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TECHNICAL SPECIFICATION

**LTE;**
**Evolved Universal Terrestrial Radio Access (E-UTRA);**
**User Equipment (UE) radio transmission and reception**
**(3GPP TS 36.101 version 11.22.0 Release 11)**

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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.

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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain"

[3] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[4] 3GPP TS 36.211: "Physical Channels and Modulation".

[5] 3GPP TS 36.212: "Multiplexing and channel coding".

[6] 3GPP TS 36.213: "Physical layer procedures".

[7] 3GPP TS 36.331: " Requirements for support of radio resource management ".

[8] 3GPP TS 36.307: " Requirements on User Equipments (UEs) supporting a release-independent frequency band".

[9] 3GPP TS 36.423: "X2 application protocol (X2AP) ".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# 3.2 Symbols

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

| | |
|---|---|
| $BW_{Channel}$ | Channel bandwidth |
| $BW_{Channel,block}$ | Sub-block bandwidth, expressed in MHz. $BW_{Channel,block} = F_{edge,block,high} - F_{edge,block,low}$. |
| $BW_{Channel\_CA}$ | Aggregated channel bandwidth, expressed in MHz. |
| $BW_{GB}$ | Virtual guard band to facilitate transmitter (receiver) filtering above / below edge CCs. |

| | |
|---|---|
| $E_{RS}$ | Transmitted energy per RE for reference symbols during the useful part of the symbol, i.e. excluding the cyclic prefix, (average power normalized to the subcarrier spacing) at the eNode B transmit antenna connector |
| $\hat{E}_s$ | The averaged received energy per RE of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set of REs used for the transmission of physical channels (including user specific RSs when present), divided by the number of REs within the set, and normalized to the subcarrier spacing |
| F | Frequency |
| $F_{Interferer}$ (offset) | Frequency offset of the interferer |
| $F_{Interferer}$ | Frequency of the interferer |
| $F_C$ | Frequency of the carrier centre frequency |
| $F_{C,block, high}$ | Center frequency of the highest transmitted/received carrier in a sub-block. |
| $F_{C,block, low}$ | Center frequency of the lowest transmitted/received carrier in a sub-block. |
| $F_{C\_low}$ | The centre frequency of the *lowest carrier*, expressed in MHz. |
| $F_{C\_high}$ | The centre frequency of the *highest carrier*, expressed in MHz. |
| $F_{DL\_low}$ | The lowest frequency of the downlink operating band |
| $F_{DL\_high}$ | The highest frequency of the downlink operating band |
| $F_{UL\_low}$ | The lowest frequency of the uplink operating band |
| $F_{UL\_high}$ | The highest frequency of the uplink operating band |
| $F_{edge,block,low}$ | The lower sub-block edge, where $F_{edge,block,low} = F_{C,block,low} - F_{offset.}$ |
| $F_{edge,block,high}$ | The upper sub-block edge, where $F_{edge,block,high} = F_{C,block,high} + F_{offset.}$ |
| $F_{edge\_low}$ | The *lower edge* of aggregated channel bandwidth, expressed in MHz. |
| $F_{edge\_high}$ | The *higher edge* of aggregated channel bandwidth, expressed in MHz. |
| $F_{offset}$ | Frequency offset from $F_{C\_high}$ to the *higher edge* or $F_{C\_low}$ to the *lower edge.* |
| $F_{offset,block,low}$ | Separation between lower edge of a sub-block and the center of the lowest component carrier within the sub-block |
| $F_{offset,block,high}$ | Separation between higher edge of a sub-block and the center of the highest component carrier within the sub-block |
| $F_{offset\_NS\_23}$ | Frequency offset in MHz needed if NS_23 is used |
| $F_{OOB}$ | The boundary between the E-UTRA out of band emission and spurious emission domains. |
| $I_o$ | The power spectral density of the total input signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the UE antenna connector, including the own-cell downlink signal |
| $I_{or}$ | The total transmitted power spectral density of the own-cell downlink signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the eNode B transmit antenna connector |
| $\hat{I}_{or}$ | The total received power spectral density of the own-cell downlink signal (power averaged over the useful part of the symbols within the transmission bandwidth configuration, divided by the total number of RE for this configuration and normalised to the subcarrier spacing) at the UE antenna connector |
| $I_{ot}$ | The received power spectral density of the total noise and interference for a certain RE (average power obtained within the RE and normalized to the subcarrier spacing) as measured at the UE antenna connector |
| $L_{CRB}$ | Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks |
| $N_{cp}$ | 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 |
| $N_{oc1}$ | The power spectral density of a white noise source (average power per RE normalized to the subcarrier spacing), simulating interference in non-CRS symbols in ABS subframe from cells that are not defined in a test procedure, as measured at the UE antenna connector. |

| | |
|---|---|
| $N_{oc2}$ | The power spectral density of a white noise source (average power per RE normalized to the subcarrier spacing), simulating interference in CRS symbols in ABS subframe from all cells that are not defined in a test procedure, as measured at the UE antenna connector. |
| $N_{oc3}$ | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing), simulating interference in non-ABS subframe from cells that are not defined in a test procedure, as measured at the UE antenna connector |
| $N_{oc}'$ | The power spectral density (average power per RE normalised to the subcarrier spacing) of the summation of the received power spectral densities of the strongest interfering cells explicitly defined in a test procedure plus $N_{oc}$, as measured at the UE antenna connector. The respective power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value. |
| $N_{Offs\text{-}DL}$ | Offset used for calculating downlink EARFCN |
| $N_{Offs\text{-}UL}$ | Offset used for calculating uplink EARFCN |
| $N_{otx}$ | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing) simulating eNode B transmitter impairments as measured at the eNode B transmit antenna connector |
| $N_{RB}$ | Transmission bandwidth configuration, expressed in units of resource blocks |
| $N_{RB\_agg}$ | The number of the aggregated RBs within the fully allocated Aggregated Channel bandwidth. |
| $N_{RB\_alloc}$ | Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth. |
| $N_{RB,c}$ | The transmission bandwidth configuration of component carrier *c*, expressed in units of resource blocks |
| $N_{RB,largest\ BW}$ | The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks |
| $N_{UL}$ | Uplink EARFCN. |
| Rav | Minimum average throughput per RB. |
| $P_{CMAX}$ | The configured maximum UE output power. |
| $P_{CMAX,\,c}$ | The configured maximum UE output power for serving cell *c*. |
| $P_{EMAX}$ | Maximum allowed UE output power signalled by higher layers. Same as IE *P-Max*, defined in [7]. |
| $P_{EMAX,\,c}$ | Maximum allowed UE output power signalled by higher layers for serving cell *c*. 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. |
| Puw | Power of an unwanted DL signal |
| Pw | Power of a wanted DL signal |
| $RB_{start}$ | Indicates the lowest RB index of transmitted resource blocks. |
| $RB_{end}$ | Indicates the highest RB index of transmitted resource blocks. |
| $\Delta f_{OOB}$ | Δ Frequency of Out Of Band emission. |
| $\Delta R_{IB,c}$ | Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*. |
| $\Delta T_{IB,c}$ | Allowed maximum configured output power relaxation due to support for inter-band CA operation, for serving cell *c*. |
| $\Delta T_C$ | Allowed operating band edge transmission power relaxation. |
| $\Delta T_{C,c}$ | Allowed operating band edge transmission power relaxation for serving cell *c*. |
| $\rho_A$ | According to Clause 5.2 in TS 36.213 [6] |
| $\rho_B$ | According to Clause 5.2 in TS 36.213 [6] |
| σ | Test specific auxiliary variable used for the purpose of downlink power allocation, defined in Annex C.3.2. |
| $W_{gap}$ | Sub-block gap size |

## 3.3 Abbreviations

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

| | |
|---|---|
| ABS | Almost Blank Subframe |
| ACLR | Adjacent Channel Leakage Ratio |
| ACS | Adjacent Channel Selectivity |
| A-MPR | Additional Maximum Power Reduction |
| AWGN | Additive White Gaussian Noise |
| BS | Base Station |
| CA | Carrier Aggregation |
| CA_X | CA for band X where X is the applicable E-UTRA operating band |
| CA_X-X | Non-contiguous intra band CA for band X where X is the applicable E-UTRA operating band |
| CA_X-Y | CA for band X and Band Y where X and Y are the applicable E-UTRA operating band |
| CC | Component Carriers |
| CPE | Customer Premise Equipment |
| CPE_X | Customer Premise Equipment for E-UTRA operating band X |
| CW | Continuous Wave |
| DL | Downlink |
| DIP | Dominant Interferer Proportion |
| 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 |
| PCC | Primary Component Carrier |
| P-MPR | Power Management Maximum Power Reduction |
| 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 |
| SCC | Secondary Component Carrier |
| SINR | Signal-to-Interference-and-Noise Ratio |
| SNR | Signal-to-Noise Ratio |
| SSS | Secondary Synchronization Signal |
| SSS_RA | SSS-to-RS EPRE ratio for the channel SSS |
| TDD | Time Division Duplex |
| UE | User Equipment |
| UL | Uplink |
| UL-MIMO | Up Link Multiple Antenna transmission |
| UMTS | Universal Mobile Telecommunications System |
| UTRA | UMTS Terrestrial Radio Access |
| UTRAN | UMTS Terrestrial Radio Access Network |
| xCH_RA | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols not containing cell-specific RS |
| xCH_RB | xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols containing cell-specific RS |

# 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

## 4.3A Applicability of minimum requirements (CA, UL-MIMO)

The requirements in clauses 5, 6 and 7 which are specific to CA and UL-MIMO are specified as suffix A, B, C, D where;

a) Suffix A additional requirements need to support CA

b) Suffix B additional requirements need to support UL-MIMO

c) Suffix C additional requirements need to support TBD

d) Suffix D additional requirements need to support TBD

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

A terminal which supports more than one feature (CA and UL-MIMO) in clauses 5, 6 and 7 shall meet all of the separate corresponding requirements.

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

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

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

## 4.4 RF requirements in later releases

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

NOTE: For 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 or carrier aggregation configurations 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 |
| 22 | 3410 MHz | – | 3490 MHz | 3510 MHz | – | 3590 MHz | FDD |
| 23 | 2000 MHz | – | 2020 MHz | 2180 MHz | – | 2200 MHz | FDD |
| 24 | 1626.5 MHz | – | 1660.5 MHz | 1525 MHz | – | 1559 MHz | FDD |
| 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| 27 | 807 MHz | – | 824 MHz | 852 MHz | – | 869 MHz | FDD |
| 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| 29 | N/A | | | 717 MHz | – | 728 MHz | FDD[2] |
| ... | | | | | | | |
| 33 | 1900 MHz | – | 1920 MHz | 1900 MHz | – | 1920 MHz | TDD |
| 34 | 2010 MHz | – | 2025 MHz | 2010 MHz | – | 2025 MHz | TDD |
| 35 | 1850 MHz | – | 1910 MHz | 1850 MHz | – | 1910 MHz | TDD |
| 36 | 1930 MHz | – | 1990 MHz | 1930 MHz | – | 1990 MHz | TDD |
| 37 | 1910 MHz | – | 1930 MHz | 1910 MHz | – | 1930 MHz | TDD |
| 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |
| 39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| 40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| 41 | 2496 MHz | | 2690 MHz | 2496 MHz | | 2690 MHz | TDD |
| 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |
| 43 | 3600 MHz | – | 3800 MHz | 3600 MHz | – | 3800 MHz | TDD |
| 44 | 703 MHz | – | 803 MHz | 703 MHz | – | 803 MHz | TDD |
| NOTE 1: Band 6 is not applicable<br>NOTE 2: Restricted to E-UTRA operation when carrier aggregation is configured. The downlink operating band is paired with the uplink operating band (external) of the carrier aggregation configuration that is supporting the configured Pcell. | | | | | | | |

# 5.5A Operating bands for CA

E-UTRA carrier aggregation is designed to operate in the operating bands defined in Tables 5.5A-1 and 5.5A-2.

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

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit | | | Downlink (DL) operating band BS transmit / UE receive | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| | | $F_{UL\_low}$ – $F_{UL\_high}$ | | | $F_{DL\_low}$ – $F_{DL\_high}$ | | | |
| CA_1 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| CA_7 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| CA_38 | 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |
| CA_40 | 40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| CA_41 | 41 | 2496 MHz | | 2690 MHz | 2496 MHz | | 2690 MHz | TDD |

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

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit | | | Downlink (DL) operating band BS transmit / UE receive | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| | | $F_{UL\_low}$ – $F_{UL\_high}$ | | | $F_{DL\_low}$ – $F_{DL\_high}$ | | | |
| CA_1-5 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_1-18 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | |
| CA_1-19 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| CA_1-21 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 21 | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | |
| CA_2-17 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| CA_2-29 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| CA_3-5 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_3-7 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| CA_3-8 | 3 | 1710 MHz | | 1785 MHz | 1805 MHz | | 1880 MHz | FDD |
| | 8 | 880 MHz | | 915 MHz | 925 MHz | | 960 MHz | |
| CA_3-20 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_4-5 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_4-7 | 4 | 1710 MHz | | 1755 MHz | 2110 MHz | | 2155 MHz | FDD |
| | 7 | 2500 MHz | | 2570 MHz | 2620 MHz | | 2690 MHz | |
| CA_4-12 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_4-13 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_4-17 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| CA_4-29 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| CA_5-12 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_5-17 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| CA_7-20 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_8-20 | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_11-18 | 11 | 1427.9 MHz | – | 1447.9 MHz | 1475.9 MHz | – | 1495.9 MHz | FDD |
| | 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | |

**Table 5.5A-3: Intra-band non-contiguous CA operating bands**

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit | | | Downlink (DL) operating band BS transmit / UE receive | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| | | $F_{UL\_low}$ | – | $F_{UL\_high}$ | $F_{DL\_low}$ | – | $F_{DL\_high}$ | |
| CA_25-25 | 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| CA_41-41 | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

# 5.5B Operating bands for UL-MIMO

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

**Table 5.5B-1: Void**

# 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.

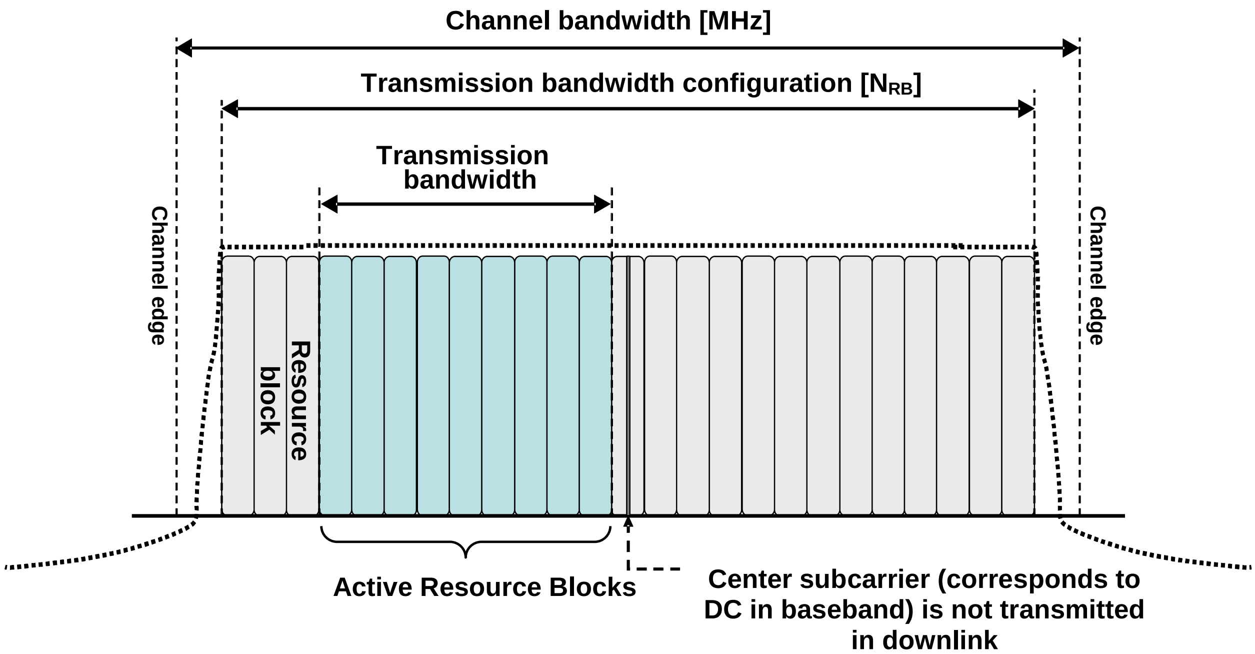


**Figure 5.6-1: Definition of channel bandwidth and transmission bandwidth configuration for one E-UTRA carrier**

## 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[3] | Yes[1, 3] |
| 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] | |
| 22 | | | Yes | Yes | Yes[1] | Yes[1] |
| 23 | Yes | Yes | Yes | Yes | Yes[1] | Yes[1] |
| 24 | | | Yes | Yes | | |
| 25 | Yes | Yes | Yes | Yes | Yes[1] | Yes[1] |
| 26 | Yes | Yes | Yes | Yes[1] | Yes[1] | |
| 27 | Yes | Yes | Yes | Yes[1] | | |
| 28 | | Yes | Yes | Yes[1] | Yes[1] | Yes[1, 2] |
| ... | | | | | | |
| 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[3] | Yes[3] |
| 39 | | | Yes | Yes | Yes | Yes |
| 40 | | | Yes | Yes | Yes | Yes |
| 41 | | | Yes | Yes | Yes | Yes |
| 42 | | | Yes | Yes | Yes | Yes |
| 43 | | | Yes | Yes | Yes | Yes |
| 44 | | Yes | Yes | Yes | Yes | Yes |

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: [2] For the 20 MHz bandwidth, the minimum requirements are specified for E-UTRA UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz

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

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

# 5.6A Channel bandwidth for CA

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

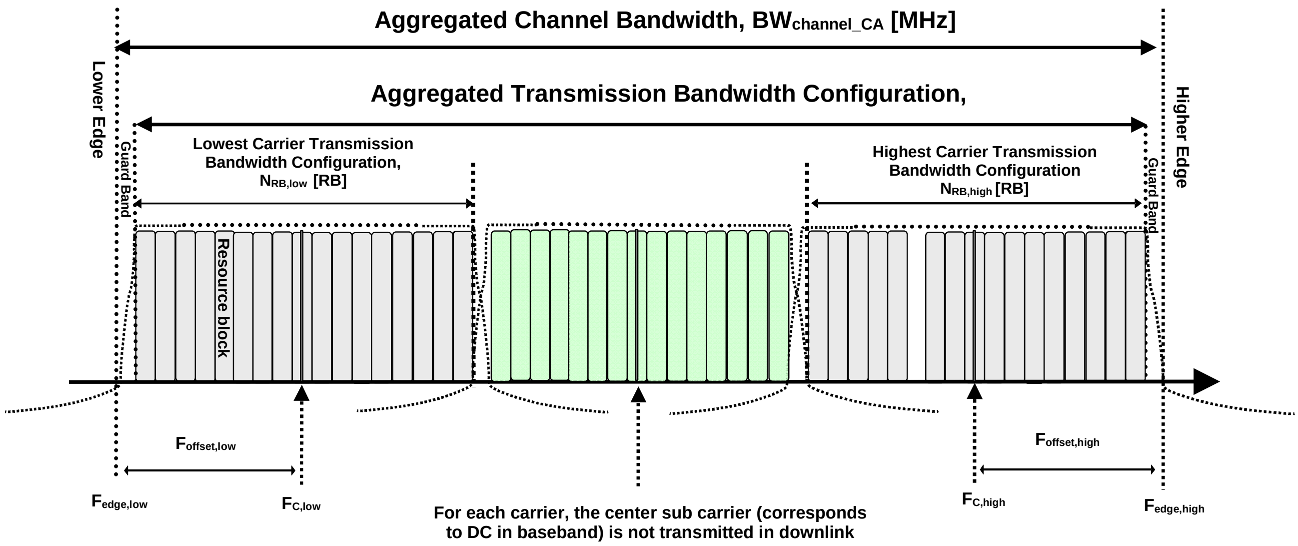


**Figure 5.6A-1. Definition of Aggregated channel bandwidth and aggregated channel bandwidth edges**

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

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

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

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

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

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

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

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

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

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

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

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

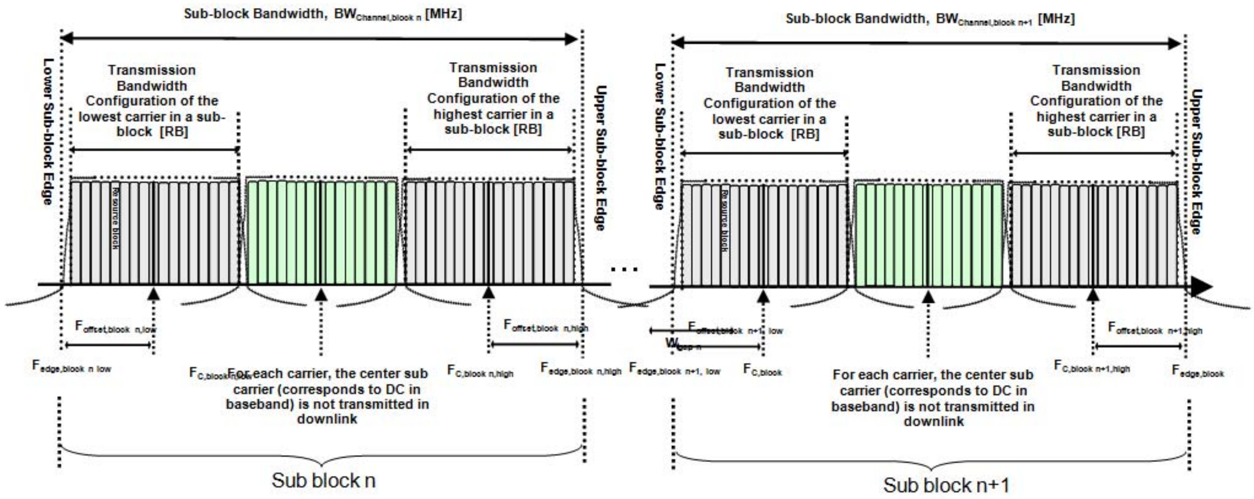


**Figure 5.6A-2. Non-contiguous intraband CA terms and definitions**

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

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

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

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

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

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

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

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

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

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

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

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

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

| CA Bandwidth Class | Aggregated Transmission Bandwidth Configuration | Maximum number of CC | Nominal Guard Band $BW_{GB}$ |
|---|---|---|---|
| A | $N_{RB,agg} \le 100$ | 1 | $a_1 BW_{Channel(1)} - 0.5\Delta f_1$ (NOTE 2) |
| B | $N_{RB,agg} \le 100$ | 2 | NOTE 3 |
| C | $100 < N_{RB,agg} \le 200$ | 2 | $0.05\ max(BW_{Channel(1)}, BW_{Channel(2)}) - 0.5\Delta f_1$ |
| D | $200 < N_{RB,agg} \le 300$ | 3 | NOTE 3 |
| E | $300 < N_{RB,agg} \le 400$ | 4 | NOTE 3 |
| F | $400 < N_{RB,agg} \le 500$ | 5 | NOTE 3 |
| NOTE 1: $BW_{Channel(1)}$ and $BW_{Channel(2)}$ are channel bandwidths of two E-UTRA component carriers according to Table 5.6-1 and $\Delta f_1 = \Delta f$ for the downlink with $\Delta f$ the subcarrier spacing while $\Delta f_1$ = 0 for the uplink.<br>NOTE 2: $a_1$ = 0.16/1.4 for $BW_{Channel(1)}$ = 1.4 MHz whereas $a_1$ = 0.05 for all other channel bandwidths.<br>NOTE 3: Applicaple for later releases. | | | |

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

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

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

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

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

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

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

| E-UTRA CA configuration / Bandwidth combination set | | | | | |
|---|---|---|---|---|---|
| **E-UTRA CA configuration** | **Uplink CA configurations (NOTE 3)** | **Component carriers in order of increasing carrier frequency** | | **Maximum aggregated bandwidth [MHz]** | **Bandwidth combination set** |
| | | **Channel bandwidths for carrier [MHz]** | **Channel bandwidths for carrier [MHz]** | | |
| CA_1C | CA_1C | 15 | 15 | 40 | 0 |
| | | 20 | 20 | | |
| CA_7C | CA_7C | 15 | 15 | 40 | 0 |
| | | 20 | 20 | | |
| CA_38C | CA_38C | 15 | 15 | 40 | 0 |
| | | 20 | 20 | | |
| CA_40C | CA_40C | 10 | 20 | 40 | 0 |
| | | 15 | 15 | | |
| | | 20 | 10, 20 | | |
| CA_41C | CA_41C | 10 | 20 | 40 | 0 |
| | | 15 | 15, 20 | | |
| | | 20 | 10, 15, 20 | | |
| NOTE 1: The CA configuration refers to an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.<br>NOTE 2: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.<br>NOTE 3: Uplink CA configurations are the configurations supported by the present release of specifications. | | | | | |

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

| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **E-UTRA CA Configuration** | **Uplink CA configurations (NOTE 4)** | **E-UTRA Bands** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Maximum aggregated bandwidth [MHz]** | **Bandwidth combination set** |
| CA_1A-5A | - | 1 | | | | Yes | | | 20 | 0 |
| | | 5 | | | | Yes | | | | |
| CA_1A-18A | - | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 18 | | | Yes | Yes | Yes | | | |
| CA_1A-19A | - | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 19 | | | Yes | Yes | Yes | | | |
| CA_1A-21A | - | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 21 | | | Yes | Yes | Yes | | | |
| CA_2A-17A | - | 2 | | | Yes | Yes | | | 20 | 0 |
| | | 17 | | | Yes | Yes | | | | |
| CA_2A-29A | - | 2 | | | Yes | Yes | | | 20 | 0 |
| | | 29 | | Yes | Yes | Yes | | | | |
| CA_3A-5A | - | 3 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 3 | | | | Yes | | | 20 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| CA_3A-7A | - | 3 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| CA_3A-8A | - | 3 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 8 | | | Yes | Yes | | | | |
| | | 3 | | | | Yes | | | 20 | 1 |
| | | 8 | | | Yes | Yes | | | | |
| CA_3A-20A | - | 3 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| CA_4A-5A | - | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| CA_4A-7A | - | 4 | | | Yes | Yes | | | 30 | 0 |
| | | 7 | | | Yes | Yes | Yes | Yes | | |
| CA_4A-12A | - | 4 | Yes | Yes | Yes | Yes | | | 20 | 0 |
| | | 12[5] | | | Yes | Yes | | | | |
| CA_4A-13A | - | 4 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 13 | | | | Yes | | | | |
| | | 4 | | | Yes | Yes | | | 20 | 1 |
| | | 13 | | | | Yes | | | | |
| CA_4A-17A | - | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 17[5] | | | Yes | Yes | | | | |
| CA_4A-29A | - | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 29 | | Yes | Yes | Yes | | | | |
| CA_5A -12A | - | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| CA_5A-17A | - | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 17 | | | Yes | Yes | | | | |
| CA_7A-20A | - | 7 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| CA_8A-20A | - | 8 | | | Yes | Yes | | | 20 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| CA_11A-18A | - | 11 | | | Yes | Yes | | | 25 | 0 |
| | | 18 | | | Yes | Yes | Yes | | | |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.
NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set
NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.
NOTE 4: Uplink CA configurations are the configurations supported by the present release of specifications.
NOTE 5: For the corresponding CA configuration, UE may not support Pcell transmissions in this E-UTRA band.

