocks

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

**Table A.5.2.6-1: OP.6 TDD: OCNG TDD Pattern when user data is in 2 non-contiguous blocks**

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

# 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 | 45 ns | 410 ns |
| Extended Vehicular A model (EVA) | 9 | 357 ns | 2510 ns |
| Extended Typical Urban model (ETU) | 9 | 991 ns | 5000 ns |

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

| Excess tap delay [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 30Hz | 30 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** | $R_{eNB} = 1$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ |

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

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 $\alpha$ and $\beta$ for different correlation types are given in Table B.2.3.2-1.

**Table B.2.3.2-1**

| Low correlation | | Medium Correlation | | High Correlation | |
|---|---|---|---|---|---|
| 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} = $ (16×16 matrix)<br><br>1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894 0.9541 0.9430 0.9105 0.8587 0.8999 0.8894 0.8587 0.8099<br>0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430 0.9430 0.9541 0.9430 0.9105 0.8894 0.8999 0.8894 0.8587<br>0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767 0.9105 0.9430 0.9541 0.9430 0.8587 0.8894 0.8999 0.8894<br>0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882 0.8587 0.9105 0.9430 0.9541 0.8099 0.8587 0.8894 0.8999<br>0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894 0.9541 0.9430 0.9105 0.8587<br>0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430 0.9430 0.9541 0.9430 0.9105<br>0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767 0.9105 0.9430 0.9541 0.9430<br>0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882 0.8587 0.9105 0.9430 0.9541<br>0.9541 0.9430 0.9105 0.8587 0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999 0.9882 0.9767 0.9430 0.8894<br>0.9430 0.9541 0.9430 0.9105 0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541 0.9767 0.9882 0.9767 0.9430<br>0.9105 0.9430 0.9541 0.9430 0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882 0.9430 0.9767 0.9882 0.9767<br>0.8587 0.9105 0.9430 0.9541 0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 0.8894 0.9430 0.9767 0.9882<br>0.8999 0.8894 0.8587 0.8099 0.9541 0.9430 0.9105 0.8587 0.9882 0.9767 0.9430 0.8894 1.0000 0.9882 0.9541 0.8999<br>0.8894 0.8999 0.8894 0.8587 0.9430 0.9541 0.9430 0.9105 0.9767 0.9882 0.9767 0.9430 0.9882 1.0000 0.9882 0.9541<br>0.8587 0.8894 0.8999 0.8894 0.9105 0.9430 0.9541 0.9430 0.9430 0.9767 0.9882 0.9767 0.9541 0.9882 1.0000 0.9882<br>0.8099 0.8587 0.8894 0.8999 0.8587 0.9105 0.9430 0.9541 0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 0.9882 1.0000 |

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

| 2x2 case | N/A |
|---|---|
| 2x2 case | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ |
| 2x2 case | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{pmatrix}$ |

$$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 $(t,\tau)$ representation, with $\tau_d$ the delay, $a$ a constant and $f_D$ the Doppler frequency. The same $h(t,\tau)$ is used to describe the fading channel between every pair of Tx and Rx.

# B.2.5 Void

# B.2.6 MBSFN Propagation Channel Profile

Table B.2.6-1 shows propagation conditions that are used for the MBSFN performance requirements in multi-path fading environment in an extended delay spread environment.

**Table B.2.6-1: Propagation Conditions for Multi-Path Fading Environments for MBSFN Performance Requirements in an extended delay spread environment**

| Extended Delay Spread | |
| --- | --- |
| Maximum Doppler frequency [5Hz] | |
| Relative Delay [ns] | Relative Mean Power [dB] |
| 0 | 0 |
| 30 | -1.5 |
| 150 | -1.4 |
| 310 | -3.6 |
| 370 | -0.6 |
| 1090 | -7.0 |
| 12490 | -10 |
| 12520 | -11.5 |
| 12640 | -11.4 |
| 12800 | -13.6 |
| 12860 | -10.6 |
| 13580 | -17.0 |
| 27490 | -20 |
| 27520 | -21.5 |
| 27640 | -21.4 |
| 27800 | -23.6 |
| 27860 | -20.6 |
| 28580 | -27.0 |

# B.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

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

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

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

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.
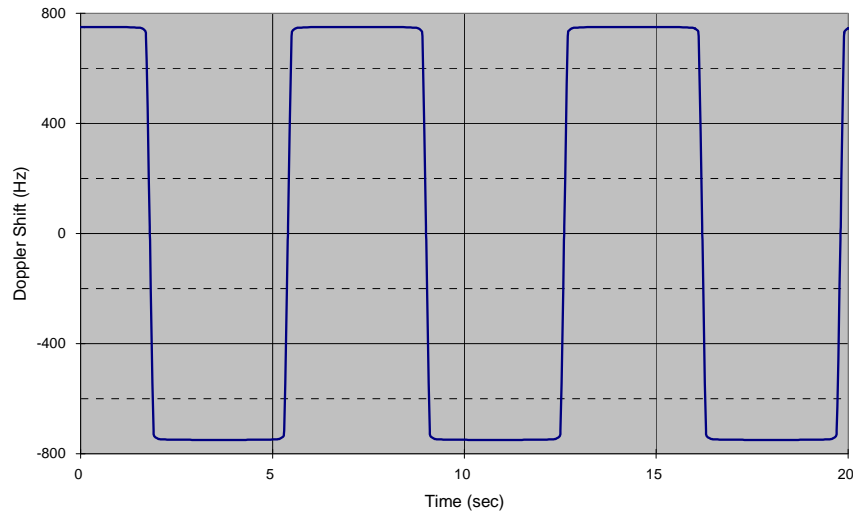


**Figure B.3-1: Doppler shift trajectory**

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, 7, or 8)

Single-layer transmission on antenna port 5 or on antenna port 7 or 8 without a simultaneous transmission on the other antenna port, is defined by using a precoder vector $W(i)$ of size $2\times1$ randomly selected with the number of layers $\upsilon = 1$ from Table 6.3.4.2.3-1 in [4] as beamforming weights. This precoder takes as an input the signal $y^{(p)}(i)$, $i = 0,1,...,M_{\text{symb}}^{\text{ap}} - 1$, for antenna port $p \in \{5,7,8\}$, with $M_{\text{symb}}^{\text{ap}}$ the number of modulation symbols including the user-specific reference symbols (DRS), and generates a block of signals $y_{bf}(i) = \begin{bmatrix} y_{bf}(i) & \tilde{y}_{bf}(i) \end{bmatrix}^T$ the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

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

Single-layer transmission on antenna port 7 or 8 with a simultaneous transmission on the other antenna port, is defined by using a pair of precoder vectors $W_1(i)$ and $W_2(i)$ each of size $2 \times 1$, which are not identical and randomly selected with the number of layers $\upsilon = 1$ from Table 6.3.4.2.3-1 in [4], as beamforming weights, and normalizing the transmit power as follows:

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = \frac{1}{\sqrt{2}} \left( W_1(i) y^{(7)}(i) + W_2(i) y^{(8)}(i) \right)$$

The precoder update granularity is according to Table 8.3.2-1.