**Table 5.6A.1-3: E-UTRA CA configurations and bandwidth combination sets defined for non-contiguous intra-band CA**

| E-UTRA CA configuration / Bandwidth combination set | | | | | |
|---|---|---|---|---|---|
| E-UTRA CA configuration | Uplink CA configurations (NOTE 1) | Component carriers in order of increasing carrier frequency | | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
| | | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | | |
| CA_25A-25A | - | 5, 10 | 5, 10 | 20 | 0 |
| CA_41A-41A | - | 10, 15, 20 | 10, 15, 20 | 40 | 0 |
| NOTE 1: Uplink CA configurations are the configurations supported by the present release of specifications. | | | | | |

# 5.6B Channel bandwidth for UL-MIMO

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

## 5.6B.1 Void

# 5.7 Channel arrangement

## 5.7.1 Channel spacing

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

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

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

## 5.7.1A Channel spacing for CA

For intra-band contiguous carrier aggregation bandwidth class C, the nominal channel spacing between two adjacent E-UTRA component carriers is defined as the following:

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

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

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

## 5.7.2 Channel raster

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

### 5.7.2A Channel raster for CA

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

### 5.7.3 Carrier frequency and EARFCN

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

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

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

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

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

| E-UTRA Operating Band | Downlink | | | Uplink | | |
|---|---|---|---|---|---|---|
| | $F_{DL\_low}$ (MHz) | $N_{Offs-DL}$ | Range of $N_{DL}$ | $F_{UL\_low}$ (MHz) | $N_{Offs-UL}$ | Range of $N_{UL}$ |
| 1 | 2110 | 0 | 0 – 599 | 1920 | 18000 | 18000 – 18599 |
| 2 | 1930 | 600 | 600 – 1199 | 1850 | 18600 | 18600 – 19199 |
| 3 | 1805 | 1200 | 1200 – 1949 | 1710 | 19200 | 19200 – 19949 |
| 4 | 2110 | 1950 | 1950 – 2399 | 1710 | 19950 | 19950 – 20399 |
| 5 | 869 | 2400 | 2400 – 2649 | 824 | 20400 | 20400 – 20649 |
| 6 | 875 | 2650 | 2650 – 2749 | 830 | 20650 | 20650 – 20749 |
| 7 | 2620 | 2750 | 2750 – 3449 | 2500 | 20750 | 20750 – 21449 |
| 8 | 925 | 3450 | 3450 – 3799 | 880 | 21450 | 21450 – 21799 |
| 9 | 1844.9 | 3800 | 3800 – 4149 | 1749.9 | 21800 | 21800 – 22149 |
| 10 | 2110 | 4150 | 4150 – 4749 | 1710 | 22150 | 22150 – 22749 |
| 11 | 1475.9 | 4750 | 4750 – 4949 | 1427.9 | 22750 | 22750 – 22949 |
| 12 | 729 | 5010 | 5010 - 5179 | 699 | 23010 | 23010 - 23179 |
| 13 | 746 | 5180 | 5180 – 5279 | 777 | 23180 | 23180 – 23279 |
| 14 | 758 | 5280 | 5280 – 5379 | 788 | 23280 | 23280 – 23379 |
| … | | | | | | |
| 17 | 734 | 5730 | 5730 – 5849 | 704 | 23730 | 23730 – 23849 |
| 18 | 860 | 5850 | 5850 – 5999 | 815 | 23850 | 23850 – 23999 |
| 19 | 875 | 6000 | 6000 – 6149 | 830 | 24000 | 24000 – 24149 |
| 20 | 791 | 6150 | 6150 – 6449 | 832 | 24150 | 24150 – 24449 |
| 21 | 1495.9 | 6450 | 6450 – 6599 | 1447.9 | 24450 | 24450 – 24599 |
| 22 | 3510 | 6600 | 6600 – 7399 | 3410 | 24600 | 24600 – 25399 |
| 23 | 2180 | 7500 | 7500 – 7699 | 2000 | 25500 | 25500 – 25699 |
| 24 | 1525 | 7700 | 7700 - 8039 | 1626.5 | 25700 | 25700 – 26039 |
| 25 | 1930 | 8040 | 8040 - 8689 | 1850 | 26040 | 26040 – 26689 |
| 26 | 859 | 8690 | 8690 - 9039 | 814 | 26690 | 26690 – 27039 |
| 27 | 852 | 9040 | 9040 – 9209 | 807 | 27040 | 27040 – 27209 |
| 28 | 758 | 9210 | 9210 – 9659 | 703 | 27210 | 27210 – 27659 |
| 29[2] | 717 | 9660 | 9660 – 9769 | N/A | | |
| … | | | | | | |
| 33 | 1900 | 36000 | 36000 – 36199 | 1900 | 36000 | 36000 – 36199 |
| 34 | 2010 | 36200 | 36200 – 36349 | 2010 | 36200 | 36200 – 36349 |
| 35 | 1850 | 36350 | 36350 – 36949 | 1850 | 36350 | 36350 – 36949 |
| 36 | 1930 | 36950 | 36950 – 37549 | 1930 | 36950 | 36950 – 37549 |
| 37 | 1910 | 37550 | 37550 – 37749 | 1910 | 37550 | 37550 – 37749 |
| 38 | 2570 | 37750 | 37750 – 38249 | 2570 | 37750 | 37750 – 38249 |
| 39 | 1880 | 38250 | 38250 – 38649 | 1880 | 38250 | 38250 – 38649 |
| 40 | 2300 | 38650 | 38650 – 39649 | 2300 | 38650 | 38650 – 39649 |
| 41 | 2496 | 39650 | 39650 –41589 | 2496 | 39650 | 39650 –41589 |
| 42 | 3400 | 41590 | 41590 – 43589 | 3400 | 41590 | 41590 – 43589 |
| 43 | 3600 | 43590 | 43590 – 45589 | 3600 | 43590 | 43590 – 45589 |
| 44 | 703 | 45590 | 45590 – 46589 | 703 | 45590 | 45590 – 46589 |

NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.
NOTE 2: Restricted to E-UTRA operation when carrier aggregation is configured.

### 5.7.4 TX–RX frequency separation

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

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

| E-UTRA Operating Band | TX - RX carrier centre frequency separation |
|---|---|
| 1 | 190 MHz |
| 2 | 80 MHz. |
| 3 | 95 MHz. |
| 4 | 400 MHz |
| 5 | 45 MHz |
| 6 | 45 MHz |
| 7 | 120 MHz |
| 8 | 45 MHz |
| 9 | 95 MHz |
| 10 | 400 MHz |
| 11 | 48 MHz |
| 12 | 30 MHz |
| 13 | -31 MHz |
| 14 | -30 MHz |
| 17 | 30 MHz |
| 18 | 45 MHz |
| 19 | 45 MHz |
| 20 | -41 MHz |
| 21 | 48 MHz |
| 22 | 100 MHz |
| 23 | 180 MHz |
| 24 | -101.5 MHz |
| 25 | 80 MHz |
| 26 | 45 MHz |
| 27 | 45 MHz |
| 28 | 55 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.

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

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

# 6 Transmitter characteristics

## 6.1 General

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

## 6.2 Transmit power

### 6.2.1 Void

### 6.2.2 UE maximum output power

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non CA configuration and UL-MIMO unless otherwise stated. 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 | 31 | +2/-3 | | | 23 | ±2 | | |
| | | | | | | | | |
| 17 | | | | | 23 | ±2 | | |
| 18 | | | | | 23 | ±2[5] | | |
| 19 | | | | | 23 | ±2 | | |
| 20 | | | | | 23 | ±2[2] | | |
| 21 | | | | | 23 | ±2 | | |
| 22 | | | | | 23 | +2/-3.5[2] | | |
| 23 | | | | | 23[6] | ±2[6] | | |
| 24 | | | | | 23 | ±2 | | |
| 25 | | | | | 23 | ±2[2] | | |
| 26 | | | | | 23 | ±2[2] | | |
| 27 | | | | | 23 | ±2 | | |
| 28 | | | | | 23 | +2/-2.5 | | |
| … | | | | | | | | |
| 33 | | | | | 23 | ±2 | | |
| 34 | | | | | 23 | ±2 | | |
| 35 | | | | | 23 | ±2 | | |
| 36 | | | | | 23 | ±2 | | |
| 37 | | | | | 23 | ±2 | | |
| 38 | | | | | 23 | ±2 | | |
| 39 | | | | | 23 | ±2 | | |
| 40 | | | | | 23 | ±2 | | |
| 41 | | | | | 23 | ±2[2] | | |
| 42 | | | | | 23 | +2/-3 | | |
| 43 | | | | | 23 | +2/-3 | | |
| 44 | | | | | 23 | +2/[-3] | | |

NOTE 1: Void
NOTE 2: [2] refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or $F_{UL\_high}$ – 4 MHz and $F_{UL\_high}$, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB
NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.
NOTE 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance
NOTE 5: For a UE that supports both Band 18 and Band 26, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB for transmission bandwidths confined within 815 MHz and 818 MHz.
NOTE 6: When NS_20 is signalled, the total output power within 2000-2005 MHz shall be limited to 7 dBm.

## 6.2.2A UE maximum output power for CA

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

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

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the requirements in subclause 6.2.2 apply.

For intra-band contiguous carrier aggregation the maximum output power is specified in Table 6.2.2A-1.

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

| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|
| CA_1C | | | | | 23 | +2/-2 | | |
| CA_7C | | | | | 23 | +2/-2[2] | | |
| CA_38C | | | | | 23 | +2/-2 | | |
| CA_40C | | | | | 23 | +2/-2 | | |
| CA_41C | | | | | 23 | +2/-2[2] | | |

NOTE 1: Void
NOTE 2: If all transmitted resource blocks (Figure 5.6A-1) over all component carriers are confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 MHz or/and $F_{UL\_high}$ – 4 MHz and $F_{UL\_high}$, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB
NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance
NOTE 4: For intra-band contiguous carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).

For intra-band non-contiguous carrier aggregation with one uplink carrier on the PCC, the requirements in subclause 6.2.2 apply.

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

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

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

| EUTRA band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 23 | +2/-3 | | |
| 2 | | | | | 23 | +2/-3[2] | | |
| 3 | | | | | 23 | +2/-3[2] | | |
| 4 | | | | | 23 | +2/-3 | | |
| 5 | | | | | 23 | +2/-3 | | |
| 6 | | | | | 23 | +2/-3 | | |
| 7 | | | | | 23 | +2/-3[2] | | |
| 8 | | | | | 23 | +2/-3[2] | | |
| 9 | | | | | 23 | +2/-3 | | |
| 10 | | | | | 23 | +2/-3 | | |
| 11 | | | | | 23 | +2/-3 | | |
| 12 | | | | | 23 | +2/-3[2] | | |
| 13 | | | | | 23 | +2/-3 | | |
| 14 | | | | | 23 | +2/-3 | | |
| | | | | | | | | |
| 17 | | | | | 23 | +2/-3 | | |
| 18 | | | | | 23 | +2/-3 | | |
| 19 | | | | | 23 | +2/-3 | | |
| 20 | | | | | 23 | +2/-3[2] | | |
| 21 | | | | | 23 | +2/-3 | | |
| 22 | | | | | 23 | +2/-4.5[2] | | |
| … | | | | | | | | |
| 23 | | | | | 23 | +2/-3 | | |
| 24 | | | | | 23 | +2/-3 | | |
| 25 | | | | | 23 | +2/-3[2] | | |
| 26 | | | | | 23 | +2/-3[2] | | |
| 27 | | | | | 23 | +2/-3 | | |
| 28 | | | | | 23 | +2/[-3] | | |
| … | | | | | | | | |
| 33 | | | | | 23 | +2/-3 | | |
| 34 | | | | | 23 | +2/-3 | | |
| 35 | | | | | 23 | +2/-3 | | |
| 36 | | | | | 23 | +2/-3 | | |
| 37 | | | | | 23 | +2/-3 | | |
| 38 | | | | | 23 | +2/-3 | | |
| 39 | | | | | 23 | +2/-3 | | |
| 40 | | | | | 23 | +2/-3 | | |
| 41 | | | | | 23 | +2/-3[2] | | |
| 42 | | | | | 23 | +2/-4 | | |
| 43 | | | | | 23 | +2/-4 | | |
| 44 | | | | | 23 | +2/[-3] | | |
| NOTE 1: Void<br>NOTE 2: [2] refers to the transmission bandwidths (Figure 5.6-1) confined within $F_{UL\_low}$ and $F_{UL\_low}$ + 4 6MHz or $F_{UL\_high}$ – 4 MHz and $F_{UL\_high}$, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB<br>NOTE 3: For the UE which supports both Band 11 and Band 21 operating frequencies, the tolerance is FFS.<br>NOTE 4: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance | | | | | | | | |

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

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

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

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

For UE Power Class 1 and 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 1 and 3**

| Modulation | Channel bandwidth / Transmission bandwidth ($N_{RB}$) | | | | | | MPR (dB) |
|---|---|---|---|---|---|---|---|
| | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | |
| QPSK | > 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 PRACH, PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

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

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

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

Where $M_A$ is defined as follows

$$M_A = \begin{cases} 8.00-10.12A & ; 0.00< A \leq 0.33 \\ 5.67 - 3.07A & ; 0.33< A \leq 0.77 \\ 3.31 & ; 0.77< A \leq 1.0 \end{cases}$$

Where

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

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

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

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

For inter-band carrier aggregation with uplink assigned to one E-UTRA band (Table 5.6A-1), the requirements in subclause 6.2.3 apply.

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

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

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

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

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

$$MPR = CEIL \{M_{A,} 0.5\}$$

Where $M_A$ is defined as follows

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

Where

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

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

For intra-band carrier aggregation, the MPR is evaluated per slot and given by the maximum value taken over the transmission(s) on all component carriers within the slot; the maximum MPR over the two slots is then applied for the entire subframe.

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

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

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

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2B-1 is specified in Table 6.2.3-1. The requirements shall be met with UL-MIMO configurations defined in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector.

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

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

### 6.2.4 UE maximum output power with additional requirements

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

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

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

<table>
<tr><th>Network Signalling value</th><th>Requirements (subclause)</th><th>E-UTRA Band</th><th>Channel bandwidth (MHz)</th><th>Resources Blocks ($N_{RB}$)</th><th>A-MPR (dB)</th></tr>
<tr><td>NS_01</td><td>6.6.2.1.1</td><td>Table 5.5-1</td><td>1.4, 3, 5, 10, 15, 20</td><td>Table 5.6-1</td><td>N/A</td></tr>
<tr><td rowspan="5">NS_03</td><td rowspan="5">6.6.2.2.1</td><td rowspan="5">2, 4,10, 23, 25, 35, 36</td><td>3</td><td>>5</td><td>≤ 1</td></tr>
<tr><td>5</td><td>>6</td><td>≤ 1</td></tr>
<tr><td>10</td><td>>6</td><td>≤ 1</td></tr>
<tr><td>15</td><td>>8</td><td>≤ 1</td></tr>
<tr><td>20</td><td>>10</td><td>≤ 1</td></tr>
<tr><td rowspan="2">NS_04</td><td rowspan="2">6.6.2.2.2</td><td rowspan="2">41</td><td>5</td><td>>6</td><td>≤ 1</td></tr>
<tr><td>10, 15, 20</td><td colspan="2">Table 6.2.4-4</td></tr>
<tr><td>NS_05</td><td>6.6.3.3.1</td><td>1</td><td>10,15,20</td><td>≥ 50</td><td>≤ 1</td></tr>
<tr><td>NS_06</td><td>6.6.2.2.3</td><td>12, 13, 14, 17</td><td>1.4, 3, 5, 10</td><td>Table 5.6-1</td><td>N/A</td></tr>
<tr><td>NS_07</td><td>6.6.2.2.3<br>6.6.3.3.2</td><td>13</td><td>10</td><td colspan="2">Table 6.2.4-2</td></tr>
<tr><td>NS_08</td><td>6.6.3.3.3</td><td>19</td><td>10, 15</td><td>> 44</td><td>≤ 3</td></tr>
<tr><td rowspan="2">NS_09</td><td rowspan="2">6.6.3.3.4</td><td rowspan="2">21</td><td rowspan="2">10, 15</td><td>> 40</td><td>≤ 1</td></tr>
<tr><td>> 55</td><td>≤ 2</td></tr>
<tr><td>NS_10</td><td></td><td>20</td><td>15, 20</td><td colspan="2">Table 6.2.4-3</td></tr>
<tr><td>NS_11</td><td>6.6.2.2.1<br>6.6.3.3.13</td><td>23</td><td>1.4, 3, 5, 10, 15, 20</td><td colspan="2">Table 6.2.4-5</td></tr>
<tr><td>NS_12</td><td>6.6.3.3.5</td><td>26</td><td>1.4, 3, 5</td><td colspan="2">Table 6.2.4-6</td></tr>
<tr><td>NS_13</td><td>6.6.3.3.6</td><td>26</td><td>5</td><td colspan="2">Table 6.2.4-7</td></tr>
<tr><td>NS_14</td><td>6.6.3.3.7</td><td>26</td><td>10, 15</td><td colspan="2">Table 6.2.4-8</td></tr>
<tr><td>NS_15</td><td>6.6.3.3.8</td><td>26</td><td>1.4, 3, 5, 10, 15</td><td colspan="2">Table 6.2.4-9<br>Table 6.2.4-10</td></tr>
<tr><td>NS_16</td><td>6.6.3.3.9</td><td>27</td><td>3, 5, 10</td><td colspan="2">Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13</td></tr>
<tr><td>NS_17</td><td>6.6.3.3.10</td><td>28</td><td>5, 10</td><td>Table 5.6-1</td><td>N/A</td></tr>
<tr><td rowspan="2">NS_18</td><td rowspan="2">6.6.3.3.11</td><td rowspan="2">28</td><td>5</td><td>≥ 2</td><td>≤ 1</td></tr>
<tr><td>10, 15, 20</td><td>≥ 1</td><td>≤ 4</td></tr>
<tr><td>NS_19</td><td>6.6.3.3.12</td><td>44</td><td>10, 15, 20</td><td colspan="2">Table 6.2.4-14</td></tr>
<tr><td>NS_20</td><td>6.2.2<br>6.6.2.2.1<br>6.6.3.3.14</td><td>23</td><td>5, 10, 15, 20</td><td colspan="2">Table 6.2.4-15</td></tr>
<tr><td>NS_22</td><td>6.6.3.3.15</td><td>42, 43</td><td>5, 10, 15, 20</td><td colspan="2">Table 6.2.4-16</td></tr>
<tr><td>NS_23</td><td>6.6.3.3.16</td><td>42, 43</td><td>5, 10, 15, 20</td><td colspan="2">N/A</td></tr>
<tr><td>...</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>NS_32</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

**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 bandwidth [MHz] | 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

**Table 6.2.4-4: A-MPR requirements for "NS_04" with bandwidth >5MHz**

| Channel bandwidth [MHz] | Parameters | Region A | Region B | Region C |
|---|---|---|---|---|
| 10 | $RB_{start}$ | 0 – 12 | 13 – 36 | 37 – 49 |
| | $RB_{start}$ + $L_{CRB}$ [RBs] | N/A | >37 | N/A [3] |
| | A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |
| 15 | $RB_{start}$ | 0 – 18 | 19 – 55 | 56 – 74 |
| | $RB_{start}$ + $L_{CRB}$ [RBs] | N/A | >56 | N/A [3] |
| | A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |
| 20 | $RB_{start}$ | 0 – 24 | 25 – 74 | 75 – 99 |
| | $RB_{start}$ + $L_{CRB}$ [RBs] | N/A [3] | >75 | N/A [3] |
| | A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |

NOTE 1: $RB_{start}$ indicates the lowest RB index of transmitted resource blocks
NOTE 2: $L_{CRB}$ is the length of a contiguous resource block allocation
NOTE 3: [3] refers to any RB allocation that starts in Region A or C is allowed the specified A-MPR
NOTE 4: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis
NOTE 5: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe

**Table 6.2.4-5: A-MPR for "NS_11"**

<table>
<tr><th>Channel Bandwidth [MHz]</th><th colspan="15">Parameters</th></tr>
<tr><td rowspan="3">3</td><td>Fc [MHz]</td><td colspan="3"><2004</td><td colspan="7">≥2004</td><td colspan="4"></td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="3">1-15</td><td colspan="7">>5</td><td colspan="4"></td></tr>
<tr><td>A-MPR [dB]</td><td colspan="3">≤5</td><td colspan="7">≤ 1</td><td colspan="4"></td></tr>
<tr><td rowspan="3">5</td><td>Fc [MHz]</td><td colspan="3"><2004</td><td colspan="7">2004 ≤ Fc <2007</td><td colspan="4">≥2007</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="3">1-25</td><td colspan="4">1-6 & 15-25</td><td colspan="3">8-12</td><td colspan="4">>6</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="3">≤7</td><td colspan="4">≤ 4</td><td colspan="3">0</td><td colspan="4">≤ 1</td></tr>
<tr><td rowspan="4">10</td><td>Fc [MHz]</td><td colspan="7">2005 ≤ Fc <2015</td><td colspan="7">2015</td></tr>
<tr><td>$RB_{start}$</td><td colspan="7">0-49</td><td colspan="7">0-49</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="7">1-50</td><td colspan="7">1-50</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="7">≤ 12</td><td colspan="7">0</td></tr>
<tr><td rowspan="8">15</td><td>Fc [MHz]</td><td colspan="14"><2012.5</td></tr>
<tr><td>$RB_{start}$</td><td>0-4</td><td colspan="8">5-21</td><td colspan="4">22-56</td><td>57-74</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td>≥1</td><td colspan="3">7-50</td><td colspan="5">0-6 & ≥50</td><td colspan="2">≤25</td><td colspan="2">>25</td><td>>0</td></tr>
<tr><td>A-MPR [dB]</td><td>≤15</td><td colspan="3">≤7</td><td colspan="5">≤10</td><td colspan="2">0</td><td colspan="2">≤6</td><td>≤15</td></tr>
<tr><td>Fc [MHz]</td><td colspan="14">2012.5</td></tr>
<tr><td>$RB_{start}$</td><td colspan="2">0-12</td><td colspan="6">13-39</td><td colspan="4">40-65</td><td colspan="2">66-74</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="2">≥1</td><td colspan="4">≥30</td><td colspan="2"><30</td><td colspan="4">≥ (69 – $RB_{start}$)</td><td colspan="2">≥1</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="2">≤10</td><td colspan="4">≤6</td><td colspan="2">0</td><td colspan="4">≤2</td><td colspan="2">≤6.5</td></tr>
<tr><td rowspan="4">20</td><td>Fc [MHz]</td><td colspan="14">2010</td></tr>
<tr><td>$RB_{start}$</td><td>0-12</td><td colspan="7">13-29</td><td colspan="5">30-68</td><td>69-99</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td>≥1</td><td colspan="4">10-60</td><td colspan="3">1-9 & >60</td><td colspan="3">1-24</td><td colspan="2">≥25</td><td>≥1</td></tr>
<tr><td>A-MPR [dB]</td><td>≤15</td><td colspan="4">≤7</td><td colspan="3">≤10</td><td colspan="3">0</td><td colspan="2">≤7</td><td>≤15</td></tr>
</table>