# B.4.2 Dual-layer beamforming (antenna ports 7 and 8)

Dual-layer transmission on antenna ports 7 and 8 is defined by using a precoder matrix $W(i)$ of size $2 \times 2$ randomly selected with the number of layers $\upsilon = 2$ from Table 6.3.4.2.3-1 in [4] as beamforming weights. This precoder takes as an input a block of signals for antenna ports 7 and 8, $y(i) = \begin{bmatrix} y^{(7)}(i) & y^{(8)}(i) \end{bmatrix}^T$, $i = 0,1,...,M_{symb}^{ap} - 1$, with $M_{symb}^{ap}$ being the number of modulation symbols per antenna port including the user-specific reference symbols, and generates a block of signals $y_{bf}(i) = \begin{bmatrix} y_{bf}(i) & \tilde{y}_{bf}(i) \end{bmatrix}^T$ the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W(i) \begin{bmatrix} y^{(7)}(i) \\ y^{(8)}(i) \end{bmatrix},$$

The precoder update granularity is 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 = $\rho_A$ + σ |
| | PBCH_RB = $\rho_B$ + σ |
| PSS | PSS_RA = 0 dB (Note 3) |
| SSS | SSS_RA = 0 dB (Note 3) |
| PCFICH | PCFICH_RB = $\rho_B$ + σ |
| PDCCH | PDCCH_RA = $\rho_A$ + σ |
| | PDCCH_RB = $\rho_B$ + σ |
| PDSCH | PDSCH_RA = $\rho_A$ |
| | PDSCH_RB = $\rho_B$ |
| PMCH | PMCH_RA = $\rho_A$ |
| | PMCH_RB = $\rho_B$ |
| MBSFN RS | MBSFN RS_RA = $\rho_A$ |
| | MBSFN RS_RB = $\rho_B$ |
| OCNG | OCNG_RA = $\rho_A$ + σ |
| | OCNG_RB = $\rho_B$ + σ |

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

NOTE 2: MBSFN RS and OCNG are not defined downlink physical channels in [4].

NOTE 3: Assuming PSS and SSS transmitted on a single antenna port.

NOTE 4: $\rho_A$, $\rho_B$ 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 $p$ |
| Energy per resource element EPRE | | Test specific | 1. The complex-valued symbols $y^{(p)}(i)$ and $a_{k,l}^{(p)}$ defined in [4] shall conform to the given EPRE value. 2. For TM8, the reference point for EPRE is before the precoder in Annex B.4. |

# 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 | 0,85 * nominal | Nominal | Nominal |
| Lithium | 0,95 * nominal | 1,1 * Nominal | 1,1 * Nominal |
| Mercury/nickel & cadmium | 0,90 * nominal | | Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

# E.2.3    Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

**Table E.2.3-1**

| 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).
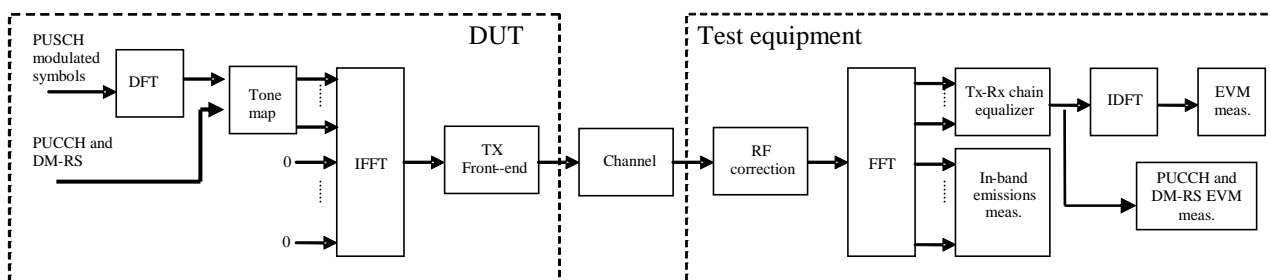


**Figure F.1-1: EVM measurement points**

## 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)

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

where

$T_m$ is a set of $\left| T_m \right|$ 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

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

where

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

$\Delta_{RB}$ is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB),

$f_{\min}$ (resp. $f_{\max}$) is the lower (resp. upper) edge of the UL system BW,

$f_l$ and $f_h$ are the lower and upper edge of the allocated BW, and

$Y(t, f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection (ii)

The relative in-band emissions are, given by

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

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::

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

where

$z(v)$ is the time domain samples of the signal under test.

The PUCCH or PUSCH demodulation reference signal or PUCCH data signal under test is equalised and, in the case of PUCCH data signal decoded according to:

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

where

$z(v)$ is the time domain samples of the signal under test.

To minimize the error, the signal under test should be modified with respect to a set of parameters following the procedure explained below.

Notation:

$\Delta\tilde{t}$ is the sample timing difference between the FFT processing window in relation to nominal timing of the ideal signal.

$\Delta\tilde{f}$ is the RF frequency offset.

$\tilde{\varphi}(t,f)$ is the phase response of the TX chain.

$\tilde{a}(t,f)$ is the amplitude response of the TX chain.

In the following $\Delta\tilde{c}$ represents the middle sample of the EVM window of length $W$ (defined in the next subsections) or the last sample of the first window half if $W$ is even.

The EVM analyser shall

➤  detect the start of each slot and estimate $\Delta\tilde{t}$ and $\Delta\tilde{f}$ ,

➤  determine $\Delta\tilde{c}$ so that the EVM window of length $W$ is centred

- on the time interval determined by the measured cyclic prefix minus 16 samples of the considered OFDM symbol for symbol 0 for normal CP, i.e. the first 16 samples of the CP should not be taken into account for this step. In the determination of the number of excluded samples, a sampling rate of 30.72MHz was assumed. If a different sampling rate is used, the number of excluded samples is scaled linearly.

- on the measured cyclic prefix of the considered OFDM symbol 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 $\Delta \tilde{c} + \alpha - \left\lfloor \dfrac{W}{2} \right\rfloor$ or $\Delta \tilde{c} + \left\lfloor \dfrac{W}{2} \right\rfloor$, where $\alpha = 0$ if $W$ is odd and $\alpha = 1$ if $W$ is even. The EVM analyser shall then

➢ calculate EVM$_l$ with $\Delta \tilde{t}$ set to $\Delta \tilde{c} + \alpha - \left\lfloor \dfrac{W}{2} \right\rfloor$,

➢ calculate EVM$_h$ with $\Delta \tilde{t}$ set to $\Delta \tilde{c} + \left\lfloor \dfrac{W}{2} \right\rfloor$.

# 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 | | | 128 | 9 | 5 | 55.6 |
| 3 | | | 256 | 18 | 12 | 66.7 |
| 5 | 160 | 144 | 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 | | 128 | 32 | 28 | 87.5 |
| 3 | | 256 | 64 | 58 | 90.6 |
| 5 | 512 | 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 $\overline{\text{EVM}}_l$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_l$ in the expressions above and $\overline{\text{EVM}}_h$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_h$.

Thus we get:

$$EVM = \max(\overline{\text{EVM}}_l, \overline{\text{EVM}}_h)$$

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 $\overline{\text{EVM}}_l > \overline{\text{EVM}}_h$, and it is set to $\Delta\tilde{t} = \Delta\tilde{t}_h$ otherwise, where $\overline{\text{EVM}}_l$ and $\overline{\text{EVM}}_h$ are the general average EVM values calculated in the same 20 slots over which the intermediate average $\overline{EVM}_{DMRS}$ is calculated. Note that in some cases, the general average EVM may be calculated only for the purpose of timing selection for the demodulation reference signal EVM.

Then the results are further averaged to get the EVM for the demodulation reference signal, $EVM_{DMRS}$,

$$EVM_{DMRS} = \sqrt{\frac{1}{6}\sum_{j=1}^{6} \overline{EVM}_{DMRS,j}^2}$$

The PRACH EVM, $EVM_{PRACH}$, is averaged over two preamble sequence measurements for preamble formats 0, 1, 2, 3, and it is averaged over 10 preamble sequence measurements for preamble format 4.

The EVM requirements shall be tested against the maximum of the RMS average at the window $W$ extremities of the EVM measurements:

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

Thus we get:

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

# F.7 Spectrum Flatness

The data shall be taken from FFT coded data symbols and the demodulation reference symbols of the allocated resource block.

# Annex G (informative):
# Change history

**Table G.1: Change History**

| Date | TSG# | TSG Doc. | CR | Subject | Old | New |
|------|------|----------|-----|---------|-----|-----|
| 11-2007 | R4#45 | R4-72206 | | TS36.101V0.1.0 approved by RAN4 | - | |
| 12-2007 | RP#38 | RP-070979 | | Approved version at TSG RAN #38 | 1.0.0 | 8.0.0 |
| 03-2008 | RP#39 | RP-080123 | 3 | TS36.101 - Combined updates of E-UTRA UE requirements | 8.0.0 | 8.1.0 |
| 05-2008 | RP#40 | RP-080325 | 4 | TS36.101 - Combined updates of E-UTRA UE requirements | 8.1.0 | 8.2.0 |
| 09-2008 | RP#41 | RP-080638 | 5r1 | Addition of Ref Sens figures for 1.4MHz and 3MHz Channel bandwiidths | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 7r1 | Transmitter intermodulation requirements | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 10 | CR for clarification of additional spurious emission requirement | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 15 | Correction of In-band Blocking Requirement | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 18r1 | TS36.101: CR for section 6: NS_06 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 19r1 | TS36.101: CR for section 6: Tx modulation | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 20r1 | TS36.101: CR for UE minimum power | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 21r1 | TS36.101: CR for UE OFF power | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 24r1 | TS36.101: CR for section 7: Band 13 Rx sensitivity | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 26 | UE EVM Windowing | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080638 | 29 | Absolute ACLR limit | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 23r2 | TS36.101: CR for section 6: UE to UE co-existence | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 30 | Removal of [ ] for UE Ref Sens figures | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 31 | Correction of PA, PB definition to align with RAN1 specification | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 37r2 | UE Spurious emission band UE co-existence | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 44 | Definition of specified bandwidths | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 48r3 | Addition of Band 17 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 50 | Alignment of the UE ACS requirement | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 52r1 | Frequency range for Band 12 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 54r1 | Absolute power tolerance for LTE UE power control | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080731 | 55 | TS36.101 section 6: Tx modulation | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 6r2 | DL FRC definition for UE Receiver tests | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 46 | Additional UE demodulation test cases | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 47 | Updated descriptions of FRC | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 49 | Definition of UE transmission gap | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 51 | Clarification on High Speed train model in 36.101 | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080732 | 53 | Update of symbol and definitions | 8.2.0 | 8.3.0 |
| 09-2008 | RP#41 | RP-080743 | 56 | Addition of MIMO (4x2) and (4x4) Correlation Matrices | 8.2.0 | 8.3.0 |
| 12-2008 | RP#42 | RP-080908 | 94r2 | CR TX RX channel frequency separation | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 105r1 | UE Maximum output power for Band 13 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 60 | UL EVM equalizer definition | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 63 | Correction of UE spurious emissions | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 66 | Clarification for UE additional spurious emissions | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 72 | Introducing ACLR requirement for coexistance with UTRA 1.6MHZ channel from 36.803 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 75 | Removal of [] from Section 6 transmitter characteristcs | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 81 | Clarification for PHS band protection | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 101 | Alignement for the measurement interval for transmit signal quality | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 98r1 | Maximum power | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 57r1 | CR UE spectrum flatness | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 71r1 | UE in-band emission | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080909 | 58r1 | CR Number of TX exceptions | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080951 | 99r2 | CR UE output power dynamic | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080951 | 79r1 | LTE UE transmitter intermodulation | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080910 | 91 | Update of Clause 8 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080950 | 106r1 | Structure of Clause 9 including CSI requirements for PUCCH mode 1-0 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 59 | CR UE ACS test frequency offset | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 65 | Correction of spurious response parameters | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 80 | Removal of LTE UE narrowband intermodulation | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 90r1 | Introduction of Maximum Sensitivity Degradation | 8.3.0 | 8.4.0 |