**Table 6.2.4-6: A-MPR for “NS_12”**

| Channel bandwidth [MHz] | Parameters | Region A | | Region B |
|---|---|---|---|---|
| 1.4 | $RB_{start}$ | 0 | | 1-2 |
| | $L_{CRB}$ [RBs] | ≤3 | ≥4 | ≥4 |
| | A-MPR [dB] | ≤3 | ≤6 | ≤3 |
| 3 | $RB_{start}$ | 0-3 | | 4-5 |
| | $L_{CRB}$ [RBs] | 4-9 | 1-3 and 10-15 | ≥9 |
| | A-MPR [dB] | ≤4 | ≤3 | ≤3 |
| 5 | $RB_{start}$ | 0-6 | | 7-9 |
| | $L_{CRB}$ [RBs] | ≤8 | ≥9 | ≥15 |
| | A-MPR [dB] | ≤5 | ≤3 | ≤3 |

**Table 6.2.4-7: A-MPR for “NS_13”**

| Channel bandwidth [MHz] | Parameters | Region A | |
|---|---|---|---|
| 5 | $RB_{start}$ | 0-2 | |
| | $L_{CRB}$ [RBs] | ≤5 | ≥18 |
| | A-MPR [dB] | ≤3 | ≤2 |

**Table 6.2.4-8: A-MPR for “NS_14”**

| Channel bandwidth [MHz] | Parameters | Region A | |
|---|---|---|---|
| 10 | $RB_{start}$ | 0 | |
| | $L_{CRB}$ [RBs] | ≤5 | =50 |
| | A-MPR [dB] | ≤3 | ≤1 |
| 15 | $RB_{start}$ | ≤8 | |
| | $L_{CRB}$ [RBs] | ≤16 | ≥50 |
| | A-MPR [dB] | ≤3 | ≤1 |

**Table 6.2.4-9: A-MPR for “NS_15” for E-UTRA highest channel edge > 845 MHz and ≤ 849 MHz**

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

**Table 6.2.4-10: A-MPR for “NS_15” for E-UTRA highest channel edge ≤ 845 MHz**

| Channel bandwidth [MHz] | Parameters | Region A | Region B | Region C |
|---|---|---|---|---|
| 5 | $RB_{end}$ [RB] | | | 19-24 |
| | $L_{CRB}$ [RB] | | | ≥18 |
| | A-MPR [dB] | | | ≤2 |
| 10 | $RB_{end}$ [RB] | 0-4 | 29-44 | 45-49 |
| | $L_{CRB}$ [RB] | ≤2 | ≥24 | >0 |
| | A-MPR [dB] | ≤4 | ≤4 | ≤9 |
| 15 | $RB_{end}$ [RB] | 0-12 | 44-61 | 62-74 |
| | $L_{CRB}$ [RB] | ≤2 | ≥20 | >0 |
| | A-MPR [dB] | ≤4 | ≤5 | ≤9 |

**Table 6.2.4-11: A-MPR for “NS_16” with channel lower edge at ≥807 MHz and <808.5 MHz**

| Channel bandwidth [MHz] | Parameter | Region A | Region B | Region C | Region D | Region E |
|---|---|---|---|---|---|---|
| 3 MHz | $RB_{start}$ | 0 | 1-2 | | | |
| | $L_{CRB}$ [RBs] | ≥12 | 12 | | | |
| | A-MPR [dB] | ≤2 | ≤1 | | | |
| 5 MHz | $RB_{start}$ | 0-1 | 2 | 2-9 | 2-5 | |
| | $L_{CRB}$ [RBs] | 1 - 25 | 12 | 15-18 | 20 | |
| | A-MPR [dB] | ≤5 | ≤1 | ≤2 | ≤3 | |
| 10 MHz | $RB_{start}$ | 0 - 8 | 0-14 | | 15-20 | 15-24 |
| | $L_{CRB}$ [RBs] | 1 - 12 | 15-20 | ≥24 | ≥30 | 24-27 |
| | A-MPR [dB] | ≤5 | ≤3 | ≤7 | ≤3 | ≤1 |

**Table 6.2.4-12: A-MPR for “NS_16” with channel lower edge at ≥808.5 MHz and <812 MHz**

| Channel bandwidth [MHz] | Parameter | Region A | Region B | Region C | Region D | Region E |
|---|---|---|---|---|---|---|
| 5 MHz | $RB_{start}$ | 0 | 0-1 | 1-5 | | |
| | $L_{CRB}$ [RBs] | 16-20 | ≥24 | 16-20 | | |
| | A-MPR [dB] | ≤2 | ≤3 | ≤1 | | |
| 10 MHz | $RB_{start}$ | 0-6 | | 0-10 | 0-14 | 11-20 |
| | $L_{CRB}$ [RBs] | 1-12 | 15-20 | 24-32 | ≥36 | 24-32 |
| | A-MPR [dB] | ≤5 | ≤2 | ≤4 | ≤5 | ≤1 |

**Table 6.2.4-13: A-MPR for “NS_16” with channel lower edge at ≥812 MHz**

| Channel bandwidth [MHz] | Parameter | Region A | Region B | Region C | Region D |
|---|---|---|---|---|---|
| 10 MHz | $RB_{start}$ | 0 - 9 | 0 | 1-14 | 0-5 |
| | $L_{CRB}$ [RBs] | 27-32 | 36-40 | 36-40 | ≥45 |
| | A-MPR [dB] | ≤1 | ≤2 | ≤1 | ≤3 |

**Table 6.2.4-14: A-MPR for “NS_19”**

| Channel bandwidth [MHz] | Parameters | Region A | | Region B |
|---|---|---|---|---|
| 10 | $RB_{start}$ | | | 0-6 |
| | $L_{CRB}$ [RBs] | | | ≥40 |
| | A-MPR [dB] | | | ≤1 |
| 15 | $RB_{start}$ | 0-6 | | 7-20 |
| | $L_{CRB}$ [RBs] | ≤18 | ≥36 | ≥42 |
| | A-MPR [dB] | ≤2 | ≤3 | ≤2 |
| 20 | $RB_{start}$ | 0-14 | | 15-30 |
| | $L_{CRB}$ [RBs] | ≤40 | ≥45 | ≥50 |
| | A-MPR [dB] | ≤2 | ≤3 | ≤2 |

**Table 6.2.4-15: A-MPR for "NS_20"**

<table>
<tr><th>Channel Bandwidth [MHz]</th><th colspan="13">Parameters</th></tr>
<tr><td rowspan="4">5</td><td>Fc [MHz]</td><td colspan="3">< 2007.5</td><td colspan="6">2007.5 ≤ Fc < 2012.5</td><td colspan="3">2012.5 ≤ Fc ≤ 2017.5</td></tr>
<tr><td>$RB_{start}$</td><td colspan="3">≤24</td><td colspan="4">0-3</td><td colspan="2">4-6</td><td colspan="3">≤24</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="3">>0</td><td colspan="2">15-19</td><td colspan="2">≥20</td><td colspan="2">≥18</td><td colspan="3">1-25</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="3">≤17</td><td colspan="2">≤1</td><td colspan="2">≤4</td><td colspan="2">≤2</td><td colspan="3">≤ 0</td></tr>
<tr><td rowspan="8">10</td><td>Fc [MHz]</td><td colspan="12">2005</td></tr>
<tr><td>$RB_{start}$</td><td colspan="3">0-25</td><td colspan="6">26-34</td><td colspan="3">35-49</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="3">>0</td><td colspan="3">8-15</td><td colspan="3">>15</td><td colspan="3">>0</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="3">≤16</td><td colspan="3">≤2</td><td colspan="3">≤5</td><td colspan="3">≤ 6</td></tr>
<tr><td>Fc [MHz]</td><td colspan="12">2015</td></tr>
<tr><td>$RB_{start}$</td><td colspan="6">0-5</td><td colspan="6">6-10</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="6">≥32</td><td colspan="6">≥40</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="6">≤4</td><td colspan="6">≤2</td></tr>
<tr><td rowspan="4">15</td><td>Fc [MHz]</td><td colspan="12">2012.5</td></tr>
<tr><td>$RB_{start}$</td><td colspan="4">0-14</td><td colspan="4">15-24</td><td colspan="2">25-39</td><td colspan="2">61-74</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="2">1-9 & 40-75</td><td colspan="2">10-39</td><td colspan="2">24-29</td><td colspan="2">≥30</td><td colspan="2">≥36</td><td colspan="2">≤6</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="2">≤11</td><td colspan="2">≤6</td><td colspan="2">≤1</td><td colspan="2">≤7</td><td colspan="2">≤5</td><td colspan="2">≤6</td></tr>
<tr><td rowspan="4">20</td><td>Fc [MHz]</td><td colspan="12">2010</td></tr>
<tr><td>$RB_{start}$</td><td colspan="2">0-21</td><td colspan="4">22-31</td><td colspan="2">32-38</td><td colspan="2">39-49</td><td>50-68</td><td>69-99</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="2">>0</td><td colspan="2">1-9 & 31-75</td><td colspan="2">10-30</td><td colspan="2">≥15</td><td colspan="2">≥24</td><td>≥25</td><td>>0</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="2">≤17</td><td colspan="2">≤12</td><td colspan="2">≤6</td><td colspan="2">≤9</td><td colspan="2">≤7</td><td>≤5</td><td>≤16</td></tr>
<tr><td colspan="14">NOTE 1: When NS_20 is signaled the minimum requirements for the 10 MHz bandwidth are specified for E-UTRA UL carrier center frequencies of 2005 MHz or 2015 MHz.<br>NOTE 2: When NS_20 is signaled the minimum requirements for the 15 MHz channel bandwidth are specified for E-UTRA UL carrier center frequency of 2012.5 MHz.</td></tr>
</table>

**Table 6.2.4-16: A-MPR for "NS_22"**

| Channel bandwidth [MHz] | Parameters | Region A | Region B | Region C | Region D |
|---|---|---|---|---|---|
| 5 | No A-MPR is needed for 5 MHz channel bandwidth | | | | |
| 10 | $RB_{start}$ | 0-13 | 0-17 | ≤ 6 | ≥12 |
| | $L_{CRB}$ [RBs] | > 36 | 33-36 | ≤ 32 | ≤ 32 |
| | RBstart + LCRB [RBs] | N/A | N/A | N/A | ≥44 |
| | A-MPR [dB] | ≤ 4 | ≤ 3 | ≤ 3 | ≤ 3 |
| 15 | $RB_{start}$ | 0-24 | 0-38 | ≤ 14 | ≥ 23 |
| | $L_{CRB}$ [RBs] | > 50 | 37-50 | ≤ 36 | ≤ 36 |
| | RBstart + LCRB [RBs] | N/A | N/A | N/A | ≥59 |
| | A-MPR [dB] | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 3 |
| 20 | $RB_{start}$ | 0-35 | 0-51 | ≤ 21 | ≥ 31 |
| | $L_{CRB}$ [RBs] | > 64 | 49-64 | ≤ 48 | ≤ 48 |
| | RBstart + LCRB [RBs] | N/A | N/A | N/A | ≥79 |
| | A-MPR [dB] | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 3 |
| NOTE 1; $RB_{start}$ indicates the lowest RB index of transmitted resource blocks<br>NOTE 2; $L_{CRB}$ is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.<br>NOTE 4; For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. | | | | | |

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

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

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

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

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

If for intra-band carrier aggregation the UE is configured for transmissions on a single serving cell, then subclauses 6.2.3 and 6.2 4 apply with the Network Signaling value indicated by the field *additionalSpectrumEmission*.

For intra-band contiguous aggregation with the UE configured for transmissions on two serving cells, the maximum output power reduction specified in Table 6.2.4A-1 is allowed for all serving cells of the applicable uplink CA configurations according to the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10*. Then clause 6.2.3A does not apply, i.e. the carrier aggregation MPR = 0 dB, unless the value indicated is CA_NS_31.

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

| CA Network Signalling value | Requirements (subclause) | Uplink CA Configuration | A-MPR [dB] (subclause) |
|---|---|---|---|
| CA_NS_01 | 6.6.3.3A.1 | CA_1C | 6.2.4A.1 |
| CA_NS_02 | 6.6.3.3A.2 | CA_1C | 6.2.4A.2 |
| CA_NS_03 | 6.6.3.3A.3 | CA_1C | 6.2.4A.3 |
| CA_NS_04 | 6.6.2.2A.1, 6.6.3.3A.8 | CA_41C | 6.2.4A.4 |
| CA_NS_05 | 6.6.3.3A.4 | CA_38C | 6.2.4A.5 |
| CA_NS_06 | 6.6.3.3A.5 | CA_7C | 6.2.4A.6 |
| … | | | |
| CA_NS_31 | NOTE 1 | Table 5.6A.1-1 (NOTE 1) | N/A |
| CA_NS_32 | Reserved | | |
| NOTE 1: Applicable for uplink CA configurations listed in Table 5.6A.1-1 for which none of the additional requirements in subclauses 6.6.2.2A or 6.6.3.3A apply.<br>NOTE 2: The index of the sequence CA_NS corresponds to the value of *additionalSpectrumEmissionSCell-r10*. | | | |

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

For intra-band carrier aggregation, the A-MPR is evaluated per slot and given by the maximum value taken over the transmission(s) on all component carriers within the slot; the maximum A-MPR over the two slots is then applied for the entire subframe.

For the UE maximum output power modified by A-MPR specified in table 6.2.4A-1, the power limits specified in subclause 6.2.5A apply.

### 6.2.4A.1 A-MPR for CA_NS_01 for CA_1C

If the UE is configured to CA_1C and it receives IE CA_NS_01 the allowed maximum output power reduction applied to transmissions on the PCC and the SCC for contiguously aggregated signals is specified in table 6.2.4A.1-1.

**Table 6.2.4A.1-1: Contiguous allocation A-MPR for CA_NS_01**

| CA_1C: CA_NS_01 | $RB_{start}$ | $L_{CRB}$ [RBs] | $RB_{start} + L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM [dB] |
|---|---|---|---|---|
| 100 RB / 100 RB | 0 – 23 and 176 – 199 | > 0 | N/A | ≤ 12.0 |
| | 24 – 105 | > 64 | N/A | ≤ 6.0 |
| | 106 – 175 | N/A | > 175 | ≤ 5.0 |
| 75 RB / 75 RB | 0 – 6 and 143 – 149 | $0 < L_{CRB} \le 10$ | N/A | ≤ 11.0 |
| | | > 10 | N/A | ≤ 6.0 |
| | 7 – 90 | > 44 | N/A | ≤ 5.0 |
| | 91 – 142 | N/A | > 142 | ≤ 2.0 |
| NOTE 1: $RB_{\_start}$ indicates the lowest RB index of transmitted resource blocks<br>NOTE 2: $L_{\_CRB}$ is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis<br>NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe | | | | |

If the UE is configured to CA_1C and it receives IE CA_NS_01 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

$$\text{A-MPR} = \text{CEIL}\{M_{A,}\ 0.5\}$$

Where $M_A$ is defined as follows

$$M_A = \quad -22.5\,A + 17 \qquad ; 0 \le A < 0.20$$

$-11.0\ A + 14.7 \quad ; 0.20 \le A < 0.70$

$-1.7\ A + 8.2 \quad ; 0.70 \le A \le 1$

Where $A = N_{RB\_alloc} / N_{RB\_agg.}$

### 6.2.4A.2 A-MPR for CA_NS_02 for CA_1C

If the UE is configured to CA_1C and it receives IE CA_NS_02 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.2-1.

**Table 6.2.4A.2-1: Contiguous allocation A-MPR for CA_NS_02**

| CA_1C: CA_NS_02 | $RB_{end}$ | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16 –QAM [dB] |
|---|---|---|---|
| 100 RB / 100 RB | 0 –20 | > 0 | ≤ 4 dB |
| | 21 – 46 | > 0 | ≤ 3 dB |
| | 47 – 99 | > $RB_{end}$ - 20 | ≤ 3 dB |
| | 100 – 184 | > 75 | ≤ 6 dB |
| | 185 – 199 | > 0 | ≤ 10 dB |
| 75 RB / 75 RB | 0 – 48 | > 0 | ≤ 2 dB |
| | 49 – 80 | > $RB_{end}$ - 20 | ≤ 3 dB |
| | 81 – 129 | > 60 | ≤ 5 dB |
| | 130 – 149 | > 84 | ≤ 6 dB |
| | 130 – 149 | 1 – 84 | ≤ 2 dB |

If the UE is configured to CA_1C and it receives IE CA_NS_02 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$\text{A-MPR} = \text{CEIL}\ \{M_{A,}\ 0.5\}$$

Where $M_A$ is defined as follows

$M_A = \quad -22.5\ A + 17 \quad ; 0 \le A < 0.20$

$-11.0\ A + 14.7 \quad ; 0.20 \le A < 0.70$

$-1.7\ A + 8.2 \quad ; 0.70 \le A \le 1$

Where $A = N_{RB\_alloc} / N_{RB\_agg.}$

### 6.2.4A.3 A-MPR for CA_NS_03 for CA_1C

If the UE is configured to CA_1C and it receives IE CA_NS_03 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.3-1.

**Table 6.2.4A.3-1: Contiguous allocation A-MPR for CA_NS_03**

| CA_1C: CA_NS_03 | $RB_{end}$ | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM [dB] |
|---|---|---|---|
| 100 RB / 100 RB | 0 – 26 | > 0 | ≤ 10 dB |
| | 27 – 63 | ≥ $RB_{end}$ - 27 | ≤ 6 dB |
| | 27 – 63 | < $RB_{end}$ - 27 | ≤ 1 dB |
| | 64 – 100 | > $RB_{end}$ - 20 | ≤ 4 dB |
| | 101 – 171 | > 68 | ≤ 7 dB |
| | 172 – 199 | > 0 | ≤ 10 dB |
| 75 RB / 75 RB | 0 – 20 | > 0 | ≤ 10 dB |
| | 21 – 45 | > 0 | ≤ 4 dB |
| | 46 – 75 | > $RB_{end}$ – 13 | ≤ 2 dB |
| | 76 – 95 | > 45 | ≤ 5 dB |
| | 96 – 149 | > 43 | ≤ 8 dB |
| | 120 – 149 | 1 - 43 | ≤ 6 dB |

If the UE is configured to CA_1C and it receives IE CA_NS_03 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$\text{A-MPR} = \text{CEIL}\ \{M_{A,}\ 0.5\}$$

Where $M_A$ is defined as follows

$$M_A = \begin{cases} -23.33A + 17.5 & ; 0 \le A < 0.15 \\ -7.65A + 15.15 & ; 0.15 \le A \le 1 \end{cases}$$

Where $A = N_{RB\_alloc} / N_{RB\_agg.}$

## 6.2.4A.4 A-MPR for CA_NS_04

If the UE is configured to CA_41C and it receives IE CA_NS_04 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.4-1.

**Table 6.2.4A.4-1: Contiguous Allocation A-MPR for CA_NS_04**

| CA Bandwidth Class C | $RB_{Start}$ | $L_{CRB}$ [RBs] | $RB_{start}$ + $L_{CRB}$ [RBs] | A-MPR for QPSK [dB] | A-MPR for 16QAM [dB] |
|---|---|---|---|---|---|
| 50RB / 100 RB | 0 – 44 and 105 – 149 | >0 | N/A | ≤4dB | ≤4dB |
| | 45 – 104 | N/A | >105 | ≤3dB | ≤4dB |
| 75 RB / 75 RB | 0 – 44 and 105 – 149 | >0 | N/A | ≤4dB | ≤4dB |
| | 45 – 104 | N/A | >105 | ≤4dB | ≤4dB |
| 100 RB / 75 RB | 0 – 49 and 125 – 174 | >0 | N/A | ≤4dB | ≤4dB |
| | 50 - 124 | N/A | >125 | ≤3dB | ≤4dB |
| 100 RB / 100 RB | 0 – 59 and 140 – 199 | >0 | N/A | ≤3dB | ≤4dB |
| | 60– 139 | N/A | >140 | ≤3dB | ≤4dB |
| NOTE 1: $RB_{start}$ indicates the lowest RB index of transmitted resource blocks<br>NOTE 2: $L_{CRB}$ is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis<br>NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe | | | | | |

If the UE is configured to CA_41C and it receives IE CA_NS_04 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

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

Where $M_A$ is defined as follows

$$M_A = 11.0, \quad 0 \le A < 0.05$$
$$= -55.0A + 13.75, \quad 0.05 \le A < 0.15$$
$$= -4.0A + 6.10, \quad 0.15 \le A < 0.40$$
$$= -0.83A + 4.83, \quad 0.40 \le A \le 1$$

Where $A = N_{RB\_alloc} / N_{RB\_agg}$.

### 6.2.4A.5 A-MPR for CA_NS_05 for CA_38C

If the UE is configured to CA_38C and it receives IE CA_NS_05 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.5-1.

**Table 6.2.4A.5-1: Contigous Allocation A-MPR for CA_NS_05**

| CA_38C | $RB_{end}$ | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM [dB] |
|---|---|---|---|
| 100RB/100RB | 0 – 12 | >0 | ≤ 5 dB |
| | 13 – 79 | > $RB_{end}$ – 13 | ≤ 2 dB |
| | 80 – 180 | >60 | ≤ 6 dB |
| | 181 – 199 | > 0 | ≤ 11 dB |
| 75RB/75RB | 0 – 70 | > max (0, $RB_{end}$ -10) | ≤ 2 dB |
| | 71- 108 | > 60 | ≤ 5 dB |
| | 109 – 139 | >0 | ≤ 5 dB |
| | 140 – 149 | ≤ 70 | ≤ 2 dB |
| | 140 – 149 | >70 | ≤ 6 dB |
| NOTE 1: $RB_{end}$ indicates the highest RB index of transmitted resource blocks<br>NOTE 2: $L_{CRB}$ is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis<br>NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe | | | |

If the UE is configured to CA_38C and it receives IE CA_NS_05 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

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

Where MA is defined as follows

$$M_A = -14.17\ A + 16.50 \quad ; 0 \le A < 0.60$$
$$-2.50\ A + 9.50 \quad ; 0.60 \le A \le 1$$

Where $A = N_{RB\_alloc} / N_{RB\_agg}$.

### 6.2.4A.6 A-MPR for CA_NS_06

If the UE is configured to CA_7C and it receives IE CA_NS_06 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.6-1.

**Table 6.2.4A.6-1: Contiguous Allocation A-MPR for CA_NS_06**

| CA Bandwidth Class C | $RB_{\_end}$ | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM [dB] |
|---|---|---|---|
| 100RB/100RB | 0 –22 | >0 | ≤4 dB |
| | 23 – 99 | > max(0, $RB_{end}$ – 25) | ≤ 2 dB |
| | 100 – 142 | > 75 | ≤ 3 dB |
| | 143 – 177 | >70 | ≤ 5 dB |
| | 178 – 199 | > 0 | ≤ 10 dB |
| 75RB/75RB | 0 – 7 | >0 | ≤ 5 dB |
| | 8- 74 | > max(0, $RB_{end}$ – 10) | ≤ 2 dB |
| | 75 – 109 | >64 | ≤ 2 dB |
| | 110 – 144 | >35 | ≤ 6 dB |
| | 145 – 149 | >0 | ≤ 10 dB |

If the UE is configured to CA_7C and it receives IE CA_NS_06 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows:

$$\text{A-MPR} = \text{CEIL}\ \{M_{A,}\ 0.5\}$$

Where $M_A$ is defined as follows

$$M_A = \begin{cases} -13.33A + 17.5 & ;\ 0 \le A < 0.15 \\ -6.47A + 16.47 & ;\ 0.15 \le A \le 1 \end{cases}$$

Where $A = N_{RB\_alloc} / N_{RB\_agg.}$

## 6.2.4B UE maximum output power with additional requirements for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in subclause 6.2.4 shall apply to the maximum output power specified in Table 6.2.2B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. Unless stated otherwise, an A-MPR of 0 dB shall be used.

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

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.4 apply.

## 6.2.5 Configured transmitted power

The UE is allowed to set its configured maximum output power $P_{CMAX,c}$ for serving cell *c*. The configured maximum output power $P_{CMAX,c}$ is set within the following bounds:

$$P_{CMAX\_L,c} \le P_{CMAX,c} \le P_{CMAX\_H,c}$$

with

$$P_{CMAX\_L,c} = \text{MIN}\ \{P_{EMAX,c} - \Delta T_{C,c},\ P_{PowerClass} - \text{MAX}(MPR_c + \text{A-MPR}_c + \Delta T_{IB,c} + \Delta T_{C,c},\ \text{P-MPR}_c)\ \}$$

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

where

- $P_{EMAX,c}$ is the value given by IE *P-Max* for serving cell *c*, 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;
- $MPR_c$ and A-$MPR_c$ for serving cell *c* are specified in subclause 6.2.3 and subclause 6.2.4, respectively;
- $\Delta T_{IB,c}$ is the additional tolerance for serving cell *c* as specified in Table 6.2.5-2; $\Delta T_{IB,c}$ = 0 dB otherwise;
- $\Delta T_{C,c}$ = 1.5 dB when Note 2 in Table 6.2.2-1 applies;
- $\Delta T_{C,c}$ = 0 dB when Note 2 in Table 6.2.2-1 does not apply.