| 12-2008 | RP#42 | RP-080911 | 103 | Removal of [] from Section 7 Receiver characteristic | 8.3.0 | 8.4.0 |
|---|---|---|---|---|---|---|
| 12-2008 | RP#42 | RP-080912 | 62 | Alignement of TB size n Ref Meas channel for RX characteristics | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 78 | TDD Reference Measurement channel for RX characterisctics | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 73r1 | Addition of 64QAM DL referenbce measurement channel | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 74r1 | Addition of UL Reference Measurement Channels | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 104 | Reference measurement channels for PDSCH performance requirements (TDD) | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080913 | 68 | MIMO Correlation Matrix Corrections | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080915 | 67 | Correction to the figure with the Transmission Bandwidth configuration | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080916 | 77 | Modification to EARFCN | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080917 | 85r1 | New Clause 5 outline | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080919 | 102 | Introduction of Bands 12 and 17 in 36.101 | 8.3.0 | 8.4.0 |
| 12-2008 | RP#42 | RP-080927 | 84r1 | Clarification of HST propagation conditions | 8.3.0 | 8.4.0 |
| 03-2009 | RP#43 | RP-090170 | 156r2 | A-MPR table for NS_07 | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 170 | Corrections of references (References to tables and figures) | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 108 | Removal of [ ] from Transmitter Intermodulation | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 155 | E-UTRA ACLR for below 5 MHz bandwidths | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 116 | Clarification of PHS band including the future plan | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 119 | Spectrum emission mask for 1.4 MHz and 3 MHz bandwidths | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 120 | Removal of 'Out-of-synchronization handling of output power' heading | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 126 | UE uplink power control | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 128 | Transmission BW Configuration | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 130 | Spectrum flatness | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 132r2 | PUCCH EVM | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 134 | UL DM-RS EVM | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 140 | Removal of ACLR2bis requirements | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 113 | In-band blocking | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 127 | In-band blocking and sensitivity requirement for band 17 | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 137r1 | Wide band intermodulation | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 141 | Correction of reference sensitivity power level of Band 9 | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 109 | AWGN level for UE DL demodulation performance tests | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 124 | Update of Clause 8: additional test cases | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 139r1 | Performance requirement structure for TDD PDSCH | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 142r1 | Performance requirements and reference measurement channels for TDD PDSCH demodulation with UE-specific reference symbols | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 145 | Number of information bits in DwPTS | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 160r1 | MBSFN-Unicast demodulation test case | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 163r1 | MBSFN-Unicast demodulation test case for TDD | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090173 | 162 | Clarification of EARFCN for 36.101 | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 110 | Correction to UL Reference Measurement Channel | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 114 | Addition of MIMO (4x4, medium) Correlation Matrix | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 121 | Correction of 36.101 DL RMC table notes | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 125 | Update of Clause 9 | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 138r1 | Clarification on OCNG | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 161 | CQI reference measurement channels | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 164 | PUCCH 1-1 Static Test Case | 8.4.0 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 111 | Reference Measurement Channel for TDD | 8.4.0 | 8.5.0 |
| 03-2009 | RP#44 | | | Editorial correction in Table 6.2.4-1 | 8.5.0 | 8.5.1 |
| 05-2009 | RP#44 | RP-090540 | 167 | Boundary between E-UTRA fOOB and spurious emission domain for 1.4 MHz and 3 MHz bandwiths. (Technically Endorsed CR in R4-50bis - R4-091205) | 8.5.1 | 8.6.0 |
| **05-2009** | **RP#44** | RP-090540 | **168** | EARFCN correction for TDD DL bands. (Technically Endorsed CR in R4-50bis - R4-091206) | 8.5.1 | 8.6.0 |
| **05-2009** | **RP#44** | RP-090540 | **169** | Editorial correction to in-band blocking table. (Technically Endorsed CR in R4-50bis - R4-091238) | 8.5.1 | 8.6.0 |
| **05-2009** | **RP#44** | RP-090540 | **171** | CR PRACH EVM. (Technically Endorsed CR in R4-50bis - R4- | 8.5.1 | 8.6.0 |