P-$MPR_c$ is the allowed maximum output power reduction for

a) ensuring compliance with applicable electromagnetic energy absorption requirements and addressing unwanted emissions / self desense requirements in case of simultaneous transmissions on multiple RAT(s) for scenarios not in scope of 3GPP RAN specifications;

b) ensuring compliance with applicable electromagnetic energy absorption requirements in case of proximity detection is used to address such requirements that require a lower maximum output power.

The UE shall apply P-$MPR_c$ for serving cell *c* only for the above cases. For UE conducted conformance testing P-MPR shall be 0 dB

NOTE 1: P-$MPR_c$ was introduced in the $P_{CMAX,c}$ equation such that the UE can report to the eNB the available maximum output transmit power. This information can be used by the eNB for scheduling decisions.

NOTE 2: P-$MPR_c$ may impact the maximum uplink performance for the selected UL transmission path.

For each subframe, the $P_{CMAX\_L,c}$ for serving cell *c* is evaluated per slot and given by the minimum value taken over the transmission(s) within the slot; the minimum $P_{CMAX\_L,c}$ over the two slots is then applied for the entire subframe. $P_{PowerClass}$ shall not be exceeded by the UE during any period of time.

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

$$P_{CMAX\_L,c} - MAX\{T_{L,c}, T(P_{CMAX\_L,c})\} \leq P_{UMAX,c} \leq P_{CMAX\_H,c} + T(P_{CMAX\_H,c})$$

where the tolerance $T(P_{CMAX,c})$ for applicable values of $P_{CMAX,c}$ is specified in Table 6.2.5-1. The tolerance $T_{L,c}$ is the absolute value of the lower tolerance for the applicable operating band as specified in Table 6.2.2-1.

**Table 6.2.5-1: $P_{CMAX,c}$ tolerance**

| $P_{CMAX,c}$ (dBm) | Tolerance $T(P_{CMAX,c})$ (dB) |
|---|---|
| $23 < P_{CMAX,c} \leq 33$ | 2.0 |
| $21 \leq P_{CMAX,c} \leq 23$ | 2.0 |
| $20 \leq P_{CMAX,c} < 21$ | 2.5 |
| $19 \leq P_{CMAX,c} < 20$ | 3.5 |
| $18 \leq P_{CMAX,c} < 19$ | 4.0 |
| $13 \leq P_{CMAX,c} < 18$ | 5.0 |
| $8 \leq P_{CMAX,c} < 13$ | 6.0 |
| $-40 \leq P_{CMAX,c} < 8$ | 7.0 |

For the UE which supports inter-band carrier aggregation configurations with the uplink assigned to one E-UTRA band the $\Delta T_{IB,c}$ is defined for applicable bands in Table 6.2.5-2.

**Table 6.2.5-2: $\Delta T_{IB,c}$**

| Inter-band CA Configuration | E-UTRA Band | $\Delta T_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-5A | 1 | 0.3 |
| | 5 | 0.3 |
| CA_1A-18A | 1 | 0.3 |
| | 18 | 0.3 |
| CA_1A-19A | 1 | 0.3 |
| | 19 | 0.3 |
| CA_1A-21A | 1 | 0.3 |
| | 21 | 0.3 |
| CA_2A-17A | 2 | 0.3 |
| | 17 | 0.8 |
| CA_2A-29A | 2 | 0.3 |
| | | |
| CA_3A-5A | 3 | 0.3 |
| | 5 | 0.3 |
| CA_3A-7A | 3 | 0.5 |
| | 7 | 0.5 |
| CA_3A-8A | 3 | 0.3 |
| | 8 | 0.3 |
| CA_3A-20A | 3 | 0.3 |
| | 20 | 0.3 |
| CA_4A-5A | 4 | 0.3 |
| | 5 | 0.3 |
| CA_4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-12A | 4 | 0.3 |
| | 12 | 0.8 |
| CA_4A-13A | 4 | 0.3 |
| | 13 | 0.3 |
| CA_4A-17A | 4 | 0.3 |
| | 17 | 0.8 |
| CA_4A-29A | 4 | 0.3 |
| CA_5A-12A | 5 | 0.8 |
| | 12 | 0.4 |
| CA_5A-17A | 5 | 0.8 |
| | 17 | 0.4 |
| CA_7A-20A | 7 | 0.3 |
| | 20 | 0.3 |
| CA_8A-20A | 8 | 0.4 |
| | 20 | 0.4 |
| CA_11A-18A | 11 | 0.3 |
| | 18 | 0.3 |

NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations

NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations

NOTE 3: In case the UE supports more than one of the above inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one inter-band carrier aggregation configurations then:

- When the E-UTRA operating band frequency range is ≤ 1GHz, the applicable additional tolerance shall be the average of the tolerances above, truncated to one decimal place for that operating band among the supported CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported carrier aggregation configurations involving such band shall be applied
- When the E-UTRA operating band frequency range is >1GHz, the applicable additional tolerance shall be the maximum tolerance above that applies for that operating band among the supported CA configurations

NOTE: The above additional tolerances do not apply to supported UTRA operating bands with frequency range below 1 GHz that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations when such bands are belonging only to band combination(s) where one band is <1GHz and another band is >1.7GHz and there is no harmonic relationship between the low band UL and high band DL. Otherwise the above additional tolerances also apply to supported UTRA operating bands that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.

NOTE: To meet the $\Delta T_{IB,c}$ requirements for CA_3A-7A with state-of-the-art technology, an increase in power consumption of the UE may be required. It is also expected that as the state-of-the-art technology evolves in the future, this possible power consumption increase can be reduced or eliminated.

### 6.2.5A Configured transmitted power for CA

For uplink carrier aggregation the UE is allowed to set its configured maximum output power $P_{CMAX,c}$ for serving cell *c* and its total configured maximum output power $P_{CMAX}$.

The configured maximum output power $P_{CMAX,c}$ on serving cell *c* shall be set as specified in subclause 6.2.5.

For uplink intra-band contiguous carrier aggregation, $MPR_c$ = MPR and $A\text{-}MPR_c$ = A-MPR with MPR and A-MPR specified in subclause 6.2.3A and subclause 6.2.4A respectively. There is one power management term for the UE, denoted P-MPR, and $P\text{-}MPR_c$ = P-MPR. $P_{CMAX,c}$ is calculated under the assumption that the transmit power is increased by the same amount in dB on all component carriers.

**Table 6.2.5A-1:Void**

The total configured maximum output power PCMAX shall be set within the following bounds:

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

For uplink intra-band contiguous carrier aggregation,

$$P_{CMAX\_L} = \text{MIN}\{10 \log_{10} \sum p_{EMAX,c} - \Delta T_C , P_{PowerClass} - \text{MAX}(MPR + A\text{-}MPR + \Delta T_{IB,c} + \Delta T_C, P\text{-}MPR)\}$$

$$P_{CMAX\_H} = \text{MIN}\{10 \log_{10} \sum p_{EMAX,c} , P_{PowerClass}\}$$

where

- $p_{EMAX,c}$ is the linear value of $P_{EMAX,c}$ which is given by IE *P-Max* for serving cell *c* in [7] ;
- $P_{PowerClass}$ is the maximum UE power specified in Table 6.2.2A-1 without taking into account the tolerance specified in the Table 6.2.2A-1;
- MPR and A-MPR are specified in subclause 6.2.3A and subclause 6.2.4A respectively;
- $\Delta T_{IB,c}$ is the additional tolerance for serving cell *c* as specified in Table 6.2.5-2;
- P-MPR is the power management term for the UE;
- $\Delta T_C$ is the highest value $\Delta T_{C,c}$ among all serving cells *c* in the subframe over both timeslots. $\Delta T_{C,c}$ = 1.5 dB when Note 2 in Table 6.2.2A-1 applies to the serving cell *c*, otherwise $\Delta T_{C,c}$ = 0 dB.

For each subframe, the $P_{CMAX\_L}$ is evaluated per slot and given by the minimum value taken over the transmission(s) within the slot; the minimum $P_{CMAX\_L}$ over the two slots is then applied for the entire subframe. $P_{PowerClass}$ shall not be exceeded by the UE during any period of time.

The measured maximum output power $P_{UMAX}$ over all serving cells shall be within the following range:

$$P_{CMAX\_L} - \text{MAX}\{T_L, T_{LOW}(P_{CMAX\_L})\} \le P_{UMAX} \le P_{CMAX\_H} + T_{HIGH}(P_{CMAX\_H})$$

$$P_{UMAX} = 10 \log_{10} \sum p_{UMAX,c}$$

where $p_{UMAX,c}$ denotes the measured maximum output power for serving cell *c* expressed in linear scale. The tolerances $T_{LOW}(P_{CMAX})$ and $T_{HIGH}(P_{CMAX})$ for applicable values of $P_{CMAX}$ are specified in Table 6.2.5A-2 for intra-band carrier aggregation. The tolerance $T_L$ is the absolute value of the lower tolerance for applicable E-UTRA CA configurations as specified in Table 6.2.2A-1 for intra-band contiguous carrier aggregation.

**Table 6.2.5A-2: $P_{CMAX}$ tolerance for dual uplink intra-band contiguous CA**

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

**Table 6.2.5A-3: Void**

## 6.2.5B Configured transmitted power for UL-MIMO

For UE supporting UL-MIMO, the transmitted power is configured per each UE.

The definitions of configured maximum output power $P_{CMAX,c}$, the lower bound $P_{CMAX\_L,c}$, and the higher bound $P_{CMAX\_H,c}$ specified in subclause 6.2.5 shall apply to UE supporting UL-MIMO, where

- $P_{PowerClass}$ and $\Delta T_{C,c}$ are specified in subclause 6.2.2B;
- $MPR_c$ is specified in subclause 6.2.3B;
- A-$MPR_c$ is specified in subclause 6.2.4B.

The measured configured maximum output power $P_{UMAX,c}$ for serving cell $c$ shall be within the following bounds:

$$P_{CMAX\_L,c} - MAX\{T_L, T_{LOW}(P_{CMAX\_L,c})\} \le P_{UMAX,c} \le P_{CMAX\_H,c} + T_{HIGH}(P_{CMAX\_H,c})$$

where $T_{LOW}(P_{CMAX\_L,c})$ and $T_{HIGH}(P_{CMAX\_H,c})$ are defined as the tolerance and applies to $P_{CMAX\_L,c}$ and $P_{CMAX\_H,c}$ separately, while $T_L$ is the absolute value of the lower tolerance in Table 6.2.2B-1 for the applicable operating band.

For UE with two transmit antenna connectors in closed-loop spatial amultiplexing scheme, the tolerance is specified in Table 6.2.5B-1. The requirements shall be met with UL-MIMO configurations specified in Table 6.2.2B-2.

**Table 6.2.5B-1: $P_{CMAX,c}$ tolerance in closed-loop spatial multiplexing scheme**

| $P_{CMAX,c}$ (dBm) | Tolerance $T_{LOW}(P_{CMAX\_L,c})$ (dB) | Tolerance $T_{HIGH}(P_{CMAX\_H,c})$ (dB) |
|---|---|---|
| $P_{CMAX,c} = 23$ | 3.0 | 2.0 |
| $22 \le P_{CMAX,c} < 23$ | 5.0 | 2.0 |
| $21 \le P_{CMAX,c} < 22$ | 5.0 | 3.0 |
| $20 \le P_{CMAX,c} < 21$ | 6.0 | 4.0 |
| $16 \le P_{CMAX,c} < 20$ | 5.0 | |
| $11 \le P_{CMAX,c} < 16$ | 6.0 | |
| $-40 \le P_{CMAX,c} < 11$ | 7.0 | |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.5 apply.

## 6.3 Output power dynamics

### 6.3.1 (Void)

### 6.3.2 Minimum output power

The minimum controlled output power of the UE is defined as the broadband transmit power of the UE, i.e. the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

#### 6.3.2.1 Minimum requirement

The minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2.1-1.

**Table 6.3.2.1-1: Minimum output power**

| | **Channel bandwidth / Minimum output power / Measurement bandwidth** | | | | | |
|---|---|---|---|---|---|---|
| | **1.4 MHz** | **3.0 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Minimum output power | -40 dBm | | | | | |
| Measurement bandwidth | 1.08 MHz | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

### 6.3.2A UE Minimum output power for CA

For intra-band contiguous carrier aggregation, the minimum controlled output power of the UE is defined as the transmit power of the UE per component carrier, i.e., the power in the channel bandwidth of each component carrier for all transmit bandwidth configurations (resource blocks), when the power on both component carriers are set to a minimum value.

#### 6.3.2A.1 Minimum requirement for CA

For intra-band contiguous carrier aggregation the minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2A.1-1.

**Table 6.3.2A.1-1: Minimum output power for intra-band contiguous CA UE**

| | **CC Channel bandwidth / Minimum output power / Measurement bandwidth** | | | | | |
|---|---|---|---|---|---|---|
| | **1.4 MHz** | **3.0 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Minimum output power | -40 dBm | | | | | |
| Measurement bandwidth | | | | 9.0 MHz | 13.5 MHz | 18 MHz |

### 6.3.2B UE Minimum output power for UL-MIMO

For UE supporting UL-MIMO, the minimum controlled output power is defined as the broadband transmit power of the UE, i.e. the sum of the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks) at each transmit antenna connector, when the UE power is set to a minimum value.

### 6.3.2B.1 Minimum requirement

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3.2B.1-1.

**Table 6.3.2B.1-1: Minimum output power**

| | **Channel bandwidth / Minimum output power / Measurement bandwidth** | | | | | |
|---|---|---|---|---|---|---|
| | **1.4 MHz** | **3.0 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Minimum output power | -40 dBm | | | | | |
| Measurement bandwidth | 1.08 MHz | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.2 apply.

## 6.3.3 Transmit OFF power

Transmit OFF power is defined as the mean power when the transmitter is OFF. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the UE is not considered to be OFF.

### 6.3.3.1. Minimum requirement

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

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

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

## 6.3.3A UE Transmit OFF power for CA

For intra-band contiguous carrier aggregation, transmit OFF power is defined as the mean power per component carrier when the transmitter is OFF on both component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During measurements gaps, the UE is not considered to be OFF.

### 6.3.3A.1 Minimum requirement for CA

For intra-band contiguous carrier aggregation the transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power shall not exceed the values specified in Table 6.3.3A.1-1.

**Table 6.3.3A.1-1: Transmit OFF power for intra-band contiguous CA UE**

| | 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 | | | | 9.0 MHz | 13.5 MHz | 18 MHz |

## 6.3.3B UE Transmit OFF power for UL-MIMO

For UE supporting UL-MIMO, the transmit OFF power is defined as the mean power at each transmit antenna connector when the transmitter is OFF at all transmit antenna connectors. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the UE is not considered to be OFF.

### 6.3.3B.1 Minimum requirement

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1ms) excluding any transient periods. The transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3.3B.1-1.