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| 05-2009 | RP#44 | RP-090540 | **172** | CR EVM correction. (Technically Endorsed CR in R4-50bis - R4-091309) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **177** | CR power control accuracy. (Technically Endorsed CR in R4-50bis - R4-091418) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **179** | Correction of SRS requirements. (Technically Endorsed CR in R4-50bis - R4-091426) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **186** | Clarification for EVM. (Technically Endorsed CR in R4-50bis - R4-091512) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **187** | Removal of [ ] from band 17 Refsens values and ACS offset frequencies | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **191** | Completion of band17 requirements | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **192** | Removal of 1.4 MHz and 3 MHz bandwidths from bands 13, 14 and 17. | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **223** | CR: 64 QAM EVM | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | **201** | CR In-band emissions | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 203 | CR EVM exclusion period | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 204 | CR In-band emissions timing | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 206 | CR Minimum Rx exceptions | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 207 | CR UL DM-RS EVM | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 218r1 | A-MPR table for NS_07 | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 205r1 | CR In-band emissions in shortened subframes | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 200r1 | CR PUCCH EVM | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 178r2 | No additional emission mask indication. (Technically Endorsed CR in R4-50bis - R4-091421) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 220r1 | Spectrum emission requirements for band 13 | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 197r2 | CR on aggregate power tolerance | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090540 | 196r2 | CR: Rx IP2 performance | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090541 | 198r1 | Maximum output power relaxation | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090542 | 166 | Update of performance requirement for TDD PDSCH with MBSFN configuration. (Technically Endorsed CR in R4-50bis - R4-091180) | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090542 | **175** | Adding AWGN levels for some TDD DL performance requirements. (Technically Endorsed CR in R4-50bis - R4-091406) | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090542 | **182** | OCNG Patterns for Single Resource Block FRC Requirements. (Technically Endorsed CR in R4-50bis - R4-091504) | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090542 | 170r1 | Update of Clause 8: PHICH and PMI delay. (Technically Endorsed CR in R4-50bis - R4-091275) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | 183 | Requirements for frequency-selective fading test. (Technically Endorsed CR in R4-50bis - R4-091505) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | **199** | CQI requirements under AWGN conditions | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | **188r1** | Adaptation of UL-RMC-s for supporting more UE categories | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | **193r1** | Correction of the LTE UE downlink reference measurement channels | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | **184r1** | Requirements for frequency non-selective fading tests. (Technically Endorsed CR in R4-50bis - R4-091506) | 8.5.1 | 8.6.0 |
| 05-2009 | RP#44 | RP-090543 | **185r1** | Requirements for PMI reporting. (Technically Endorsed CR in R4-50bis - R4-091510) | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090543 | 221r1 | Correction to DL RMC-s for Maximum input level for supporting more UE-Categories | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090543 | 216 | Addition of 15 MHz and 20 MHz bandwidths into band 38 | 8.5.1 | 8.6.0 |
| 05-2009 | **RP#44** | RP-090559 | 180 | Introduction of Extended LTE800 requirements. (Technically Endorsed CR in R4-50bis - R4-091432) | 8.6.0 | 9.0.0 |
| 09-2009 | **RP#45** | RP-090826 | 239 | A-MPR for Band 19 | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 225 | LTE UTRA ACLR1 centre frequency definition for 1.4 and 3 MHz BW | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 227 | Harmonization of text for LTE Carrier leakage | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 229 | Sensitivity requirements for Band 38 15 MHz and 20 MHz bandwidths | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 236 | Operating band edge relaxation of maximum output power for Band 18 and 19 | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 238 | Addition of 5MHz channel bandwidth for Band 40 | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090822 | 245 | Removal of unnecessary requirements for 1.4 and 3 MHz bandwidths on bands 13 and 17 | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 261 | Correction of LTE UE ACS test parameter | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 263R1 | Correction of LTE UE ACLR test parameter | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 286 | Uplink power and RB allocation for receiver tests | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 320 | CR Sensitivity relaxation for small BW | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 324 | Correction of Band 3 spurious emission band UE co-existence | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 249R1 | CR Pcmax definition (working assumption) | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 330 | Spectrum flatness clarification | 9.0.0 | 9.1.0 |

| 09-2009 | **RP#45** | RP-090877 | 332 | Transmit power: removal of TC and modification of REFSENS note | 9.0.0 | 9.1.0 |
|---|---|---|---|---|---|---|
| 09-2009 | **RP#45** | RP-090877 | 282R1 | Additional SRS relative power requirement and update of measurement definition | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090877 | 284R1 | Power range applicable for relative tolerance | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 233 | TDD UL/DL configurations for CQI reporting | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 235 | Further clarification on CQI test configurations | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 243 | Corrections to UL- and DL-RMC-s | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 247 | Reference measurement channel for multiple PMI requirements | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 290 | CQI reporting test for a scenario with frequency-selective interference | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 265R2 | CQI reference measurement channels | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090878 | 321R1 | CR RI Test | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090875 | 231 | Correction of parameters for demodulation performance requirement | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090875 | 241R1 | UE categories for performance tests and correction to RMC references | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090875 | 333 | Clarification of Ês definition in the demodulation requirement | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090875 | 326 | Editorial corrections and updates to PHICH PBCH test cases. | 9.0.0 | 9.1.0 |
| 09-2009 | **RP#45** | RP-090875 | 259R3 | Test case numbering in section 8 Performance tests | 9.0.0 | 9.1.0 |
| 12-2009 | RP-46 | RP-091264 | 335 | Test case numbering in TDD PDSCH performance test (Technically endorsed at RAN 4 52bis in R4-093523) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 337 | Adding beamforming model for user-specfic reference signal (Technically endorsed at RAN 4 52bis in R4-093525) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 339R1 | Adding redundancy sequences to PMI test (Technically endorsed at RAN 4 52bis in R4-093581) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 341 | Throughput value correction at FRC for Maximum input level (Technically endorsed at RAN 4 52bis in R4-093660) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 343 | Correction to the modulated E-UTRA interferer (Technically endorsed at RAN 4 52bis in R4-093662) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 345R1 | OCNG: Patterns and present use in tests (Technically endorsed at RAN 4 52bis in R4-093664) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 347 | OCNG: Use in receiver and performance tests (Technically endorsed at RAN 4 52bis in R4-093666) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 349 | Miscellaneous corrections on CSI requirements (Technically endorsed at RAN 4 52bis in R4-093676) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 351 | Removal of RLC modes (Technically endorsed at RAN 4 52bis in R4-093677) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 353 | CR Rx diversity requirement (Technically endorsed at RAN 4 52bis in R4-093703) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 355 | A-MPR notation in NS_07 (Technically endorsed at RAN 4 52bis in R4-093706) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 359 | Single- and multi-PMI requirements (Technically endorsed at RAN 4 52bis in R4-093846) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 363 | CQI reference measurement channel (Technically endorsed at RAN 4 52bis in R4-093970) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 364 | LTE MBSFN Channel Model (Technically endorsed at RAN 4 52bis in R4-094020) | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 367 | Numbering of PDSCH (User-Specific Reference Symbols) Demodulation Tests | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 369 | Numbering of PDCCH/PCFICH, PHICH, PBCH Demod Tests | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 371 | Remove [ ] from Reference Measurement Channels in Annex A | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 373R1 | Corrections to RMC-s for Maximum input level test for low UE categories | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 377 | Correction of UE-category for R.30 | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091286 | 378 | Introduction of Extended LTE1500 requirements for TS36.101 | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 384 | CR: Removal of 1.4 MHz and 3 MHz channel bandwidths from additional spurious emissions requirements for Band 1 PHS protection | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 386R3 | Clarification of measurement conditions of spurious emission requirements at the edge of spurious domain | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 390 | Spurious emission table correction for TDD bands 33 and 38. | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 392R2 | 36.101 Symbols and abreviations for Pcmax | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 394 | UTRAACLR1 requirement definition for 1.4 and 3 MHz BW completed | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 396 | Introduction of the ACK/NACK feedback modes for TDD requirements | 9.1.0 | 9.2.0 |