**Table 6.3.3B.1-1: Transmit OFF power per antenna port**

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

## 6.3.4 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.

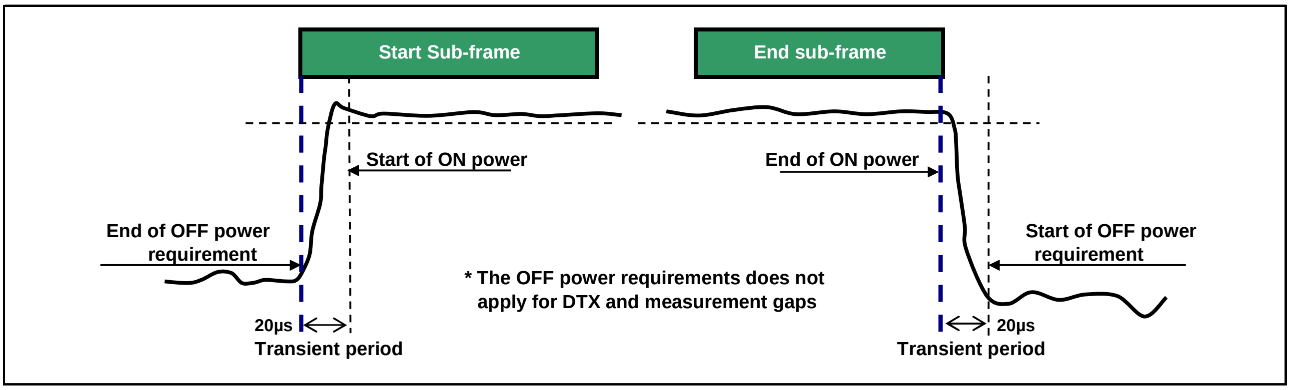


**Figure 6.3.4.1-1: General ON/OFF time mask**

### 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 |

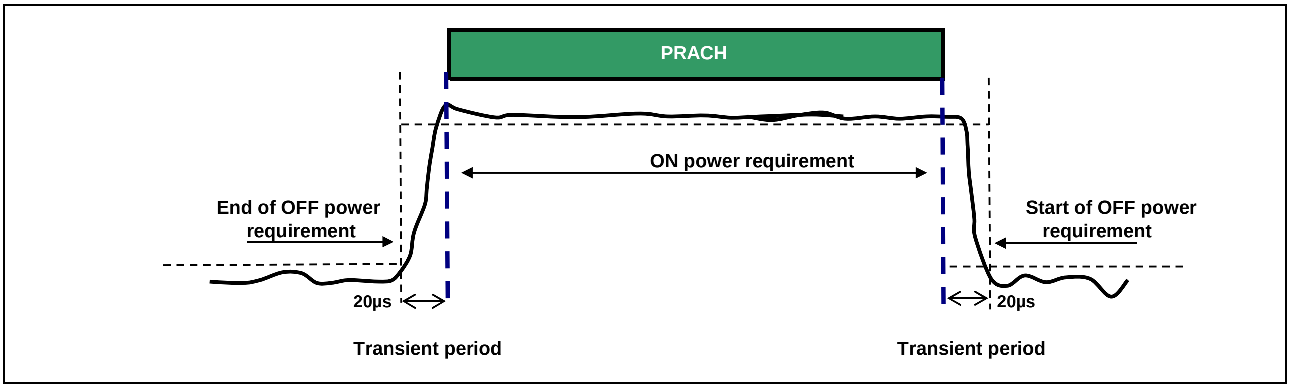


**Figure 6.3.4.2-1: PRACH ON/OFF time mask**

#### 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.

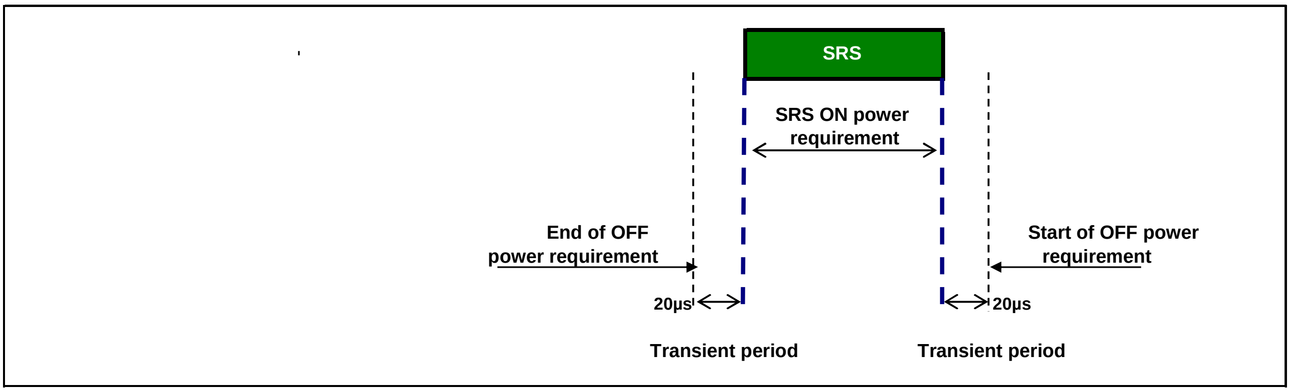


**Figure 6.3.4.2.2-1: Single SRS time mask**

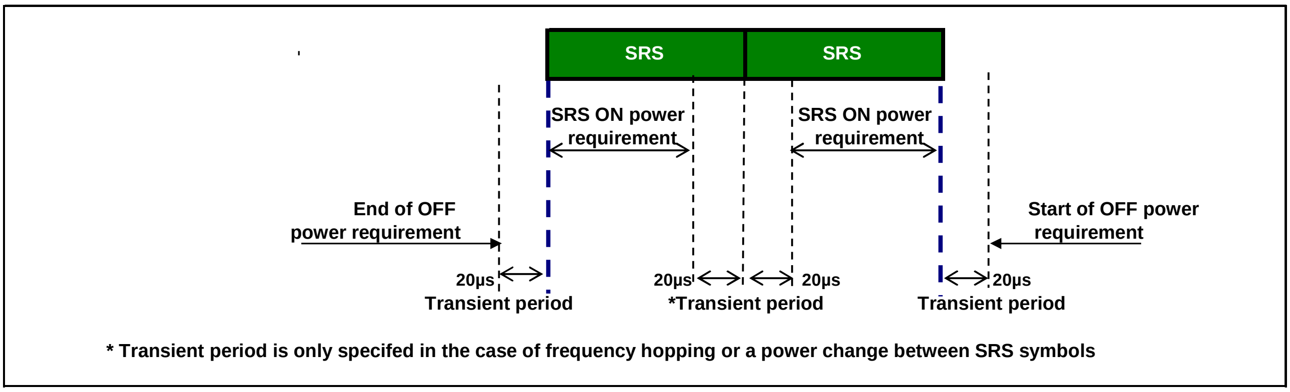


**Figure 6.3.4.2.2-2: Dual SRS time mask for the case of UpPTS transmissions**

### 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

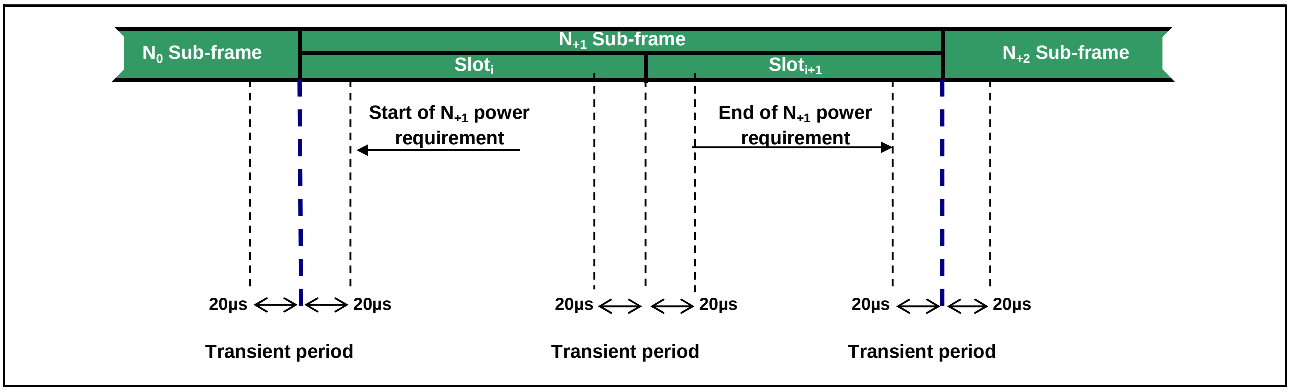


**Figure 6.3.4.3-1: Transmission power template**

### 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.

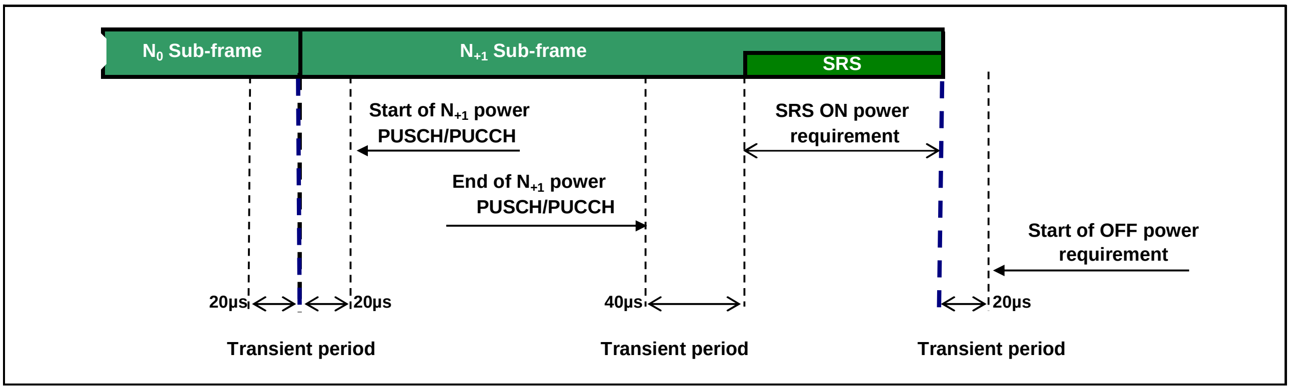


**Figure 6.3.4.4-1: PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after**

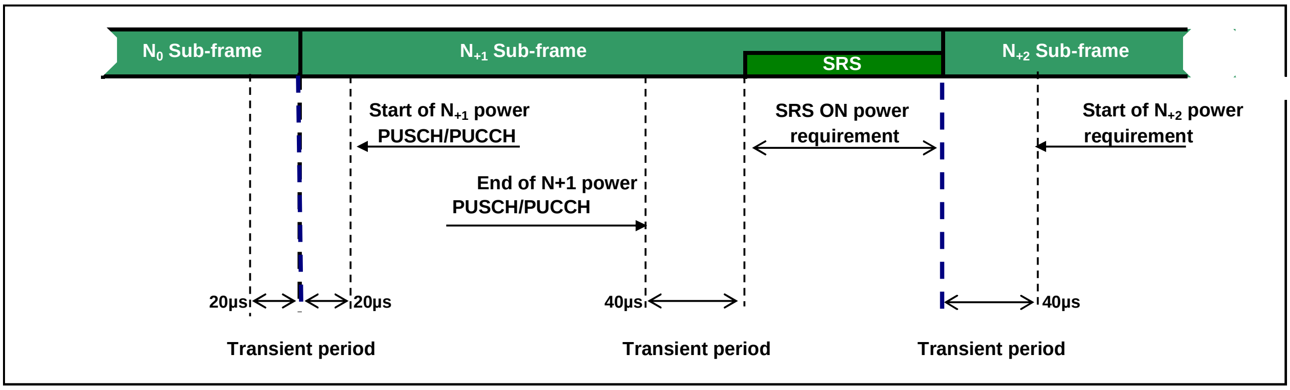


**Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS**

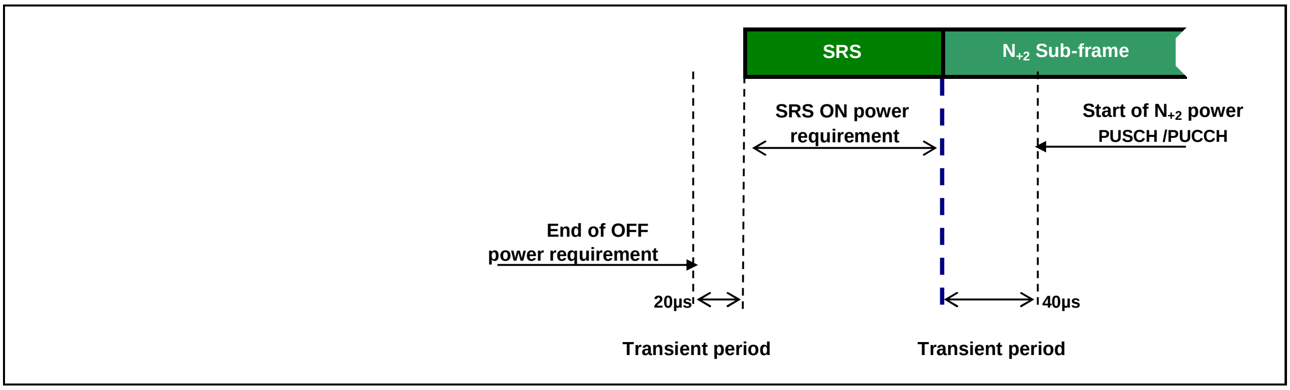


**Figure 6.3.4.4-3: PUCCH/PUSCH/SRS time mask when there is a transmission after SRS but not before**

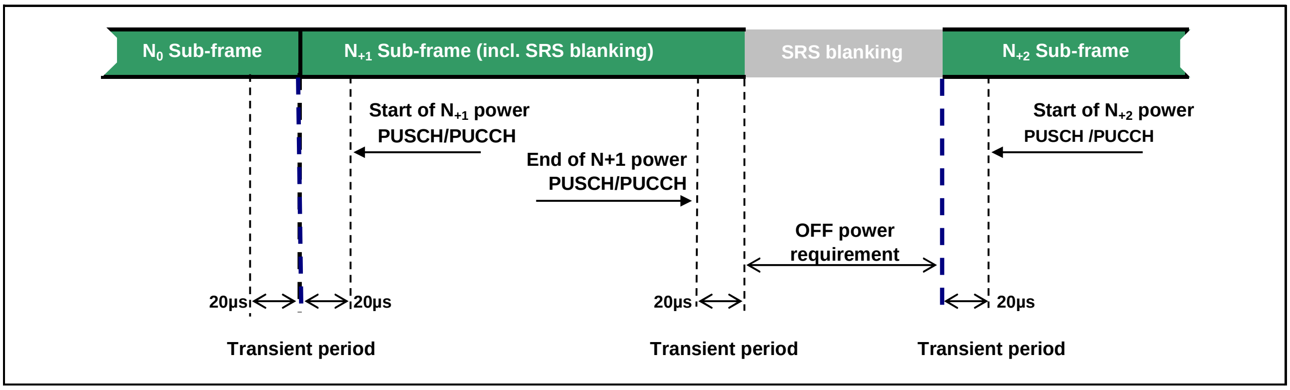


**Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking**

## 6.3.4A ON/OFF time mask for CA

For intra-band contiguous carrier aggregation, the general output power ON/OFF time mask specified in subclause 6.3.4.1 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in subclause 6.3.4.1 shall only be applicable for each component carrier when all the component carriers are OFF.

## 6.3.4B ON/OFF time mask for UL-MIMO

For UE supporting UL-MIMO, the ON/OFF time mask requirements in subclause 6.3.4 apply at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the general ON/OFF time mask requirements specified in subclause 6.3.4.1 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.4 apply.

## 6.3.5 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 PUMAX as defined in subclause 6.2.5 (i.e, the actual power as would be measured assuming no measurement error). This power shall be within the power limits specified in subclause 6.2.5.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of two test patterns. The test patterns are a monotonically increasing power sweep and a monotonically decreasing power sweep over a range bounded by the requirements of minimum power and maximum power specified in subclauses 6.3.2 and 6.2.2. For these exceptions the power tolerance limit is a maximum of ±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. | | |

### 6.3.5A Power control for CA

The requirements apply for one single PUCCH, PUSCH or SRS transmission of contiguous PRB allocation per component carrier with power setting in accordance with Clause 5.1 of [6].

#### 6.3.5A.1 Absolute power tolerance

The absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on each active component carriers larger than 20ms. The requirement can be tested by time aligning any transmission gaps on the component carriers.

##### 6.3.5A.1.1 Minimum requirements

For intra-band contiguous carrier aggregation bandwidth classe C the absolute power control tolerance per component carrier is given in Table 6.3.5.1.1-1.

#### 6.3.5A.2 Relative power tolerance

##### 6.3.5A.2.1 Minimum requirements

The requirements apply when the power of the target and reference sub-frames on each component carrier exceed -20 dBm and the total power is limited by $P_{UMAX}$ as defined in subclause 6.2.5A. For the purpose of these requirements, the power in each component carrier is specified over only the transmitted resource blocks.

For intra-band contiguous carrier aggregation bandwidth classe C, the UE shall meet the following requirements for transmission on both assigned component carriers when the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame:

a) for all possible combinations of PUSCH and PUCCH transitions per component carrier, the corresponding requirements given in Table 6.3.5.2.1-1:

b) for SRS transitions on each component carrier, the requirements for combinations of PUSCH/PUCCH and SRS transitions given in Table 6.3.5.2.1-1 with simultaneous SRS of constant SRS bandwidth allocated in the target and reference subrames:

c) for RACH on the primary component carrier, the requirements given in Table 6.3.5.2.1-1 for PRACH

For a) and b) above, the power step ΔP between the reference and target subframes shall be set by a TPC command and/or an uplink scheduling grant transmitted by means of an appropriate DCI Format.

For a), b) and c) above, two exceptions are allowed for each component carrier for a power per carrier ranging from -20 dBm to $P_{UMAX,c}$ as defined in subclause 6.2.5. For these exceptions the power tolerance limit is ±6.0 dB in Table 6.3.5.2.1-1.

#### 6.3.5A.3 Aggregate power control tolerance

Aggregate power control tolerance is the ability of a UE to maintain its power in non-contiguous transmission within 21 ms in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in [6] are constant on all active component carriers.

##### 6.3.5A.3.1 Minimum requirements

For intra-band contiguous carrier aggregation bandwidth classe C, the aggregate power tolerance per component carrier is given in Table 6.3.5.3.1-1 with either simultaneous PUSCH or simultaneous PUCCH-PUSCH (if supported by the UE) configured. The average power per PRB shall be aligned across both assigned carriers before the start of the test. The requirement can be tested with the transmission gaps time aligned between component carriers.

### 6.3.5B Power control for UL-MIMO

For UE supporting UL-MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.5 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL-MIMO configurations specified in Table 6.2.2B-2, wherein

- The Maximum output power requirements for UL-MIMO are specified in subclause 6.2.2B
- The Minimum output power requirements for UL-MIMO are specified in subclause 6.3.2B
- The requirements for configured transmitted power for UL-MIMO are specified in subclause 6.2.5B.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.3.5 apply.

## 6.4 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.

## 6.5.1A Frequency error for CA

For intra-band contiguous carrier aggregation the UE modulated carrier frequencies per band shall be accurate to within ±0.1 PPM observed over a period of one timeslot compared to the carrier frequency of primary component carrier received from the E-UTRA in the corresponding band.

## 6.5.1B Frequency error for UL-MIMO

For UE(s) supporting UL-MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±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
- In-band emissions for the non-allocated RB

All the parameters defined in subclause 6.5.2 are defined using the measurement methodology specified in Annex F.

### 6.5.2.1 Error Vector Magnitude

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further modified by selecting the absolute phase and absolute amplitude of the Tx chain. The EVM result is defined after the front-end IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH and 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 is an additive sinusoid waveform that has the same frequency as a modulated waveform carrier frequency. The measurement interval is one slot in the time domain.

### 6.5.2.2.1 Minimum requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.5.2.2.1-1.

**Table 6.5.2.2.1-1: Minimum requirements for relative carrier leakage power**

| Parameters | Relative limit (dBc) | Applicable frequencies |
|---|---|---|
| Output power >10 dBm | -28 | Carrier center frequency < 1 GHz |
| | -25 | Carrier center frequency ≥ 1 GHz |
| 0 dBm ≤ Output power ≤10 dBm | -25 | |
| -30 dBm ≤ Output power ≤0 dBm | -20 | |
| -40 dBm ≤ Output power < -30 dBm | -10 | |

## 6.5.2.3 In-band emissions

The in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB.

The basic in-band emissions measurement interval is defined over one slot in the time domain. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one SC-FDMA symbol, accordingly.

### 6.5.2.3.1 Minimum requirements

The relative in-band emission shall not exceed the values specified in Table 6.5.2.3.1-1.

**Table 6.5.2.3.1-1: Minimum requirements for in-band emissions**

| Parameter description | Unit | Limit (Note 1) | | Applicable Frequencies |
|---|---|---|---|---|
| **General** | dB | $\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$ $20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$ $-57\,dBm/180\,kHz-P_{RB}\}$ | | Any non-allocated (Note 2) |
| **IQ Image** | dB | -28 | Image frequencies when carrier center frequency < 1 GHz and Output power > 10 dBm | Image frequencies (Notes 2, 3) |
| | | -25 | Image frequencies when carrier center frequency < 1 GHz and Output power ≤ 10 dBm | |
| | | -25 | Image frequencies when carrier center frequency ≥ 1 GHz | |
| **Carrier leakage** | dBc | -28 | Output power > 10 dBm and carrier center frequency < 1 GHz | Carrier frequency (Notes 4, 5) |
| | | -25 | Output power > 10 dBm and carrier center frequency ≥ 1 GHz | |
| | | -25 | 0 dBm ≤ Output power ≤10 dBm | |
| | | -20 | -30 dBm ≤ Output power ≤ 0 dBm | |
| | | -10 | -40 dBm ≤ Output power < -30 dBm | |

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: $L_{CRB}$ is the Transmission Bandwidth (see Figure 5.6-1).
NOTE 7: $N_{RB}$ is the Transmission Bandwidth Configuration (see Figure 5.6-1).
NOTE 8: $EVM$ is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.
NOTE 9: $\Delta_{RB}$ is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth.
NOTE 10: $P_{RB}$ is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

## 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 | |

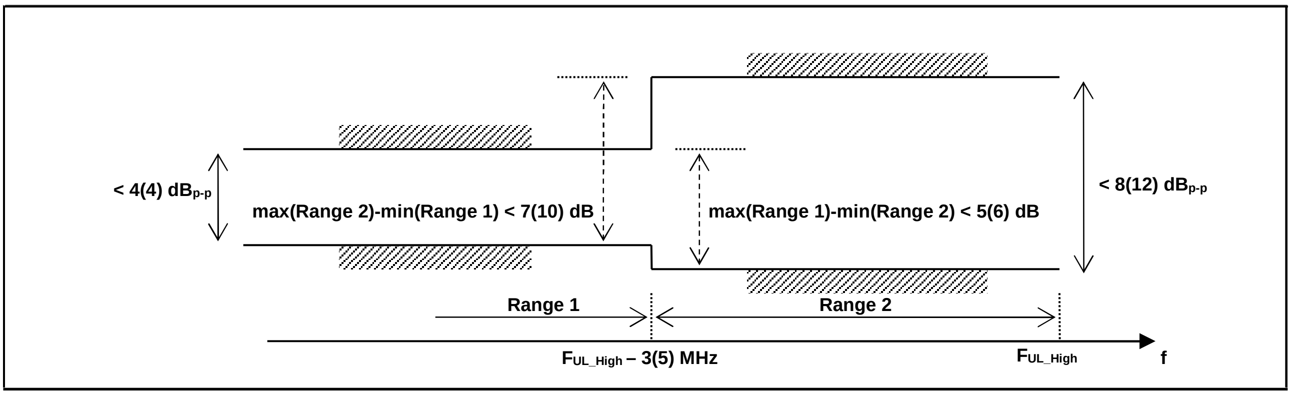


**Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).**

## 6.5.2A Transmit modulation quality for CA

The requirements in this clause apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

### 6.5.2A.1 Error Vector Magnitude

For the intra-band contiguous carrier aggregation, the Error Vector Magnitude requirement should be defined for each component carrier. Requirements only apply with PRB allocation in one of the component carriers. Similar transmitter impairment removal procedures are applied for CA waveform before EVM calculation as is specified for non-CA waveform in sub-section 6.5.2.1.

When a single component carrier is configured Table 6.5.2.1.1-1 apply.

The EVM requirements are according to Table 6.5.2A.1-1 if CA is configured in uplink.

**Table 6.5.2A.1-1: Minimum requirements for Error Vector Magnitude**

| Parameter | Unit | Average EVM Level per CC | Reference Signal EVM Level |
|---|---|---|---|
| QPSK or BPSK | % | 17.5 | 17.5 |
| 16QAM | % | 12.5 | 12.5 |

### 6.5.2A.2 Carrier leakage for CA

Carrier leakage is an additive sinusoid waveform that is confined within the aggregated transmission bandwidth configuration. The carrier leakage requirement is defined for each component carrier and is measured on the component carrier with PRBs allocated. The measurement interval is one slot in the time domain.

#### 6.5.2A.2.1 Minimum requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.5.2A.2.1-1.

**Table 6.5.2A.2.1-1: Minimum requirements for Relative Carrier Leakage Power**

| Parameters | Relative Limit (dBc) |
|---|---|
| Output power >0 dBm | -25 |
| -30 dBm ≤ Output power ≤0 dBm | -20 |
| -40 dBm ≤ Output power < -30 dBm | -10 |

### 6.5.2A.3 In-band emissions

#### 6.5.2A.3.1 Minimum requirement for CA

For intra-band contiguous carrier aggregation bandwidth class C, the requirements in Table 6.5.2A.3.1-1 and 6.5.2A.3.1-2 apply within the aggregated transmission bandwidth configuration with both component carrier (s) active and one single contiguous PRB allocation of bandwidth $L_{CRB}$ at the edge of the aggregated transmission bandwidth configuration.

The inband emission is defined as the interference falling into the non allocated resource blocks for all component carriers. The measurement method for the inband emissions in the component carrier with PRB allocation is specified in annex F. For a non allocated component carrier a spectral measurement is specified.

**Table 6.5.2A.3.1-1: Minimum requirements for in-band emissions (allocated component carrier)**

<table>
<tr><th>Parameter</th><th>Unit</th><th colspan="2">Limit</th><th>Applicable Frequencies</th></tr>
<tr><td>General</td><td>dB</td><td colspan="2">$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$<br>$20\cdot\log_{10} EVM -3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$<br>$-57\ dBm/180\ kHz - P_{RB}\}$</td><td>Any non-allocated (Note 2)</td></tr>
<tr><td>IQ Image</td><td>dB</td><td colspan="2">-25</td><td>Exception for IQ image (Note 3)</td></tr>
<tr><td rowspan="3">Carrier leakage</td><td rowspan="3">dBc</td><td>-25</td><td>Output power > 0 dBm</td><td rowspan="3">Exception for Carrier frequency (Note 4)</td></tr>
<tr><td>-20</td><td>-30 dBm ≤ Output power ≤ 0 dBm</td></tr>
<tr><td>-10</td><td>-40 dBm ≤ Output power < -30 dBm</td></tr>
<tr><td colspan="5">NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of $P_{RB}$ - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. $P_{RB}$ is defined in Note 9. The limit is evaluated in each non-allocated RB.<br>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<br>NOTE 3: Exceptions to the general limit are allowed for up to $L_{CRBs}$ +1 RBs within a contiguous width of $L_{CRBs}$ +1 non-allocated RBs. The measurement bandwidth is 1 RB.<br>NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.<br>NOTE 5: $L_{CRB}$ is the Transmission Bandwidth (see Figure 5.6-1) not exceeding $\lfloor N_{RB}/2-1 \rfloor$<br>NOTE 6: $N_{RB}$ is the Transmission Bandwidth Configuration (see Figure 5.6-1) of the component carrier with RBs allocated.<br>NOTE 7: $EVM$ is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.<br>NOTE 8: $\Delta_{RB}$ is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth).<br>NOTE 9: $P_{RB}$ is the transmitted power per 180 kHz in allocated RBs, measured in dBm.</td></tr>
</table>

**Table 6.5.2A.3.1-2: Minimum requirements for in-band emissions (not allocated component carrier)**

<table>
<tr><th>Para-meter</th><th>Unit</th><th>Meas BW Note 1</th><th colspan="2">Limit</th><th>remark</th><th>Applicable Frequencies</th></tr>
<tr><td>General</td><td>dB</td><td>BW of 1 RB (180KHz rectangular)</td><td colspan="2">$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$<br>$20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$<br>$-57\,dBm/180\,kHz-P_{RB}\}$</td><td>The reference value is the average power per allocated RB in the allocated component carrier</td><td>Any RB in the non allocated component carrier. The frequency raster of the RBs is derived when this component carrier is allocated with RBs</td></tr>
<tr><td>IQ Image</td><td>dB</td><td>BW of 1 RB (180KHz rectangular)</td><td colspan="2">-25<br>Note 2</td><td>The reference value is the average power per allocated RB in the allocated component carrier</td><td>The frequencies of the $L_{CRB}$ contiguous non-allocated RBs are unknown. The frequency raster of the RBs is derived when this component carrier is allocated with RBs</td></tr>
<tr><td rowspan="4">Carrier leakage</td><td rowspan="4">dBc</td><td rowspan="4">BW of 1 RB (180KHz rectangular)</td><td colspan="2">Note 3</td><td rowspan="4">The reference value is the total power of the allocated RBs in the allocated component carrier</td><td rowspan="4">The frequencies of the up to 2 non-allocated RBs are unknown. The frequency raster of the RBs is derived when this component carrier is allocated with RBs</td></tr>
<tr><td>-25</td><td>Output power > 0 dBm</td></tr>
<tr><td>-20</td><td>-30 dBm ≤ Output power ≤ 0 dBm</td></tr>
<tr><td>-10</td><td>-40 dBm ≤ Output power < -30 dBm</td></tr>
<tr><td colspan="7">NOTE1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.<br>NOTE 2: Exceptions to the general limit is are allowed for up to $L_{CRB}$ +1 RBs within a contiguous width of $L_{CRB}$ +1 non-allocated RBs.<br>NOTE 3: Two Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs<br>NOTE 4: Notes 1, 5, 6, 7, 8, 9 from Table 6.5.2A.3.1-1 apply for Table 6.5.2A.3.1-2 as well.<br>NOTE 5: $\Delta_{RB}$ for measured non-allocated RB in the non allocated component carrier may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.</td></tr>
</table>

## 6.5.2B Transmit modulation quality for UL-MIMO

For UE supporting UL-MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.2 apply.

The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process
- Carrier leakage (caused by IQ offset)
- In-band emissions for the non-allocated RB

#### 6.5.2B.1 Error Vector Magnitude

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in Table 6.5.2.1.1-1 which is defined in subclause 6.5.2.1 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

#### 6.5.2B.2 Carrier leakage

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Relative Carrier Leakage Power requirements specified in Table 6.5.2.2.1-1 which is defined in subclause 6.5.2.2 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

#### 6.5.2B.3 In-band emissions

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the In-band Emission requirements specified in Table 6.5.2.3.1-1 which is defined in subclause 6.5.2.3 apply at each transmit antenna connector. The requirements shall be met with the uplink MIMO configurations specified in Table 6.2.2B-2.

#### 6.5.2B.4 EVM equalizer spectrum flatness for UL-MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the EVM Equalizer Spectrum Flatness requirements specified in Table 6.5.2.4.1-1 and Table 6.5.2.4.1-2 which are defined in subclause 6.5.2.4 apply at each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

## 6.6 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.

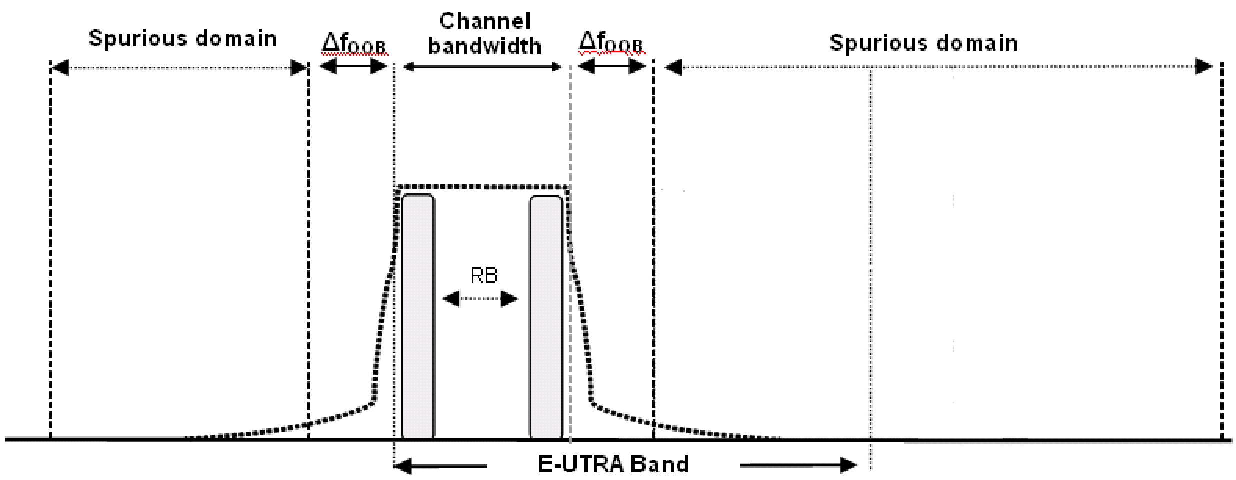


**Figure 6.6-1: Transmitter RF spectrum**

### 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 |

### 6.6.1A Occupied bandwidth for CA

For intra-band contiguous carrier aggregation the occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated power of the transmitted spectrum. The OBW shall be less than the aggregated channel bandwidth defined in subclause 5.6A.

### 6.6.1B Occupied bandwidth for UL-MIMO

For UE supporting UL-MIMO, the requirements for occupied bandwidth is specified at each transmit antenna connector. The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified in Table 6.6.1B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

**Table 6.6.1B-1: Occupied channel bandwidth**

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

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.6.1 apply.

### 6.6.2 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.

### 6.6.2.1A Spectrum emission mask for CA

For intra-band contiguous carrier aggregation the spectrum emission mask of the UE applies to frequencies (Δf$_{OOB}$) starting from the ± edge of the aggregated channel bandwidth (Table 5.6A-1) For intra-band contiguous carrier aggregation the bandwidth class C, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.1A-1 for the specified channel bandwidth.

**Table 6.6.2.1A-1: General E-UTRA CA spectrum emission mask for Bandwidth Class C**

| Spectrum emission limit [dBm]/BW$_{Channel_CA}$ | | | | | | |
|---|---|---|---|---|---|---|
| **Δf$_{OOB}$ (MHz)** | **25RB+100RB (24.95 MHz)** | **50RB+100RB (29.9 MHz)** | **75RB+75RB (30 MHz)** | **75RB+100RB (34.85 MHz)** | **100RB+100RB (39.8 MHz)** | **Measurement bandwidth** |
| ± 0-1 | -22 | -22.5 | -22.5 | -23.5 | -24 | 30 kHz |
| ± 1-5 | -10 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 5-24.95 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 24.95-29.9 | -25 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 29.9-29.95 | -25 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 29.95-30 | | -25 | -13 | -13 | -13 | 1 MHz |
| ± 30-34.85 | | -25 | -25 | -13 | -13 | 1 MHz |
| ± 34.85-34.9 | | -25 | -25 | -25 | -13 | 1 MHz |
| ± 34.9-35 | | | -25 | -25 | -13 | 1 MHz |
| ± 35-39.8 | | | | -25 | -13 | 1 MHz |
| ± 39.8-39.85 | | | | -25 | -25 | 1 MHz |
| ± 39.85-44.8 | | | | | -25 | 1 MHz |

### 6.6.2.2 Additional spectrum emission mask

This requirement is specified in terms of an "additional spectrum emission" requirement.

#### 6.6.2.2.1 Minimum requirement (network signalled value "NS_03", “NS_11”, and “NS_20”)

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

When "NS_03", "NS_11" or "NS_20" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.1-1.

**Table 6.6.2.2.1-1: Additional requirements**

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

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

#### 6.6.2.2.2 Minimum requirement (network signalled value "NS_04")

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

When "NS_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.2-1.

**Table 6.6.2.2.2-1: Additional requirements**

| | Spectrum emission limit (dBm)/ Channel bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|
| **Δ$f_{OOB}$ (MHz)** | **1.4 MHz** | **3.0 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Measurement bandwidth** |
| ± 0-1 | -10 | -13 | -15 | -18 | -20 | -21 | 30 kHz |
| ± 1-2.5 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 2.5-2.8 | -25 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 2.8-5.5 | | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 5.5-6 | | -25 | -25 | -25 | -25 | -25 | 1 MHz |
| ± 6-10 | | | -25 | -25 | -25 | -25 | 1 MHz |
| ± 10-15 | | | | -25 | -25 | -25 | 1 MHz |
| ± 15-20 | | | | | -25 | -25 | 1 MHz |
| ± 20-25 | | | | | | -25 | 1 MHz |

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

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

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

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

**Table 6.6.2.2.3-1: Additional requirements**

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

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

### 6.6.2.2A Additional Spectrum Emission Mask for CA

This requirement is specified in terms of an "additional spectrum emission" requirement.

#### 6.6.2.2A.1 Minimum requirement (network signalled value "CA_NS_04")

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

When "CA_NS_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2A.1-1.

**Table 6.6.2.2A.1-1: Additional requirements**

| Spectrum emission limit [dBm]/$BW_{Channel\_CA}$ | | | | | |
|---|---|---|---|---|---|
| $\Delta f_{OOB}$ (MHz) | 50+100RB (29.9 MHz) | 75+75RB (30 MHz) | 75+100RB (34.85 MHz) | 100+100RB (39.8 MHz) | Measurement bandwidth |
| ± 0-1 | -22.5 | -23 | -23.5 | -24 | 30 kHz |
| ± 1-5 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 5-27.9 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 27.9-28.5 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 28.5-32.85 | -25 | -25 | -25 | -13 | 1 MHz |
| ± 32.85-34.9 | -25 | -25 | -25 | -13 | 1 MHz |
| ± 34.9-37.8 | | -25 | -25 | -13 | 1 MHz |
| ± 37.8-39.85 | | | -25 | -25 | 1 MHz |
| ± 39.85-44.8 | | | | -25 | 1 MHz |

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

### 6.6.2.3 Adjacent Channel Leakage Ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. ACLR requirements for one E-UTRA carrier are specified for two scenarios for an adjacent E-UTRA and /or UTRA channel as shown in Figure 6.6.2.3-1.

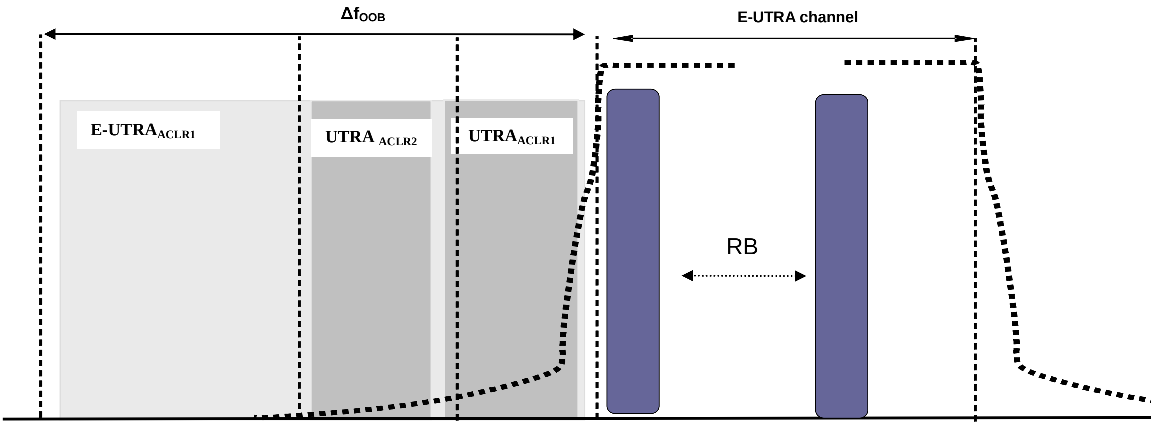


**Figure 6.6.2.3-1: Adjacent Channel Leakage requirements for one E-UTRA carrier**

### 6.6.2.3.1 Minimum requirement E-UTRA

E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned E-UTRA channel power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.1-1 and Table 6.6.2.3.1-2. 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 and Table 6.6.2.3.1-2.

**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 |

**Table 6.6.2.3.1-2: Additional E-UTRA$_{ACLR}$ requirements for Power Class 1**

| | Channel bandwidth / E-UTRA$_{ACLR1}$ / Measurement bandwidth | | | | | |
|---|---|---|---|---|---|---|
| | **1.4 MHz** | **3.0 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| E-UTRA$_{ACLR1}$ | | | 37 dB | 37 dB | | |
| E-UTRA channel Measurement bandwidth | | | 4.5 MHz | 9.0 MHz | | |
| Adjacent channel centre frequency offset [MHz] | | | +5 / -5 | +10 / -10 | | |
| NOTE 1: E-UTRA$_{ACLR1}$ shall be applicable for >23dBm | | | | | | |

### 6.6.2.3.1A Void

### 6.6.2.3.2 Minimum requirements UTRA

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

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel ($UTRA_{ACLR1}$) and the 2nd 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. | | | | | | |

### 6.6.2.3.2A Minimum requirement UTRA for CA

For intra-band contiguous carrier aggregation the UTRA Adjacent Channel Leakage power Ratio ($UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel ($UTRA_{ACLR1}$) and the 2nd UTRA adjacent channel ($UTRA_{ACLR2}$). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor $\alpha$ =0.22. The assigned aggregated channel bandwidth power is measured with a rectangular filter with measurement bandwidth specified in Table 6.6.2.3.2A-1. If the measured UTRA channel power is greater than –50dBm then the $UTRA_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.2A-1.

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

| | CA bandwidth class / $UTRA_{ACLR1/2}$ / measurement bandwidth |
|---|---|
| | **CA bandwidth class C** |
| $UTRA_{ACLR1}$ | 33 dB |
| Adjacent channel centre frequency offset (in MHz) | + $BW_{Channel\_CA}$ /2 + $BW_{UTRA}$/2 / - $BW_{Channel\_CA}$ / 2 - $BW_{UTRA}$/2 |
| $UTRA_{ACLR2}$ | 36 dB |
| Adjacent channel centre frequency offset (in MHz) | + $BW_{Channel\_CA}$ /2 + 3*$BW_{UTRA}$/2 / - $BW_{Channel\_CA}$ /2 – 3*$BW_{UTRA}$/2 |
| CA E-UTRA channel Measurement bandwidth | $BW_{Channel\_CA}$ - 2* $BW_{GB}$ |
| UTRA 5MHz channel Measurement bandwidth (Note 1) | 3.84 MHz |
| UTRA 1.6MHz channel measurement bandwidth (Note 2) | 1.28 MHz |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum. NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | |

#### 6.6.2.3.3A Minimum requirements for CA E-UTRA

For intra-band contiguous carrier aggregation the carrier aggregation E-UTRA Adjacent Channel Leakage power Ratio (CA $E\text{-}UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent aggregated channel bandwidth at nominal channel spacing. The assigned aggregated channel bandwidth power and adjacent aggregated channel bandwidth power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.3A-1. If the measured adjacent channel power is greater than –50dBm then the $E\text{-}UTRA_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.3A-1.

**Table 6.6.2.3.3A-1: General requirements for CA $E\text{-}UTRA_{ACLR}$**

| | CA bandwidth class / CA $E\text{-}UTRA_{ACLR}$ / Measurement bandwidth |
|---|---|
| | **CA bandwidth class C** |
| CA $E\text{-}UTRA_{ACLR}$ | 30 dB |
| CA E-UTRA channel Measurement bandwidth | $BW_{Channel\_CA}$ - 2* $BW_{GB}$ |
| Adjacent channel centre frequency offset (in MHz) | + $BW_{Channel\_CA}$ / - $BW_{Channel\_CA}$ |

### 6.6.2.4 Void

#### 6.6.2.4.1 Void

## 6.6.2A Void

<reserved for future use>

## 6.6.2B Out of band emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.6.2 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.6.3 apply.

### 6.6.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements inline with SM.329 [2] and E-UTRA operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.6.3.1 Minimum requirements

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.6.3.1-2 apply for all transmitter band configurations (NRB) and channel bandwidths.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

**Table 6.6.3.1-1: Boundary between E-UTRA out of band and spurious emission domain**

| Channel bandwidth | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
|---|---|---|---|---|---|---|
| OOB boundary $F_{OOB}$ (MHz) | 2.8 | 6 | 10 | 15 | 20 | 25 |

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

| Frequency Range | Maximum Level | Measurement bandwidth | Note |
|---|---|---|---|
| 9 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 | |
| 12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz | -30 dBm | 1 MHz | 1 |
| NOTE 1: Applies for Band 22, Band 42 and Band 43 | | | |

#### 6.6.3.1A Minimum requirements for CA

This clause specifies the spurious emission requirements for carrier aggregation.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

For intra-band contiguous carrier aggregation the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth (Table 5.6A-1). For frequencies ΔfOOB greater than FOOB as specified in Table 6.6.3.1A-1the spurious emission requirements in Table 6.6.3.1-2 are applicable.

**Table 6.6.3.1A-1: Boundary between E-UTRA out of band and spurious emission domain for intra-band contiguous carrier aggregation**

| CA Bandwidth Class | OOB boundary $F_{OOB}$ (MHz) |
|---|---|
| A | Table 6.6.3.1-1 |
| B | FFS |
| C | $BW_{Channel\_CA}$ + 5 |

### 6.6.3.2 Spurious emission band UE co-existence

This clause specifies the requirements for the specified E-UTRA band, for coexistence with protected bands.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

**Table 6.6.3.2-1: Requirements**

| E-UTRA Band | Spurious emission | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **Note** |
| 1 | E-UTRA Band 1, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 38, 40, 41, 42, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | Frequency range | 1880 | | 1895 | -40 | 1 | 15,27 |
| | Frequency range | 1895 | | 1915 | -15.5 | 5 | 15, 26, 27 |
| | Frequency range | 1915 | - | 1920 | +1.6 | 5 | 15, 26, 27 |
| 2 | E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 22, 23, 24, 26, 27, 28, 29, 41, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 2, 25 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 3 | E-UTRA Band 1, 7, 8, 20, 26, 27, 28, 33, 34, 38, 41, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 11, 18, 19, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 13 |
| | E-UTRA Band 22, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |
| 4 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 28, 29, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 5 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 28, 29,42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 26 | 859 | - | 869 | -27 | 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 | |
| | Frequency range | 1884.5 | - | 1919.6 | -41 | 0.3 | 7 |
| | | 1884.5 | - | 1915.7 | | | 8 |
| 7 | E-UTRA Band 1, 3, 7, 8, 20, 22, 27, 28, 29, 33, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 15, 21, 26 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 15, 21, 26 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 15, 21 |
| 8 | E-UTRA Band 1, 20, 28, 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 | 15 |
| | E-UTRA Band 22, 41, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 23 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 15, 23 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 23 |
| 9 | E-UTRA Band 1, 11, 18, 19, 21, 26, 28, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| 10 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 28, 29, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 22, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 11 | E-UTRA Band 1, 11, 18, 19, 21, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| 12 | E-UTRA Band 2, 5, 13, 14, 17, 23, 24, 25, 26, 27, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | 15 |
| 13 | E-UTRA Band 2, 4, 5, 10, 12, 13, 17, 23, 25, 26, 27, 29, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 15 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 15 |
| | E-UTRA Band 14 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 24 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 14 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 29, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 12, 15 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 12, 15 |
| 17 | E-UTRA Band 2, 5, 13, 14, 17, 23, 24, 25, 26, 27, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | 15 |
| 18 | E-UTRA Band 1, 11, 21, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 860 | - | 890 | -40 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 758 | - | 799 | -50 | 1 | |
| | Frequency range | 799 | - | 803 | -40 | 1 | 15 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| 19 | E-UTRA Band 1, 11, 21, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| 20 | E-UTRA Band 1, 3, 7, 8, 20, 22, 33, 34, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 20 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 38, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 758 | - | 788 | -50 | 1 | |
| 21 | E-UTRA Band 1, 18, 19, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| 22 | E-UTRA Band 1, 3, 7, 8, 20, 26, 27, 28, 33, 34, 38, 39, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 3510 | - | 3525 | -40 | 1 | 15 |
| | Frequency range | 3525 | - | 3590 | -50 | 1 | |
| 23 | E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 23, 24, 26, 27, 29, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 24 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 29, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 25 | E-UTRA Band 4, 5, 10,12, 13, 14, 17, 23, 24, 26, 27, 28, 29, 41, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 2 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 25 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 26 | E-UTRA Band 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 17, 18,19, 21, 23, 24, 25, 26, 29, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 703 | - | 799 | -50 | 1 | |
| | | 799 | - | 803 | -40 | 1 | 15 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| 27 | E-UTRA Band 1, 2, 3, 4, 5, 7, 10, 12, 13, | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 14, 17, 23, 25, 26, 27, 29, 38, 41, 42, 43 | | | | | | |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | |
| | E-UTRA Band 28 | $F_{DL\_low}$ | - | 790 | -50 | 1 | |
| 28 | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 25, 26, 27, 34, 38, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 1, 4, 10, 22, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 19, 24 |
| | E-UTRA Band 1 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 19, 25 |
| | Frequency range | 470 | - | 694 | -42 | 8 | 15, 32 |
| | Frequency range | 470 | - | 710 | -26.2 | 6 | 31 |
| | Frequency range | 758 | - | 773 | -32 | 1 | 15 |
| | Frequency range | 773 | - | 803 | -50 | 1 | |
| | Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 19 |
| … | | | | | | | |
| 33 | E-UTRA Band 1, 7, 8, 20, 22, 28, 34, 38, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 5 |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| 34 | E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 26, 28, 33, 38,39, 40, 41, 42, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 5 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| 35 | | | | | | | |
| 36 | | | | | | | |
| 37 | | | - | | | | |
| 38 | E-UTRA Band 1,3, 8, 20, 22, 27, 28, 29, 33, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 2620 | - | 2645 | -15.5 | 5 | 15, 22, 26 |
| | Frequency range | 2645 | - | 2690 | -40 | 1 | 15, 22 |
| 39 | E-UTRA Band 22, 34, 40, 41, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 40 | E-UTRA Band 1, 3, 7, 8, 20, 22, 26, 27, 28, 33, 34, 38, 39, 41, 42, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 41 | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13 , 14, 17, 23, 24, 25, 26, 27, 28, 29, 34, 39, 40, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 9, 11, 18, 19, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 30 |
| | Frequency range | 1839.9 | | 1879.9 | -50 | 1 | 30 |
| 42 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 11, 18, 19, 20, 21, 25, 26, 27, 28, 33, 34, 38, 40, 41, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| 43 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 20, 25, 26, 27, 28, 33, 34, 38, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 44 | E-UTRA Band 3, 5, 8, 34, 39, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 1, 40, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |

NOTE 1: $F_{DL\_low}$ and $F_{DL\_high}$ 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, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x $L_{CRB}$ x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: N/A

NOTE 4: N/A

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

NOTE 6: N/A.

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

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

NOTE 9: N/A.

NOTE 10: N/A.

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

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

NOTE 13: This requirement applies for 5, 10, 15 and 20 MHz E-UTRA channel bandwidth allocated within 1744.9MHz and 1784.9MHz.

NOTE 14: N/A.

NOTE 15: These requirements also apply for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

NOTE 16: N/A.

NOTE 17: N/A

NOTE 18: N/A

NOTE 19: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.

NOTE 20: N/A.

NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.

NOTE 22: This requirement is applicable for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.
For carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE *P-Max*.

NOTE 23 This requirement is applicable only for the following cases:
- for carriers of 5 MHz channel bandwidth when carrier centre frequency ($F_c$) is within the range 902.5 MHz ≤ $F_c$ < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB
- for carriers of 5 MHz channel bandwidth when carrier centre frequency ($F_c$) is within the range 907.5 MHz ≤ $F_c$ ≤ 912.5 MHz without any restriction on uplink transmission bandwidth.
- for carriers of 10 MHz channel bandwidth when carrier centre frequency ($F_c$) is $F_c$ = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with $RB_{start}$ > 3.

NOTE 24: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW).

NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).

NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.

NOTE 27: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.

NOTE 28: N/A.
NOTE 29: N/A.
NOTE 30: This requirement applies when the E-UTRA carrier is confined within 2545-2575 MHz and the channel bandwidth is 10 or 20 MHz.
NOTE 31: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.
NOTE 32: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.

### 6.6.3.2A Spurious emission band UE co-existence for CA

This clause specifies the requirements for the specified carrier aggregation configurations 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 6.6.3.2A-1: Requirements for intra-band contiguous CA**

| E-UTRA CA Configuration | Spurious emission | | | | | | |
|---|---|---|---|---|---|---|---|
| | Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
| CA_1C | E-UTRA Band 1, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 38, 40, 41, 42, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 10 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | - | | |
| CA_7C | E-UTRA Band 1, 3, 7, 8, 20, 22, 27, 28, 29, 33, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| CA_38C | E-UTRA Band 1,3, 8, 20, 22, 27, 28, 29, 33, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | | | | | | | |
| | | | | | | | |
| CA_40C | E-UTRA Band 1, 3, 7, 8, 20, 22, 26, 27, 33, 34, 38, 39, 41, 42, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| CA_41C | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13 , 14, 17, 23, 24, 25, 26, 27, 28, 29, 34, 39, 40, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |

NOTE 1: $F_{DL\_low}$ and $F_{DL\_high}$ 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, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x $L_{CRB}$ x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. 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: N/A

NOTE 6: N/A

NOTE 7: N/A

NOTE 8: N/A

NOTE 9: N/A

NOTE 10: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

NOTE 11: N/A

NOTE 12: N/A

NOTE: The restriction on the maximum uplink transmission to 54 RB in Notes 21, 22, and 27 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.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

#### 6.6.3.3.1 Minimum requirement (network signalled value "NS_05")

When "NS_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.1-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.1-1: Additional requirements (PHS)**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | | | | Measurement bandwidth | Note |
|---|---|---|---|---|---|---|
| | 5 MHz | 10 MHz | 15 MHz | 20 MHz | | |
| 1884.5 ≤ 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 |

#### 6.6.3.3.2 Minimum requirement (network signalled value "NS_07")

When "NS_07" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.2-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.2-1: Additional requirements**

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

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

When "NS 08" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.3-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (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 ≤ 890 | -40 | -40 | -40 | 1 MHz |

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

When "NS 09" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.4-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (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: Void

NOTE 2: To improve measurement accuracy, A-MPR values for NS_09 specified in Table 6.2.4-1 in subclause 6.2.4 are derived based on 100 kHz RBW.

### 6.6.3.3.5 Minimum requirement (network signalled value "NS_12")

When "NS 12" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.5-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.5-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 1.4 MHz, 3 MHz, 5 MHz | |
| 806 ≤ f ≤ 813.5 | -42 | 6.25 kHz |
| NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 814.2 MHz.<br>NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. | | |

### 6.6.3.3.6 Minimum requirement (network signalled value "NS_13")

When "NS 13" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.6-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.6-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 5 MHz | |
| 806 ≤ f ≤ 816 | -42 | 6.25 kHz |
| NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 819 MHz.<br>NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. | | |

#### 6.6.3.3.7 Minimum requirement (network signalled value "NS_14")

When "NS 14" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.7-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.7-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 10 MHz, 15 MHz | |
| 806 ≤ f ≤ 816 | -42 | 6.25 kHz |
| NOTE 1: The requirement applies for E-UTRA carriers with lower channel edge at or above 824 MHz.<br>NOTE 2: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. | | |

#### 6.6.3.3.8 Minimum requirement (network signalled value "NS_15")

When "NS 15" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.8-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.8-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz | |
| 851 ≤ f ≤ 859 | -53 | 6.25 kHz |
| NOTE 1: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB. | | |

#### 6.6.3.3.9 Minimum requirement (network signalled value "NS_16")

When "NS_16" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.9-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.9-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | Note |
|---|---|---|---|
| | 1.4, 3, 5, 10 MHz | | |
| 790 ≤ f ≤ 803 | -32 | 1 MHz | |

#### 6.6.3.3.10 Minimum requirement (network signalled value “NS_17”)

When “NS_17” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.10-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.10-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | Note |
|---|---|---|---|
| | 5, 10 MHz | | |
| 470 ≤ f ≤ 710 | -26.2 | 6 MHz | 1 |
| NOTE 1: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. | | | |

#### 6.6.3.3.11 Minimum requirement (network signalled value “NS_18”)

When “NS_18” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.11-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.11-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | Note |
|---|---|---|---|
| | 5, 10, 15, 20 MHz | | |
| 692-698 | -26.2 | 6 MHz | |

#### 6.6.3.3.12 Minimum requirement (network signalled value “NS_19”)

When “NS_19” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.12-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.12-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth | Note |
|---|---|---|---|
| | 3, 5, 10, 15, 20 MHz | | |
| 662 ≤ f ≤ 694 | -25 | 8 MHz | |

#### 6.6.3.3.13 Minimum requirement (network signalled value "NS_11")

When " NS_11" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.13-1. These requirements also apply for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.13-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 1.4, 3, 5, 10, 15, 20 MHz | |
| E-UTRA Band 2 | -50 | 1 MHz |
| 1998 ≤ f ≤ 1999 | -21 | 1 MHz |
| 1997 ≤ f < 1998 | -27 | 1 MHz |
| 1996 ≤ f < 1997 | -32 | 1 MHz |
| 1995 ≤ f < 1996 | -37 | 1 MHz |
| 1990 ≤ f < 1995 | -40 | 1 MHz |

#### 6.6.3.3.14 Minimum requirement (network signalled value " NS_20")

When " NS_20" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.14-1. These requirements also apply for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.14-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 5, 10, 15, 20 MHz | |
| 1990 ≤ f < 1999 | -40 | 1 MHz |
| 1999 ≤ f ≤ 2000 | -40 | Note 1 |
| Note 1: The measurement bandwidth is 1% of the applicable E-UTRA channel bandwidth. | | |

#### 6.6.3.3.15 Minimum requirement (network signalled value " NS_22")

When " NS 22" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.15-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.15-1: Additional requirement**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | MBW |
|---|---|---|
| | 5, 10, 15, 20 MHz | |
| 3400 ≤ f ≤ 3800 | -23 (Note 1, Note 3) | 5 MHz |
| | -40 (Note 2) | 1 MHz |
| Note 1: This requirement applies within an offset between 5 MHz and 25 MHz from the lower and from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.<br>Note 2: This requirement applies from 3400 MHz to 25 MHz below the lower E-UTRA channel edge and from 25 MHz above the upper E-UTRA channel edge to 3800 MHz.<br>Note 3: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band. | | |

#### 6.6.3.3.16 Minimum requirement (network signalled value “NS_23”)

When "NS 23" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.16-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.16-1: Additional requirement**

<table>
<tr><th rowspan="2">Frequency band (MHz)</th><th>Channel bandwidth / Spectrum emission limit (dBm)</th><th rowspan="2">MBW</th></tr>
<tr><th>5, 10, 15, 20 MHz</th></tr>
<tr><td rowspan="2">3400 ≤ f ≤ 3800</td><td>-23 (Note 1, Note 4)</td><td>5 MHz</td></tr>
<tr><td>-40 (Note 2)</td><td>1 MHz</td></tr>
<tr><td colspan="3">NOTE 1: This requirement applies within an offset between 5 MHz + $F_{offset\_NS\_23}$ and 25 MHz + $F_{offset\_NS\_23}$ from the lower and from the upper edges of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.<br>NOTE 2: This requirement applies from 3400 MHz to 25 MHz + $F_{offset\_NS\_23}$ below the lower E-UTRA channel edge and from 25 MHz + $F_{offset\_NS\_23}$ above the upper E-UTRA channel edge to 3800 MHz.<br>NOTE 3: $F_{offset\_NS\_23}$ is:<br>0 MHz for 5 MHz channel BW,<br>5 MHz for 10 MHz channel BW,<br>9 MHz for 15 MHz channel BW and<br>12 MHz for 20 MHz channel BW.<br>NOTE 4: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band</td></tr>
</table>

## 6.6.3.3A Additional spurious emissions for CA

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell reconfiguration message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

### 6.6.3.3A.1 Minimum requirement for CA_1C (network signalled value "CA_NS_01")

When "CA_NS_01" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.1-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.1-1: Additional requirements (PHS)**

<table>
<tr><th>Protected band</th><th colspan="3">Frequency range (MHz)</th><th>Maximum Level (dBm)</th><th>MBW (MHz)</th><th>Note</th></tr>
<tr><td>E-UTRA band 34</td><td>FDL_low</td><td>-</td><td>FDL_high</td><td>-50</td><td>1</td><td></td></tr>
<tr><td>Frequency range</td><td>1884.5</td><td>-</td><td>1915.7</td><td>-41</td><td>0.3</td><td>1</td></tr>
<tr><td colspan="7">NOTE 1: Applicable when the aggregated channel bandwidth is confined within frequency range 1940 – 1980 MHz</td></tr>
</table>

### 6.6.3.3A.2 Minimum requirement for CA_1C (network signalled value "CA_NS_02")

When "CA_NS_02" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.2-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.2-1: Additional requirements**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| E-UTRA band 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| Frequency range | 1900 | - | 1915 | -15.5 | 5 | 1, 2 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 1, 2 |
| NOTE 1: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.<br>NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | |

### 6.6.3.3A.3 Minimum requirement for CA_1C (network signalled value "CA_NS_03")

When "CA_NS_03" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.3-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.3-1: Additional requirements**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| E-UTRA band 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| Frequency range | 1880 | - | 1895 | -40 | 1 | |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 1, 2 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 1, 2 |
| NOTE 1: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.<br>NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | |

### 6.6.3.3A.4 Minimum requirement for CA_38C (network signalled value "CA_NS_05")

When "CA_NS_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.4-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth. This requirement is applicable for carriers with aggregated channel bandwidths confined in 2570 - 2615 MHz.