| 12-2009 | RP-46 | RP-091262 | 404R3 | CR Power control exception R8 | 9.1.0 | 9.2.0 |
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| 12-2009 | RP-46 | RP-091262 | 416R1 | Relative power tolerance: special case for receiver tests | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 420R1 | CSI reporting: test configuration for CQI fading requirements | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091284 | 421R1 | Inclusion of Band 20 UE RF parameters | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 425 | Editorial corrections and updates to Clause 8.2.1 FDD demodulation test cases | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 427 | CR: time mask | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 430 | Correction of the payload size for PDCCH/PCFICH performance requirements | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 432 | Transport format and test point updates to RI reporting test cases | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 434 | Transport format and test setup updates to frequency-selective interference CQI tests | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 436 | CR RI reporting configuration in PUCCH 1-1 test | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 438 | Addition of R.11-1 TDD references | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 439 | Performance requirements for LTE MBMS | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 442R1 | In Band Emissions Requirements Correction CR | 9.1.0 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 444R1 | PCMAX definition | 9.1.0 | 9.2.0 |
| 03-2010 | RP-47 | RP-100246 | 453r1 | Corrections of various errors in the UE RF requirements | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100246 | 462r1 | UTRA ACLR measurement bandwidths for 1.4 and 3 MHz | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100246 | 493 | Band 8 Coexistence Requirement Table Correction | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100246 | 489r1 | Rel 9 CR for Band 14 | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100246 | 485r1 | CR Band 1- PHS coexistence | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100247 | 501 | Fading CQI requirements for FDD mode | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100247 | 499 | CR correction to RI test | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100249 | 451 | Reporting mode, Reporting Interval and Editorial corrections for demodulation | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100249 | 464r1 | Corrections to 1PRB PDSCH performance test in presence of MBSFN. | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100249 | 458r1 | OCNG corrections | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100249 | 467 | Addition of ONCG configuration in DRS performance test | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100249 | 465r1 | PDSCH performance tests for low UE categories | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100250 | 460r1 | Use of OCNG in CSI tests | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100250 | 491r1 | Corrections to CQI test configurations | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100250 | 469r1 | Corrections of some CSI test parameters | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100251 | 456r1 | TBS correction for RMC UL TDD 16QAM full allocation BW 1.4 MHz | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100262 | 449 | Editorial corrections on Band 19 REFSENS | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100263 | 470r1 | Band 20 UE RF requirements | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100264 | 446r1 | A-MPR for Band 21 | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100264 | 448 | RF requirements for UE in later releases | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100268 | 445 | 36.101 CR: Editorial corrections on LTE MBMS reference measurement channels | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100268 | 454 | The definition of the Doppler shift for LTE MBSFN Channel Model | **9.2.0** | **9.3.0** |
| 03-2010 | RP-47 | RP-100239 | 478r3 | Modification of the spectral flatness requirement and some editorial corrections | 9.2.0 | 9.3.0 |
| 06-2010 | RP-48 | RP-100619 | 559 | Corrections of tables for Additional Spectrum Emission Mask | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 538 | Correction of transient time definition for EVM requirements | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 557r2 | CR on UE coexistence requirement | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 547r1 | Correction of antenna configuration and beam-forming model for DRS | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 536r1 | CR: Corrections on MIMO demodulation performance requirements | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 528r1 | Corrections on the definition of PCMAX | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 568 | Relaxation of the PDSCH demodulation requirements due to control channel errors | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 566 | Correction of the UE output power definition for RX tests | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 505r1 | Fading CQI requirements for TDD mode | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 521 | Correction to FRC for CQI index 0 | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 516r1 | Correction to CQI test configuration | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 532 | Correction of CQI and PMI delay configuration description for TDD | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 574 | Correction to FDD and TDD CSI test configurations | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 571 | Minimum requirements for Rank indicator reporting | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100628 | 563 | LTE MBMS performance requirements (FDD) | 9.3.0 | 9.4.0 |

| 06-2010 | RP-48 | RP-100628 | 564 | LTE MBMS performance requirements (TDD) | 9.3.0 | 9.4.0 |
|---------|-------|-----------|-----|------------------------------------------|-------|-------|
| 06-2010 | RP-48 | RP-100629 | 553r2 | Performance requirements for dual-layer beamforming | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 524r2 | CR: low Category CSI requirement | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 519 | Correction of FRC reference and test case numbering | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 526 | Correction of carrier frequency and EARFCN of Band 21 for TS36.101 | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 508r1 | Addition of PDSCH TDD DRS demodulation tests for Low UE categories | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 539 | Specification of minimum performance requirements for low UE category | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 569 | Addition of minimum performance requirements for low UE category TDD CRS single-antenna port tests | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100631 | 549r3 | Introduction of sustained downlink data-rate performance requirements | 9.3.0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100683 | 530r1 | Band 20 Rx requirements | 9.3.0 | 9.4.0 |
| 09-2010 | RP-49 | RP-100920 | 614r2 | Add OCNG to MBMS requirements | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 599 | Correction of PDCCH content for PHICH test | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 597r1 | Beamforming model for transmission on antenna port 7/8 | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 600r1 | Correction of full correlation in frequency-selective CQI test | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 601 | Correction on single-antenna transmission fixed reference channel | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 605 | Reference sensitivity requirements for the 1.4 and 3 MHz bandwidths | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 608r1 | CR for DL sustained data rate test | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 611 | Correction of references in section 10 (MBMS performance requirements) | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 613 | Band 13 and Band 14 spurious emission corrections | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 617r1 | Rx Requirements | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100926 | 576r1 | Clarification on DL-BF simulation assumptions | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 582r1 | Introduction of additional Rel-9 scenarios | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100925 | 575r1 | Correction to band 20 ue to ue Co-existence table | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 581r1 | Test configuration corrections to CQI reporting in AWGN | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 595 | Corrections to RF OCNG Pattern OP.1 and 2 | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 583 | Editorial corrections of 36.101 | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 586 | Addition of minimum performance requirements for low UE category TDD tests | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 590r1 | Downlink power for receiver tests | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 591 | OCNG use and power in beamforming tests | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 593 | Throughput for multi-datastreams transmissions | 9.4.0 | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 588 | Missing note in Additional spurious emission test with NS_07 | 9.4.0 | 9.5.0 |
| 12-2010 | RP-50 | RP-101327 | 651 | Correction to Band 12 frequency range | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101329 | 629 | Removal of [ ] from TDD Rank Indicator requirements | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101329 | 634r1 | Test configuration corrections to CQI TDD reporting in AWGN (Rel-9) | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101329 | 662r2 | Correction of the PMI reporting in Multi-Layer Spatial Multiplexing performance test | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101330 | 644 | EVM window length for PRACH | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101330 | 648 | Removal of NS signalling from TDD REFSENS tests | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101330 | 641r1 | Correction of Note 4 In Table 7.3.1-1: Reference sensitivity QPSK PREFSENS | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101330 | 660r1 | Correction on the statement of TB size and subband selection in CSI tests | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 626 | Add 20 RB UL Ref Meas channel | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 664r1 | Demodulation performance requirements for dual-layer beamforming | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 659r1 | Adding antenna configuration in CQI fading test case | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 653r1 | Additional in-band blocking requirement for Band 12 | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 677r1 | Further clarifications for the Sustained Downlink Data Rate Test | 9.5.0 | 9.6.0 |
| 12-2010 | RP-50 | RP-101341 | 658r2 | Correction on MBMS performance requirements | 9.5.0 | 9.6.0 |
| 03-2011 | RP-51 | RP-110338 | 698r1 | PDCCH and PHICH performance: OCNG and power settings | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 700r2 | Introducing UE-selected subband CQI tests | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110336 | 705r1 | Spurious emissions measurement uncertainty | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110338 | 709 | PMI performance: Power settings and precoding granularity | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 718 | Minimum requirements for the additional Rel-9 scenarios | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 722 | Corrections to power settings for Single layer beamforming with simultaneous transmission | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 727r3 | Verification framework for PUSCH 2-2 and PUCCH 2-1 reporting | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110338 | 729 | Removing the square bracket for TS36.101 | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110349 | 738 | Removal of square brackets for dual-layer beamforming demodulation performance requirements | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110349 | 753r2 | UE category coverage for dual-layer beamforming | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 755r1 | Further clarifications for the Sustained Downlink Data Rate Test | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110343 | 758 | Removal of square brackets in sustained data rate tests | 9.6.0 | 9.7.0 |
| 03-2011 | RP-51 | RP-110337 | 761r1 | Clarification to LTE relative power tolerance table | 9.6.0 | 9.7.0 |
| 04-2011 | | | | Editorial: Spec Title correction, removal of 'Draft' | 9.7.0 | 9.7.1 |

| 06-2011 | RP-52 | RP-110788 | 771 | CR: Corrections for UE to UE co-existence requirements of Band 3 | 9.7.1 | 9.8.0 |
|---------|-------|-----------|-----|-----------------------------------------------------------------|-------|-------|
| 06-2011 | RP-52 | RP-110789 | 781 | CR: Band 19 A-MPR refinement | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110789 | 804 | Clarification for MBMS reference signal levels | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110792 | 809 | FDD MBMS performance requirements for 64QAM mode | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110787 | 813 | Correction on CQI mapping index of RI test | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110789 | 823 | Corrections to in-band blocking table | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110794 | 825 | Correction of TDD Category 1 DRS and DMRS RMCs | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110794 | 827r1 | TDD MBMS performance requirements for 64QAM mode | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110787 | 777r1 | Minor corrections to DL-RMC-s for Maximum input level | 9.7.1 | 9.8.0 |

| 06-2011 | RP-52 | RP-110789 | 788r1 | PDCCH and PHICH performance: OCNG and power settings | 9.7.1 | 9.8.0 |
|---------|-------|-----------|-------|------------------------------------------------------|-------|-------|
| 06-2011 | RP-52 | RP-110789 | 817r1 | Correction on 2-X PMI test for R9 | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110791 | 815r1 | Addition of performance requirements for dual-layer beamforming category 1 UE test | 9.7.1 | 9.8.0 |
| 06-2011 | RP-52 | RP-110789 | 833 | Performance requirements for PUCCH 2-0, PUCCH 2-1 and PUSCH 2-2 tests | 9.7.1 | 9.8.0 |
| 09-2011 | RP-53 | RP-111248 | 861r1 | Removal of unnecessary channel bandwidths from REFSENS tables | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 868r1 | Clarification on BS precoding information field for RI FDD and PUCCH 2-1 PMI tests | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 871r1 | CR for B14  Rx requirement Rel 9 | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 889r1 | CR to TS36.101: Correction on the accuracy test of CQI. | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 892 | CR to TS36.101: Correction on CQI mapping index of TDD RI test | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 903 | Correction of code block numbers for some RMCs | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 906 | Correction to UL RMC for FDD and TDD | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111248 | 913r1 | Adding codebook subset restriction for single layer closed-loop spatial multiplexing test | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111251 | 882 | Sustained data rate: Correction of the ACK/NACK feedback mode | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111251 | 928 | 36.101 CR on MBSFN FDD requirements(R9) | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111251 | 937 | TDD MBMS performance requirements for 64QAM mode | 9.8.0 | 9.9.0 |
| 09-2011 | RP-53 | RP-111252 | 894 | Further clarification for the dual-layer beamforming demodulation requirements | 9.8.0 | 9.9.0 |
| 12-2011 | RP-54 | RP-111680 | 952 | Clarification on applying CSI reports during rank switching in RI FDD test - Rel-9 | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111680 | 955 | UE spurious emissions | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111682 | 958 | Add scrambling identity n_SCID for MU-MIMO test | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111680 | 965 | General review of the reference measurement channels | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111683 | 980r2 | Uplink downlink configuration for SDR TDD test scenario | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111682 | 988r1 | Correction of the TM8 power allocation settings | 9.9.0 | 9.10.0 |
| 12-2011 | RP-54 | RP-111682 | 997 | Maintenance on CQI and PMI requirements (Rel-9) | 9.9.0 | 9.10.0 |
| 03-2012 | RP-55 | RP-120291 | 1013 | RF: Updates and corrections to the RMC-s related annexes (Rel-9) | 9.10.0 | 9.11.0 |
| 03-2012 | RP-55 | RP-120294 | 1045r1 | UE spurious emissions for Band 7 and Band 38 coexistence | 9.10.0 | 9.11.0 |
| 03-2012 | RP-55 | RP-120293 | 1063r1 | TS36.101 RF editorial corrections Rel 9 | 9.10.0 | 9.11.0 |
| 06-2012 | RP-56 | RP-120770 | 1090 | Deleting square brackets in Reference Measurement Channels | 9.11.0 | 9.12.0 |
| 06-2012 | RP-56 | RP-120769 | 1125 | Addition of ETU30 channel model | 9.11.0 | 9.12.0 |
| 06-2012 | RP-56 | RP-120764 | 1210 | Correction of PHS protection requirements for TS 36.101 | 9.11.0 | 9.12.0 |
| 09-2012 | RP-57 | RP-121294 | 1228 | Correct Transport Block size in 9RB 16QAM Uplink Reference Measurement Channel | 9.12.0 | 9.13.0 |