**Table 6.6.3.3A.4-1: Additional requirements**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 1, 2, 3 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 1, 3 |
| NOTE 1: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.<br>NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.<br>NOTE 3: This requirement is applicable for carriers with aggregated channel bandwidths confined in 2570-2615 MHz. | | | | | | |

### 6.6.3.3A.5 Minimum requirement for CA_7C (network signalled value "CA_NS_06")

When "CA_NS_06" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.5-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.5-1: Additional requirements**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 1, 2 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 1,2 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | |
| NOTE 1: The requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | |

#### 6.6.3.3A.6 Void

#### 6.6.3.3A.7 Void

#### 6.6.3.3A.8 Minimum requirement for CA_41C (network signalled value "CA_NS_04")

When "CA_NS_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.8-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.8-1: Additional requirements**

| Frequency band (MHz) | Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| 2490.5 ≤ f < 2495 | -13 | 1 MHz |
| 0 < f < 2490.5 | -25 | 1 MHz |

### 6.6.3A Void

<reserved for future use>

### 6.6.3B Spurious emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Spurious emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.6.3 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-1.

If UE is configured for transmission on single-antenna port, the general requirements in subclause 6.6.3 apply.

## 6.6A Void

## 6.6B Void

## 6.7 Transmit intermodulation

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

## 6.7.1 Minimum requirement

User Equipment(s) transmitting in close vicinity of each other can produce intermodulation products, which can fall into the UE, or eNode B receive band as an unwanted interfering signal. The UE intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal at each of the transmitter antenna port with the other antenna port(s) if any is terminated. Both the wanted signal power and the intermodulation product power are measured through E-UTRA rectangular filter with measurement bandwidth shown in Table 6.7.1-1.

The requirement of transmitting intermodulation is prescribed in Table 6.7.1-1.

**Table 6.7.1-1: Transmit Intermodulation**

| BW Channel (UL) | 5MHz | | 10MHz | | 15MHz | | 20MHz | |
|---|---|---|---|---|---|---|---|---|
| Interference Signal Frequency Offset | 5MHz | 10MHz | 10MHz | 20MHz | 15MHz | 30MHz | 20MHz | 40MHz |
| Interference CW Signal Level | -40dBc | | | | | | | |
| Intermodulation Product | -29dBc | -35dBc | -29dBc | -35dBc | -29dBc | -35dBc | -29dBc | -35dBc |
| Measurement bandwidth | 4.5MHz | 4.5MHz | 9.0MHz | 9.0MHz | 13.5MHz | 13.5MHz | 18MHz | 18MHz |

## 6.7.1A Minimum requirement for CA

User Equipment(s) transmitting in close vicinity of each other can produce intermodulation products, which can fall into the UE, or eNode B receive band as an unwanted interfering signal. The UE intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product on both component carriers when an interfering CW signal is added at a level below the wanted signal at each of the transmitter antenna port with the other antenna port(s) if any is terminated. Both the wanted signal power and the intermodulation product power are measured through rectangular filter with measurement bandwidth shown in Table 6.7.1A-1.

For intra-band contiguous carrier aggregation the requirement of transmitting intermodulation is specified in Table 6.7.1A-1.

**Table 6.7.1A-1: Transmit Intermodulation**

| CA bandwidth class(UL) | C | |
|---|---|---|
| Interference Signal Frequency Offset | $BW_{Channel\_CA}$ | $2*BW_{Channel\_CA}$ |
| Interference CW Signal Level | -40dBc | |
| Intermodulation Product | -29dBc | -35dBc |
| Measurement bandwidth | $BW_{Channel\_CA}$- 2* $BW_{GB}$ | |

## 6.7.1B Minimum requirement for UL-MIMO

For UE supporting UL-MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output power at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.7.1 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.7.1 apply.

## 6.8 Void

### 6.8.1 Void

## 6.8A Void

## 6.8B Time alignment error for UL-MIMO

For UE(s) with multiple transmit antenna connectors supporting UL-MIMO, this requirement applies to frame timing differences between transmissions on multiple transmit antenna connectors in the closed-loop spatial multiplexing scheme.

The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors.

### 6.8B.1 Minimum Requirements

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

# 7 Receiver characteristics

## 7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna. . For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective sections below.

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

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

For the additional requirements for intra-band non-contiguous carrier aggregation of two component carriers (one component carrier per sub-block), an in-gap test refers to the case when the interfering signalis located at a negative offset with respect to the assigned channel frequency of the highest carrier frequency and located at a positive offset with respect to the assigned channel frequency of the lowest carrier frequency.

For the additional requirements for intra-band non-contiguous carrier aggregation of two component carriers (one component carrier per sub-block), an out-of-gap test refers to the case when the interfering signal(s) is (are) located at a positive offset with respect to the assigned channel frequency of the highest carrier frequency, or located at a negative offset with respect to the assigned channel frequency of the lowest carrier frequency.

For the additional requirements for intra-band non-contiguous carrier aggregation of two component carriers with channel bandwidth larger than or equal to 5 MHz (one component carrier per sub-block), the existing adjacent channel selectivity requirements, in-band blocking requirements (for each case), and narrow band blocking requirements apply for in-gap tests only if the corresponding interferer frequency offsets with respect to the two measured carriers satisfy the following condition in relation to the sub-block gap size $W_{gap}$ for at least one of these carriers *j*, *j* = 1,2, so that the interferer frequency position does not change the nature of the core requirement tested:

$$W_{gap} \geq 2 \cdot |F_{Interferer\ (offset),j}| - BW_{Channel(j)}$$

where$F_{Interferer\ (offset),j}$ is the interferer frequency offset with respect to carrier *j* as specified in subclause 7.5.1, subclause 7.6.1 and subclause 7.6.3 for the respective requirement and $BW_{Channel(j)}$ the channel bandwidth of carrier *j*. The interferer frequency offsets for adjacent channel selectivity, each in-band blocking case and narrow- band blocking shall be tested separately with a single in-gap interferer at a time.

# 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 ≥ 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[7] | -97[7] | -95.2[7] | | FDD |
| 19 | | | -100 | -97 | -95.2 | | FDD |
| 20 | | | -97 | -94 | -91.2 | -90 | FDD |
| 21 | | | -100 | -97 | -95.2 | | FDD |
| 22 | | | -97 | -94 | -92.2 | -91 | FDD |
| 23 | -104.7 | -101.7 | -100 | -97 | -95.2 | -94 | FDD |
| 24 | | | -100 | -97 | | | FDD |
| 25 | -101.2 | -98.2 | -96.5 | -93.5 | -91.7 | -90.5 | FDD |
| 26 | -102.7 | -99.7 | -97.5[6] | -94.5[6] | -92.7[6] | | FDD |
| 27 | -103.2 | -100.2 | -98 | -95 | | | FDD |
| 28 | | -100.2 | -98.5 | -95.5 | -93.7 | -91 | FDD |
| … | | | | | | | |
| 33 | | | -100 | -97 | -95.2 | -94 | TDD |
| 34 | | | -100 | -97 | -95.2 | | TDD |
| 35 | -106.2 | -102.2 | -100 | -97 | -95.2 | -94 | TDD |
| 36 | -106.2 | -102.2 | -100 | -97 | -95.2 | -94 | TDD |
| 37 | | | -100 | -97 | -95.2 | -94 | TDD |
| 38 | | | -100 | -97 | -95.2 | -94 | TDD |
| 39 | | | -100 | -97 | -95.2 | -94 | TDD |
| 40 | | | -100 | -97 | -95.2 | -94 | TDD |
| 41 | | | -98 | -95 | -93.2 | -92 | TDD |
| 42 | | | -99 | -96 | -94.2 | -93 | TDD |
| 43 | | | -99 | -96 | -94.2 | -93 | TDD |
| 44 | | [-100.2] | [-98] | [-95] | [-93.2] | [-92] | TDD |

NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5
NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1
NOTE 3: The signal power is specified per port
NOTE 4: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.
NOTE 5: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.
NOTE 6: [6] indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.
NOTE 7: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths.

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 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex G (informative).

For the UE which supports inter-band carrier aggregation configuration in Table 7.3.1-1A with uplink in one E-UTRA band, the minimum requirement for reference sensitivity in Table 7.3.1-1 shall be increased by the amount given in $\Delta R_{IB,c}$ in Table7.3.1-1A for the applicable E-UTRA bands.

**Table 7.3.1-1A: $\Delta R_{IB,c}$**

| Inter-band CA Configuration | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-5A | 1 | 0 |
| | 5 | 0 |
| CA_1A-18A | 1 | 0 |
| | 18 | 0 |
| CA_1A-19A | 1 | 0 |
| | 19 | 0 |
| CA_1A-21A | 1 | 0 |
| | 21 | 0 |
| CA_2A-17A | 2 | 0 |
| | 17 | 0.5 |
| CA_3A-5A | 3 | 0 |
| | 5 | 0 |
| CA_3A-7A | 3 | 0 |
| | 7 | 0 |
| CA_3A-8A | 3 | 0 |
| | 8 | 0 |
| CA_3A-20A | 3 | 0 |
| | 20 | 0 |
| CA_4A-5A | 4 | 0 |
| | 5 | 0 |
| CA_4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-12A | 4 | 0 |
| | 12 | 0.5 |
| CA_4A-13A | 4 | 0 |
| | 13 | 0 |
| CA_4A-17A | 4 | 0 |
| | 17 | 0.5 |
| CA_5A-12A | 5 | 0.5 |
| | 12 | 0.3 |
| CA_5A-17A | 5 | 0.5 |
| | 17 | 0.3 |
| CA_7A-20A | 7 | 0 |
| | 20 | 0 |
| CA_8A-20A | 8 | 0 |
| | 20 | 0 |
| CA_11A-18A | 11 | 0 |
| | 18 | 0 |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations<br>NOTE 2: The above additional tolerances also apply in intra-band CA and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations<br>NOTE 3: In case the UE supports more than one of the above inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one inter-band carrier aggregation configurations then:<br>- When the E-UTRA operating band frequency range is ≤ 1GHz, the applicable additional tolerance shall be the average of the tolerances in Table 7.3.1-1A, truncated to one decimal place that would apply for that operating band among the supported CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported carrier aggregation configurations involving such band shall be applied<br>- When the E-UTRA operating band frequency range is >1GHz, the applicable additional tolerance shall be the maximum tolerance in Table 7.3.1-1A that would apply for that operating band among the supported | | |

| |
|---|
| CA configurations |

NOTE : The above additional tolerances do not apply to supported UTRA operating bands with frequency range below 1 GHz that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations when such bands are belonging only to band combination(s) where one band is <1GHz and another band is >1.7GHz and there is no harmonic relationship between the low band UL and high band DL. Otherwise the above additional tolerances also apply to supported UTRA operating bands that correspond to the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.

**Table 7.3.1-2: Uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / $N_{RB}$ / 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 | 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 |
| 22 | | | 25 | 50 | 50[1] | 50[1] | FDD |
| 23 | 6 | 15 | 25 | 50 | 75 | 100 | FDD |
| 24 | | | 25 | 50 | | | FDD |
| 25 | 6 | 15 | 25 | 50 | 50[1] | 50[1] | FDD |
| 26 | 6 | 15 | 25 | 25[1] | 25[1] | | FDD |
| 27 | 6 | 15 | 25 | 25[1] | | | FDD |
| 28 | | 15 | 25 | 25[1] | 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 |
| 41 | | | 25 | 50 | 75 | 100 | TDD |
| 42 | | | 25 | 50 | 75 | 100 | TDD |
| 43 | | | 25 | 50 | 75 | 100 | TDD |
| 44 | | 15 | 25 | 50 | 75 | 100 | TDD |

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 |
| 23 | NS_03 |

## 7.3.1A Minimum requirements (QPSK) for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1 and Table 7.3.1-2. The reference sensitivity is defined to be met with both downlink component carriers active and either of the uplink carriers active. The UE shall meet the requirements specified in subclause 7.3.1 with the following exceptions.

For the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0a, exceptions to the aforementioned requirements are allowed when the uplink active in the lower-frequency operating band is within a specified frequency range as noted in Table 7.3.1A-0a. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0a and Table 7.3.1A-0b.

**Table 7.3.1A-0a: Reference sensitivity for carrier aggregation QPSK $P_{REFSENS,\ CA}$ (exceptions)**

| Channel bandwidth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_3A-8A[4] | 3 | | | | N/A | N/A | N/A | FDD |
| | 8 | | | N/A | N/A | | | |
| CA_4A-12A[5,6] | 4 | -89.2 | -89.2 | -90 | -89.5 | | | FDD |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_4A-17A[5,6] | 4 | | | -90 | -89.5 | | | FDD |
| | 17 | | | -96.5 | -93.5 | | | |

NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.
NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1
NOTE 3: The signal power is specified per port
NOTE 4: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).
NOTE 5: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of the high band.
NOTE 6: The requirements should be verified for UL EARFCN of the low band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB}/0.3 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB}/2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB}/2$ with $f_{DL}^{HB}$ the carrier frequency of the high band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the low band.

**Table 7.3.1A-0b: Uplink configuration for the low band (exceptions)**

| E-UTRA Band / Channel bandwidth of the high band / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **UL band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex mode** |
| CA_4A-12A | 12 | 2 | 5 | 8 | 16 | | | FDD |
| CA_4A-17A | 17 | | | 8 | 16 | | | FDD |
| NOTE 1: refers to the UL resource blocks, which shall be centred within the transmission bandwidth configuration for the channel bandwidth.<br>NOTE 2: the UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.1-2 for the uplink bandwidth in which case the allocation according to Table 7.3.1-2 applies. | | | | | | | | |

For band combinations including operating bands without uplink band (as noted in Table 5.5-1), the requirements are specified in Table 7.3.1A-0d and Table 7.3.1A-0e.

**Table 7.3.1A-0d: Reference sensitivity QPSK $P_{REFSENS}$**

| Channel bandwidth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_2A-29A | 2 | | | -98 | -95 | | | FDD |
| | 29 | | -98.7 | -97 | -94 | | | |
| CA_4A-29A | 4 | | | -100 | -97 | | | FDD |
| | 29 | | -98.7 | -97 | -94 | | | |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.<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 | | | | | | | | |

**Table 7.3.1A-0e: Uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_2A-29A | 2 | | | 25 | 50 | | | FDD |
| | 29 | | N/A | N/A | N/A | | | |
| CA_4A-29A | 4 | | | 25 | 50 | | | FDD |
| | 29 | | N/A | N/A | N/A | | | |

In all cases for single uplink inter-band CA, unless given by Table 7.3.1-3 for the band with the active uplink carrier, the applicable reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

For intra-band contiguous carrier aggregation the throughput of each component carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.1-1 and Table 7.3.1A-1. Table 7.3.1A-1 specifies the maximum number of allocated uplink resource blocks for which the intra-band contiguous carrier aggregation reference sensitivity requirement shall be met. The PCC and SCC allocations as defined in Table 7.3.1A-1 form a contiguous allocation where TX–RX frequency separations of the component carriers are as defined in Table 5.7.4-1. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2 and the downlink PCC carrier center frequency shall be configured closer to uplink operating band than the downlink SCC center frequency. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

**Table 7.3.1A-1: Intra-band contiguous CA uplink configuration for reference sensitivity**

| CA configuration / CC combination / $N_{RB\_agg}$ / Duplex mode | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Uplink CA configuration | 100RB+50RB | | 75RB+75RB | | 100RB+75RB | | 100RB+100RB | | Duplex Mode |
| | PCC | SCC | PCC | SCC | PCC | SCC | PCC | SCC | |
| CA_1C | N/A | N/A | 75 | 54 | N/A | N/A | 100 | 30 | FDD |
| CA_7C | N/A | N/A | 75 | 0 | N/A | N/A | 75 | 0 | FDD |
| CA_38C | N/A | N/A | 75 | 75 | N/A | N/A | 100 | 100 | TDD |
| CA_40C | 100 | 50 | 75 | 75 | N/A | N/A | 100 | 100 | TDD |
| CA_41C | 100 | 50 | 75 | 75 | 100 | 75 | 100 | 100 | TDD |

NOTE 1: The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.
NOTE 2: The transmitted power over both PCC and SCC shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.
NOTE 3: The UL resource blocks in both PCC and SCC shall be confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).
NOTE 4: The UL resource blocks in PCC shall be located as close as possible to the downlink operating band, while the UL resource blocks in SCC shall be located as far as possible from the downlink operating band.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, the throughput of each downlink component carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with both downlink carriers active and parameters specified in Table 7.3.1-1 and Table 7.3.1A-3 with the power level in Table 7.3.1-1 increased by $\Delta_{IBNC}$ given in Table 7.3.1A-3 for the SCC. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

**Table 7.3.1A-3: Intra-band non-contiguous CA uplink configuration for reference sensitivity with one uplink**

| CA configuration | Aggregated channel bandwidth (PCC+SCC) | $W_{gap}$ / [MHz] | UL PCC allocation | $\Delta R_{IBNC}$ (dB) | Duplex mode |
|---|---|---|---|---|---|
| CA_25A-25A | 25RB+25RB | 30.0 < $W_{gap}$ ≤ 55.0 | 10[1] | 5.0 | FDD |
| | | 0.0 < $W_{gap}$ ≤ 30.0 | 25[1] | 0.0 | |
| | 25RB+50RB | 25.0 < $W_{gap}$ ≤ 50.0 | 10[1] | 4.5 | |
| | | 0.0 < $W_{gap}$ ≤ 25.0 | 25[1] | 0.0 | |
| | 50RB+25RB | 15.0 < $W_{gap}$ ≤ 50.0 | 10[4] | 5.5 | |
| | | 0.0 < $W_{gap}$ ≤ 15.0 | 32[1] | 0.0 | |
| | 50RB+50RB | 10.0 < $W_{gap}$ ≤ 45.0 | 10[4] | 5.0 | |
| | | 0.0 < $W_{gap}$ ≤ 10.0 | 32[1] | 0.0 | |
| CA_41A-41A | NOTE 6 | NOTE 7 | NOTE 8 | 0.0 | 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.
NOTE 2: $W_{gap}$ is the sub-block gap between the two sub-blocks.
NOTE 3: The carrier center frequency of PCC in the UL operating band is configured closer to the DL operating band.
NOTE 4: [4] refers to the UL resource blocks shall be located at $RB_{start}$=33.
NOTE 5: For the TDD intra-band non-contiguous CA configurations, the minimum requirements apply only in synchronized operation between all component carriers.
NOTE 6: All combinations of channel bandwidths defined in Table 5.6A.1-3.
NOTE 7: All applicable sub-block gap sizes.
NOTE 8: The PCC allocation is same as Transmission bandwidth configuration $N_{RB}$ as defined in Table 5.6-1.

### 7.3.1B Minimum requirements (QPSK) for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.3.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{UMAX}$ is the total transmitter power over the two transmit antenna connectors.

### 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.<br>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. | | | | | | | |

## 7.4.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the maximum input level is defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.4.1 for each component carrier while both downlink carriers are active.

For intra-band contiguous carrier aggregation maximum input level is defined as the powers received at the UE antenna port over the Transmission bandwidth configuration of each CC, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel over each component carrier.

The downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.4.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2.

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

For intra-band non-contiguous carrier aggregation with two downlink carriers each carrier shall meet the requirements specified in Table 7.4.1-1 while all downlink carriers are active.

The throughput shall be ≥ 95% of the maximum throughput of the specified reference measurement channel as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) over each carrier. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1A-3.

**Table 7.4.1A-1: Maximum input level for intra-band contiguous CA**

| Rx Parameter | Units | CA Bandwidth Class | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F |
| Power in largest Transmission Bandwidth Configuration CC | dBm | | | -25 | | | |
| Power in each other CC | dBm | | | $-25 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<br>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. | | | | | | | |

### 7.4.1B Minimum requirements for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing, the minimum requirements in Clause 7.4.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ is defined as the total transmitter power over the two transmit antenna connectors.

## 7.4A Void

### 7.4A.1 Void

## 7.5 Adjacent Channel Selectivity (ACS)

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

### 7.5.1 Minimum requirements

The UE shall fulfil the minimum requirement specified in Table 7.5.1-1 for all values of an adjacent channel interferer up to –25 dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1-2 and Table 7.5.1-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).

**Table 7.5.1-1: Adjacent channel selectivity**

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

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

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + 14 dB | | | | | |
| $P_{Interferer}$ | dBm | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +42.5dB | REFSENS +39.5dB |
| $BW_{Interferer}$ | MHz | 1.4 | 3 | 5 | 5 | 5 | 5 |
| $F_{Interferer}$ (offset) | MHz | 1.4+0.0025 / -1.4-0.0025 | 3+0.0075 / -3-0.0075 | 5+0.0025 / -5-0.0025 | 7.5+0.0075 / -7.5-0.0075 | 10+0.0125 / -10-0.0125 | 12.5+0.0025 / -12.5-0.0025 |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX\_L}$ as defined in 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 subclause 6.2.5.<br>NOTE 2: The interferer consists of the Reference measurement channel specified in Annex 3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1. | | | | | | | |

## 7.5.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band, the adjacent channel requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.5.1 for each component carrier while both downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink active in the band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the adjacent channel requirements of subclause 7.5.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.5.1A-2 and Table 7.5.1A-3 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement specified in Table 7.5.1A-1 for an adjacent channel interferer on either side of the aggregated downlink signal at a specified frequency offset and for an interferer power up to -25 dBm. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5.1A-2 and 7.5.1A-3.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, each larger than or equal to 5 MHz, the adjacent channel selectivity requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in subclause 7.5.1 for each component carrier subject to in-gap and out-of-gap interferers while both downlink carriers are active. The interferer power$P_{interferer}$ for Case 1 in Table 7.5.1-2 shall be set to the maximum of the levels given by the two downlink carriers. For both Case 1 and Case 2 (Table 7.5.1-3), the wanted signal power level of each carrier shall be set in accordance with the ACS requirement (Clause 7.5.1) relative to the interferer power $P_{interferer}$.

**Table 7.5.1A-1: Adjacent channel selectivity**

| | | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| **Rx Parameter** | **Units** | **B** | **C** | **D** | **E** | **F** |
| ACS | dB | | 24 | | | |

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

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | | | REFSENS + 14 dB | | | |
| $P_{Interferer}$ | dBm | | Aggregated power + 22.5 dB | | | |
| $BW_{Interferer}$ | MHz | | 5 | | | |
| $F_{Interferer}$ (offset) | MHz | | 2.5 + $F_{offset}$ / -2.5 - $F_{offset}$ | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<br>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<br>NOTE 3: The $F_{interferer}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to $\lfloor F_{interferer}/0.015+0.5 \rfloor 0.015+0.0075$ MHz to be offset from the sub-carrier raster. | | | | | | |

**Table 7.5.1A-3: Test parameters for Adjacent channel selectivity, Case 2**

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | | -47.5+10 $\log_{10}(N_{RB,c}/N_{RB\ agg})$ | | | |
| $P_{Interferer}$ | dBm | -25 | | | | |
| $BW_{Interferer}$ | MHz | | 5 | | | |
| $F_{Interferer}$ (offset) | MHz | | 2.5+ $F_{offset}$ / -2.5- $F_{offset}$ | | | |
| NOTE 1: The transmitter shall be set to 24dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<br>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<br>NOTE 3: The $F_{interferer}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the adjacent channel interferer and shall be further adjusted to $\lfloor F_{interferer}/0.015+0.5 \rfloor 0.015+0.0075$ MHz to be offset from the sub-carrier raster. | | | | | | |

### 7.5.1B Minimum requirements for UL-MIMO

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.5.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ is defined as the total transmitter power over the two transmit antenna connectors.