| 09-2012 | RP-57 | RP-121301 | 1231 | RF: Missleading note-references in test parameters for transmission mode 8 | 9.12.0 | 9.13.0 |
| 09-2012 | RP-57 | RP-121298 | 1263 | Clarification of RB allocation for DRS demodulation tests | 9.12.0 | 9.13.0 |
| 09-2012 | RP-57 | RP-121445 | 1286r2 | Introduction of Japanese Regulatory Requirements to LTE Band 8(R9) | 9.12.0 | 9.13.0 |
| 09-2012 | RP-57 | RP-121295 | 1348 | Random precoding granularity in PMI tests | 9.12.0 | 9.13.0 |
| 12-2012 | | | | Fixes history table | 9.13.0 | 9.13.1 |
| 12-2012 | RP-58 | RP-121849 | 1380 | Correction of PCFICH power parameter setting | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121850 | 1384r1 | OCNG patterns for Sustained Data rate testing | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121850 | 1399 | Introducing the additional frequency bands of 5 MHz x 2 in 1.7 GHz in Japan to Band 3 | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121859 | 1434r1 | Band 1 to Band 33 and Band 39 UE coexistence requirements | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121862 | 1462 | Adding references to the appropriate beamforming model (Rel-9) | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121849 | 1492 | Low-channel Band 1 coexistence with PHS | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121862 | 1502 | Clean up CR for Rel_9 | 9.13.1 | 9.14.0 |
| 12-2012 | RP-58 | RP-121852 | 1507 | UE-UE coexistence between bands with small frequency separation | 9.13.1 | 9.14.0 |
| 03-2013 | RP-59 | RP-130258 | 1526 | Corrections to CQI reporting | 9.14.0 | 9.15.0 |
| 03-2013 | RP-59 | RP-130265 | 1541 | Correction related to SNR definition for Rel-9 | 9.14.0 | 9.15.0 |
| 03-2013 | RP-59 | RP-130260 | 1554 | Band 38 Note 16 correction in UE to UE co-existence table | 9.14.0 | 9.15.0 |
| 03-2013 | RP-59 | RP-130260 | 1572 | Remove [ ] from CSI test case parameters | 9.14.0 | 9.15.0 |
| 03-2013 | RP-59 | RP-130258 | 1577 | UE-UE co-existence between Band 1 and Band 33/39 | 9.14.0 | 9.15.0 |
| 07-2013 | RP-60 | RP-130763 | 1605 | Correction of transport format parameters for CQI index 10 (15 RBs) - Rel 9 | 9.15.0 | 9.16.0 |
| 07-2013 | RP-60 | RP-130763 | 1682 | RF: Corrections to RMC-s for sustained data rate test | 9.15.0 | 9.16.0 |
| 09-2013 | RP-61 | RP-131280 | 1773r1 | Corrections to sustained data rate test (Rel-9) | 9.16.0 | 9.17.0 |
| 12-2013 | RP-62 | RP-131924 | 1849 | Clean-up of uplink reference measurement channels (Rel-9) | 9.17.0 | 9.18.0 |
| 12-2013 | RP-62 | RP-131925 | 1959 | CR: 15MHz SDR test | 9.17.0 | 9.18.0 |

| 12-2013 | RP-62 | RP-131924 | 2011 | P-max for Band 38 to Band 7 coexistence | 9.17.0 | 9.18.0 |
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| 12-2013 | RP-62 | RP-131924 | 2062 | Simplification of Band 12/17 in-band blocking test cases | 9.17.0 | 9.18.0 |
| 06-2014 | RP-64 | RP-140909 | 2266 | In-band blocking case nubering re-establisment | 9.18.0 | 9.19.0 |
| 06-2014 | RP-64 | RP-1400909 | 2299 | RF: Corrections to spurious emission requirements with NS different than NS_01 (Rel-9) | 9.18.0 | 9.19.0 |
| 09-2014 | RP-65 | RP-141525 | 2475 | CQI reporting under fading: CQI indices in set | 9.19.0 | 9.20.0 |
| 09-2014 | RP-65 | RP-141525 | 2501 | Perf: Cleanup and better description of DL-RMC-s with dynamic coding rate for CSI requirements (Rel-9) | 9.19.0 | 9.20.0 |
| 09-2014 | RP-65 | RP-141525 | 2562 | Corrections to UE coex table | 9.19.0 | 9.20.0 |
| 12-2014 | RP-66 | RP-142142 | 2584 | CR for 1 PRB allocation performance in presence of MBSFN (rel-9) | 9.20.0 | 9.21.0 |
| 12-2014 | RP-66 | RP-142142 | 2617 | CQI reporting in AWGN: CQI indices in set | 9.20.0 | 9.21.0 |
| 03-2015 | RP-67 | RP-150381 | 2827 | Uplink RMCs for sustained data rate test | 9.21.0 | 9.22.0 |

# History

| Document history | | |
|---|---|---|
| V9.1.0 | October 2009 | Publication |
| V9.2.0 | February 2010 | Publication |
| V9.3.0 | April 2010 | Publication |
| V9.4.0 | June 2010 | Publication |
| V9.5.0 | October 2010 | Publication |
| V9.6.0 | January 2011 | Publication |
| V9.7.1 | May 2011 | Publication |
| V9.8.0 | June 2011 | Publication |
| V9.9.0 | November 2011 | Publication |
| V9.10.0 | January 2012 | Publication |
| V9.11.0 | March 2012 | Publication |
| V9.12.0 | July 2012 | Publication |
| V9.13.1 | January 2013 | Publication |
| V9.14.0 | February 2013 | Publication |
| V9.15.0 | April 2013 | Publication |
| V9.16.0 | July 2013 | Publication |
| V9.17.0 | October 2013 | Publication |
| V9.18.0 | January 2014 | Publication |
| V9.19.0 | July 2014 | Publication |
| V9.20.0 | October 2014 | Publication |
| V9.21.0 | February 2015 | Publication |
| V9.22.0 | April 2015 | Publication |