## 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.<br>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 | Case 5 |
|---|---|---|---|---|---|---|---|
| | $P_{Interferer}$ | dBm | -56 | -44 | | | -38 |
| | $F_{Interferer}$ (offset) | MHz | =-BW/2 – $F_{Ioffset,case 1}$<br>&<br>=+BW/2 + $F_{Ioffset,case 1}$ | ≤-BW/2 – $F_{Ioffset,case 2}$<br>&<br>≥+BW/2 + $F_{Ioffset,case 2}$ | | | -BW/2 - 11 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44 | $F_{Interferer}$ | MHz | (Note 2) | $F_{DL\_low}$ – 15<br>to<br>$F_{DL\_high}$ + 15 | Void | Void | |
| 30 | $F_{Interferer}$ | MHz | (Note 2) | $F_{DL\_low}$ – 15<br>to<br>$F_{DL\_high}$ + 15 | | | $F_{DL\_low}$ – 11 |
| 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<br>NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency -BW/2 - $F_{Ioffset, case 1}$ and<br>b. the carrier frequency +BW/2 + $F_{Ioffset, case 1}$<br>NOTE 3: $F_{Interferer}$ range values for unwanted modulated interfering signal are interferer center frequencies | | | | | | | |

For the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{Interferer}$ power defined in Table 7.6.1.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

#### 7.6.1.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the in-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.1.1 for each component carrier while both downlink carriers are active. For the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{Interferer}$ power defined in Table 7.6.1.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink in the band capable of UL operation.. The requirements for the component carrier configured in the operating band without uplink band are specified in Table 7.6.1.1-1 and Table 7.6.1.1A-0.

**Table 7.6.1.1A-0: In-band blocking for additional operating bands for carrier aggregation**

| E-UTRA band | Parameter | Unit | Case 1 | Case 2 |
|---|---|---|---|---|
| | $P_{Interferer}$ | dBm | -56 | -44 |
| | $F_{Interferer}$ (offset) | MHz | $=-BW/2 – F_{Ioffset,case 1}$ & $=+BW/2 + F_{Ioffset,case 1}$ | $\leq -BW/2 – F_{Ioffset,case 2}$ & $\geq +BW/2 + F_{Ioffset,case 2}$ |
| 29 | $F_{Interferer}$ | 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 $+BW/2 + F_{Ioffset, case 1}$
NOTE 3: $F_{Interferer}$ range values for unwanted modulated interfering signal are interferer center frequencies

For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the in-band blocking requirements of subclause 7.6.1.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.6.1.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.1.1A-1 and Tables 7.6.1.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.1.1A-1 and 7.6.1.1A-2.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, each larger than or equal to 5 MHz, the in-band blocking requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in subclause 7.6.1.1 for each component carrier subject to in-gap and out-of-gap interferers while both downlink carriers are active.

**Table 7.6.1.1A-1: In band blocking parameters**

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | | 12 | | | |
| $BW_{Interferer}$ | MHz | | 5 | | | |
| $F_{Ioffset, case 1}$ | MHz | | 7.5 | | | |
| $F_{Ioffset, case 2}$ | MHz | | 12.5 | | | |

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A
NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1

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

| CA configuration | Parameter | Unit | Case 1 | Case 2 |
|---|---|---|---|---|
| | $P_{Interferer}$ | dBm | -56 | -44 |
| | $F_{Interferer}$ (offset) | MHz | =-$F_{offset}$– $F_{Ioffset,case 1}$ & =+$F_{offset}$ + $F_{Ioffset,case 1}$ | ≤-$F_{offset}$– $F_{Ioffset,case 2}$ & ≥+$F_{offset}$ + $F_{Ioffset,case 2}$ |
| CA_1C, CA_7C, CA_38C, CA_40C, CA_41C | $F_{Interferer}$ (Range) | 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 -$F_{offset}$ - $F_{Ioffset, case 1}$ and
b. the carrier frequency +$F_{offset}$ + $F_{Ioffset, case 1}$

NOTE 3: $F_{offset}$ is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.

NOTE 4: The $F_{interferer}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer tested and shall be further adjusted to $\lfloor F_{interferer}/0.015+0.5\rfloor 0.015+0.0075$ MHz to be offset from the sub-carrier raster.

## 7.6.2 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 clause 7.7 spurious response are applicable.

**Table 7.6.2.1-1: Out-of-band blocking parameters**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + channel bandwidth specific value below | | | | | |
| | | 6 | 6 | 6 | 6 | 7 | 9 |

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX\_L}$ as defined in subclause 6.2.5.

NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.

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

| E-UTRA band | Parameter | Units | Frequency | | | |
|---|---|---|---|---|---|---|
| | | | Range 1 | Range 2 | Range 3 | Range 4 |
| | $P_{Interferer}$ | dBm | -44 | -30 | -15 | -15 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42 (NOTE 2), 43 (NOTE 2), 44 | $F_{Interferer}$ (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.<br>NOTE 2: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 2800 MHz and $F_{Interferer}$ < 4400 MHz. | | | | | | |

## 7.6.2.1A Minimum requirements for CA

For inter-band carrier aggregation with the uplink assigned to one E-UTRA band, the out-of-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The throughput in the downlink measured 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 7.6.2.1A-0. The UE shall meet these requirements for each component carrier while both downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink active in the band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the out-of-band blocking requirements of subclause 7.6.2.1A do not apply.

**Table 7.6.2.1A-0: out-of-band blocking for inter-band carrier aggregation with one active uplink**

| Parameter | Unit | Range 1 | Range 2 | Range 3 |
|---|---|---|---|---|
| $P_w$ | dBm | Table 7.6.2.1-1 for both component carriers | | |
| $P_{interferer}$ | dBm | -44 + $\Delta R_{IB,c}$ | -30 + $\Delta R_{IB,c}$ | -15 + $\Delta R_{IB,c}$ |
| $F_{interferer}$ (CW) | MHz | -60 < f – $F_{DL\_Low(1)}$ < -15<br>or<br>-60 < f – $F_{DL\_Low(2)}$ < -15<br>or<br>15 < f – $F_{DL\_High(1)}$ < 60<br>or<br>15 < f – $F_{DL\_High(2)}$ < 60 | -85 < f – $F_{DL\_Low(1)}$ ≤ -60<br>or<br>-85 < f – $F_{DL\_Low(2)}$ ≤ -60<br>or<br>60 ≤ f – $F_{DL\_High(1)}$ < 85<br>or<br>60 ≤ f – $F_{DL\_High(2)}$ < 85 | 1 ≤ f ≤ $F_{DL\_Low(1)}$ – 85<br>or<br>$F_{DL\_High(1)}$ + 85 ≤ f ≤ $F_{DL\_Low(2)}$ – 85<br>or<br>$F_{DL\_High(2)}$ + 85 ≤ f ≤ 12750 |
| NOTE 1: $F_{DL\_Low(1)}$ and $F_{DL\_High(1)}$ denote the respective lower and upper frequency limits of the lower operating band, $F_{DL\_Low(2)}$ and $F_{DL\_High(2)}$ the respective lower and upper frequency limits of the upper operating band.<br>NOTE 2: For $F_{DL\_Low(2)}$ – $F_{DL\_High(1)}$ < 145 MHz and $F_{Interferer}$ in $F_{DL\_High(1)}$ < f < $F_{DL\_Low(2)}$, $F_{Interferer}$ can be in both Range 1 and Range 2. Then the lower of the $P_{Interferer}$ applies.<br>NOTE 3: For $F_{DL\_Low(1)}$ – 15 MHz ≤ f ≤ $F_{DL\_High(1)}$ + 15 MHz and $F_{DL\_Low(2)}$ – 15 MHz ≤ f ≤ $F_{DL\_High(2)}$ + 15 MHz the appropriate adjacent channel selectivity and in-band blocking in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied.<br>NOTE 4: $\Delta R_{IB,c}$ according to Table 7.3.1-1A applies when serving cell *c* is measured. | | | | |

For Table 7.6.2.1A-0 in frequency ranges 1, 2 and 3, up to $\max\left(24, 6 \cdot \lceil N_{RB} \cdot / 6 \rceil\right)$ exceptions per downlink are allowed for spurious response frequencies when measured using a step size of 1 MHz. For these exceptions the requirements in clause 7.7.1A apply.

For intra-band contiguous carrier aggreagations the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.6.2.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2.

The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.2.1A-1 and Tables 7.6.2.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1A-1 and 7.6.2.1A-2.

For Table 7.6.2.1A-2 in frequency range 1, 2 and 3, up to $\max(24,6\cdot\lceil N_{RB}\cdot/6\rceil)$ exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

**Table 7.6.2.1A-1: Out-of-band blocking parameters**

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | | 9 | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<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. | | | | | | |

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

| CA configuration | Parameter | Units | Frequency | | |
|---|---|---|---|---|---|
| | | | Range 1 | Range 2 | Range 3 |
| | $P_{Interferer}$ | dBm | -44 | -30 | -15 |
| CA_1C, CA_3C, CA_7C , CA_38C, CA_40C, CA_41C | $F_{Interferer}$ (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 |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, the out-of-band blocking requirements are defined with the uplink configuration in accordance with table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in subclause 7.6.2.1 for each component carrier while both downlink carriers are active.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to $\max(24,6\cdot\lceil N_{RB}\cdot/6\rceil)$ exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to $\max(8,\ \lceil (N_{RB}+2\cdot L_{CRBs})/8\rceil)$ exceptions per assigned E-UTRA channel per sub-block of the E-UTRA CA configuration are allowed for spurious response frequencies when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7 spurious response are applicable.

## 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 a 4 dB below $P_{CMAX\_L}$ at the minimum uplink configuration specified in Table 7.3.1-2 with $P_{CMAX\_L}$ as defined in 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. | | | | | | | |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A, $P_{UW}$ power defined in Table 7.6.3.1-1 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

### 7.6.3.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the narrow-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.3.1 for each component carrier while both downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink active in the band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the narrow-band blocking requirements of subclause 7.6.3.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.6.3.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.6.3.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3.1A-1.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, the narrow band blocking requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in subclause 7.6.3.1 for each component carrier subject to in-gap and out-of-gap interferers while both downlink carriers are active.

**Table 7.6.3.1A-1: Narrow-band blocking**

| Parameter | Unit | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | **B** | **C** | **D** | **E** | **F** |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | | 16[4] | | | |
| $P_{uw}$ (CW) | dBm | | -55 | | | |
| $F_{uw}$ (offset for $\Delta f$ = 15 kHz) | MHz | | - $F_{offset}$ – 0.2 / + $F_{offset}$ + 0.2 | | | |
| $F_{uw}$ (offset for $\Delta f$ = 7.5 kHz) | MHz | | | | | |

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.
NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.
NOTE 3: The $F_{uw}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the intererand shall be further adjusted to $\lfloor F_{interferer} / 0.015 + 0.5 \rfloor 0.015 + 0.0075$ MHz to be offset from the sub-carrier raster.
NOTE 4: The requirement is applied for the band combinations whose component carriers' BW≥5 MHz.

# 7.6A Void

<Reserved for future use>

# 7.6B Blocking characteristics for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.6 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ is defined as the total transmitter power over the two transmit antenna connectors.

# 7.7 Spurious response

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

## 7.7.1 Minimum requirements

The throughput shall be ≥ 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.
N OTE 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 |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A, $P_{interferer}$ power defined in Table 7.7.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

## 7.7.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the spurious response requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The throughput measured in each downlink with $F_{interferer}$ in Table 7.6.2.1A-0 at spurious response frequencies 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. The UE shall meet these requirements for each component carrier while both downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink active in the band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the spurious response requirements of subclause 7.7.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.7.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7.1A-1 and 7.7.1A-2.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, the spurious response requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in clause 7.7.1 for each component carrier while both downlink carriers are active.

**Table 7.7.1A-1: Spurious response parameters**

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | | 9 | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<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. | | | | | | |

**Table 7.7.1A-2: Spurious response**

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

### 7.7.1B Minimum requirements for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.7.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ is defined as the total transmitter power over the two transmit antenna connectors.

## 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 | | | | | | | |

For the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{interferer1}$ and $P_{interferer2}$ powers defined in Table 7.8.1.1-1 are increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

### 7.8.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the wide band intermodulation requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.8.1.1 for each component carrier while both downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for both downlinks shall be met with the uplink active in the band capable of UL operation. For E-UTRA

CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the wideband intermodulation requirements of subclause 7.8.1A do not apply.

For intra-band contiguous carrier aggegation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.8.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggreagation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.8.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 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 7.8.1A-1

**Table 7.8.1A-1: Wide band intermodulation**

| Rx parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | | 12 | | | |
| $P_{Interferer\ 1}$ (CW) | dBm | -46 | | | | |
| $P_{Interferer\ 2}$ (Modulated) | dBm | -46 | | | | |
| $BW_{Interferer\ 2}$ | MHz | | 5 | | | |
| $F_{Interferer\ 1}$ (Offset) | MHz | | $–F_{offset}$-7.5<br>/<br>+ $F_{offset}$+7.5 | | | |
| $F_{Interferer\ 2}$ (Offset) | MHz | 2*$F_{Interferer\ 1}$ | | | | |
| NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,c}$ or $P_{CMAX\_L}$ as defined in subclause 6.2.5A.<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.3.1.<br>NOTE 4: The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥5MHz.<br>NOTE 5: The $F_{interferer\ 1}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the modulated interferer. | | | | | | |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink carriers, the wide band intermodulation requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements specified in subclause 7.8.1.1 for each component carrier while both downlink carriers are active. The wide band intermodulation requirements shall be supported for out-of-gap test only.

## 7.8.1B Minimum requirements for UL-MIMO

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.8.1 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ is defined as the total transmitter power over the two transmit antenna connectors.

### 7.8.2 Void

## 7.9 Spurious emissions

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

### 7.9.1 Minimum requirements

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

**Table 7.9.1-1: General receiver spurious emission requirements**

| Frequency band | Measurement bandwidth | Maximum level | Note |
|---|---|---|---|
| 30MHz ≤ f < 1GHz | 100 kHz | -57 dBm | |
| 1GHz ≤ f ≤ 12.75 GHz | 1 MHz | -47 dBm | |
| 12.75 GHz ≤ f ≤ 5th harmonic of the upper frequency edge of the DL operating band in GHz | 1 MHz | -47 dBm | 1 |
| NOTE 1: Applies only for Band 22, Band 42 and Band 43<br>NOTE 2: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1. | | | |

### 7.9.1A Minimum requirements

For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.1A-1.

**Table 7.9.1A-1: General receiver spurious emission requirements**

| Frequency band | Measurement bandwidth | Maximum level | Note |
|---|---|---|---|
| 30MHz ≤ f < 1GHz | 100 kHz | -57 dBm | |
| 1GHz ≤ f ≤ 12.75 GHz | 1 MHz | -47 dBm | |
| NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1.<br>NOTE 2: The requirements apply when the UE is configured for carrier aggregation but is not transmitting. | | | |

## 7.10 Receiver image

### 7.10.1 Void

### 7.10.1A Minimum requirements for CA

Receiver image rejection is a measure of a receiver's ability to receive the E-UTRA signal on one component carrier while it is also configured to receive an adjacent aggregated carrier. Receiver image rejection ratio is the ratio of the wanted received power on a sub-carrier being measured to the unwanted image power received on the same sub-carrier when both sub-carriers are received with equal power at the UE antenna connector.

For intra-band contiguous carrier aggregation the UE shall fulfil the minimum requirement specified in Table 7.10.1A-1 for all values of aggregated input signal up to –22 dBm.

**Table 7.10.1A-1: Receiver image rejection**

| | CA bandwidth class | | | | | | |
|---|---|---|---|---|---|---|---|
| **Rx parameter** | **Units** | **A** | **B** | **C** | **D** | **E** | **F** |
| Receiver image rejection | dB | | | 25 | | | |

# 8 Performance requirement

This clause contains performance requirements for the physical channels specified in TS 36.211 [4]. The performance requirements for the UE in this clause are specified for the measurement channels specified in Annex A.3, the propagation conditions in Annex B and the downlink channels in Annex C.3.2.

Note: For the requirements in the following sections, similar Release 8 and 9 requirements apply for time domain measurements restriction under colliding CRS.

## 8.1 General

### 8.1.1 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 and CA capabilities given for each test.

For enhanced performance requirements type A, the SINR is defined as

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

where the superscript indicates the receiver antenna connector. The above SINR definition assumes that the REs are not precoded. The SINR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in Table C.3.2-1. The SINR requirement applies for the UE categories given for each test.

**Table 8.1.1-1: Void**

#### 8.1.1.1 Simultaneous unicast and MBMS operations

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

### 8.1.2 Applicability of requirements

#### 8.1.2.1 Applicability of requirements for different channel bandwidths

In Clause 8 the test cases may be defined with different channel bandwidth to verify the same target FRC conditions with the same propagation conditions, correlation matrix and antenna configuration.

#### 8.1.2.2 Definition of CA capability

The definition with respect to CA capabilities for 2CCs is given as in Table 8.1.2.2-1.

**Table 8.1.2.2-1: Definition of CA capability with 2DL CCs**

| CA Capability | CA Capability Description |
|---|---|
| CA2_C | Intra-band contiguous CA |
| CA2_A2 | Inter-band CA |
| C2A_N2 | Intra-band non-contiguous CA |
| Note 1: CA2_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 2 DL CCs.<br>CA2_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 2 DL CCs.<br>CA2_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 2 DL CCs. | |

The supported testable aggregated CA bandwidth combinations for 2CCs for each CA capability are listed in Table 8.1.2.2-2.

**Table 8.1.2.2-2: Supported testable aggregated CA bandwidth combinations for different CA capability with 2DL CCs**

| CA Capability | Bandwidth combination for FDD CA | Bandwidth combination for TDD CA |
|---|---|---|
| CA2_C | 20+20MHz | 20+20MHz |
| CA2_A2 | 10+10MHz, 10+15MHz, 10+20MHz, 15+20MHz, 20+20MHz | NA |
| CA2_N2 | 10+10MHz | 20+20MHz |
| Note 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2. | | |

For test cases with more than one component carrier, "Fraction of Maximum Throughput" in the performance requirement refers to the ratio of the sum of throughput values of all component carriers to the sum of the nominal maximum throughput values of all component carriers, unless otherwise stated.

### 8.1.2.3 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CCs in Table 8.1.2.3-1. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 8.1.2.3-1: Applicability and test rules for CA UE demodulation tests with 2 DL CCs**

| Tests | CA capability where the tests apply | CA configuration from the selected CA capbility where the tests apply | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 2CCs in Clause 8.2.1.1.1, 8.2.1.4.3 | Any one of the supported CA capabilities | Any one of the supported FDD CA configurations | 10+10 MHz, 20+20 MHz |
| CA tests with 2CCs in Clause 8.2.1.3.1 | Each supported CA capability | Any one of the supported FDD CA configurations in each CA capability | 10+10 MHz, 20+20 MHz |
| CA tests with 2CCs in Clause 8.2.1.3.1A, 8.7.1 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.1.7.1 | CA2_C | Supported FDD intra-band contiguous CA configurations covering the lowest and highest operating bands | Largest aggregated CA bandwidth combinations |
| CA tests with 2CCs in Clause 8.2.2.1.1, 8.2.2.4.3 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.2.3.1 | Each supported CA capability | Any one of the supported TDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.2.3.1A, 8.7.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in 8.2.2.7.1 | CA2_C | Supported TDD intra-band contiguous CA configurations covering the lowest and highest operating bands | Largest aggregated CA bandwidth combinations |
| CA tests with 2CCs in Clause 8.2.1.8.1 | CA2_N2 | CA_3A-3A defined in Table 5.6A.1-3 | 10+10 MHz |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is one. | | | |

## 8.1.2.4 Test coverage for different number of component carriers

For FDD tests specified in 8.2.1.1.1, 8.2.1.3.1, 8.2.1.4.3, and 8.7.1, if corresponding CA tests are tested, the test coverage can be considered fulfilled without executing single carrier tests.

For TDD tests specified in 8.2.2.1.1, 8.2.2.3.1, 8.2.2.4.3, and 8.7.2, if corresponding CA tests are tested, the test coverage can be considered fulfilled without executing single carrier tests.

# 8.2 Demodulation of PDSCH (Cell-Specific Reference Symbols)

## 8.2.1 FDD (Fixed Reference Channel)

The parameters specified in Table 8.2.1-1 are valid for all FDD tests unless otherwise stated.

**Table 8.2.1-1: Common Test Parameters (FDD)**

| Parameter | Unit | Value |
|---|---|---|
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix | | Normal |
| Cell_ID | | 0 |
| Cross carrier scheduling | | Not configured |

### 8.2.1.1 Single-antenna port performance

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

#### 8.2.1.1.1 Minimum Requirement

For single carrier the requirements are specified in Table 8.2.1.1.1-2, with the addition of the parameters in Table 8.2.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.1.1.1-4, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.1.1.1-1: Test Parameters**

| Parameter | | Unit | Test 1- 5 | Test 6- 8 | Test 9- 15 | Test 16- 18 | Test 19 |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | 0 | 0 | 0 | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Modulation | | | QPSK | 16QAM | 64QAM | 16QAM | QPSK |
| PDSCH transmission mode | | | 1 | 1 | 1 | 1 | 1 |

Note 1: $P_B = 0$.
Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
Note 3: Void.
Note 4: Void.

**Table 8.2.1.1.1-2: Minimum performance (FRC)**

| Test num. | Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value: Fraction of maximum throughput (%) | Reference value: SNR (dB) | UE cate gory |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 MHz | R.2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 | ≥1 |
| 2 | 10 MHz | R.2 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | -0.4 | ≥1 |
| 3 | 10 MHz | R.2 FDD | OP.1 FDD | ETU300 | 1x2 Low | 70 | 0.0 | ≥1 |
| 4 | 10 MHz | R.2 FDD | OP.1 FDD | HST | 1x2 | 70 | -2.4 | ≥1 |
| 5 | 1.4 MHz | R.4 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 0.0 | ≥1 |
| 6 | 10 MHz | R.3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | 1 |
| 7 | 10 MHz | R.3 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | 1 |
| 8 | 10 MHz | R.3 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | 1 |
| 9 | 3 MHz | R.5 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥1 |
| 10 | 5 MHz | R.6 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.4 | ≥2 |
| | 5 MHz | R.6-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.5 | 1 |
| 11 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 12 | 10 MHz | R.7 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 19.0 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 18.1 | 1 |
| 13 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 19.1 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 17.8 | 1 |
| 14 | 15 MHz | R.8 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | ≥2 |
| | 15 MHz | R.8-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.8 | 1 |
| 15 | 20 MHz | R.9 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥3 |
| | 20 MHz | R.9-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.3 | 2 |
| | 20 MHz | R.9-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 16 | 3 MHz | R.0 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 17 | 10 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 18 | 20 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 19 | 10 MHz | R.41 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -5.4 | ≥1 |

Note 1: Void.
Note 2: Void.
Note 3: Void.

**Table 8.2.1.1.1-3: Test Parameters for CA**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| 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 unused PRBs | | | OCNG (Note 2) |
| Modulation | | | QPSK |
| PDSCH transmission mode | | | 1 |
| Note 1: $P_B = 0$.<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 3: PUCCH format 1b with channel selection is used to feedback ACK/NACK.<br>Note 4: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.1.1.1-4: Minimum performance (FRC) for CA**

| Test num. | Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE cate-gory |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | 2x10 MHz | R.2 FDD | OP.1 FDD (Note 1) | EVA5 | 1x2 Low | 70 | -1.1 | ≥3 (Note 2) |
| 2 | 2x20 MHz | R.42 FDD | OP.1 FDD (Note 1) | EVA5 | 1x2 Low | 70 | -1.3 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: 30usec timing difference between two CCs is applied in inter-band CA case.<br>Note 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

#### 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: $P_B = 0$<br>Note 2: The MBSFN portion of an MBSFN subframe comprises the whole MBSFN subframe except the first two symbols in the first slot.<br>Note 3: The MBSFN portion of the MBSFN subframes shall contain QPSK modulated data. Cell-specific reference signals are not inserted in the MBSFN portion of the MBSFN subframes, QPSK modulated MBSFN data is used instead. | | | |

**Table 8.2.1.1.4-2: 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 |

## 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 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 |

### 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 |
| 2 | 10 MHz | R.13 FDD | OP.1 FDD | ETU70 | 4x2 Low | 70 | -0.9 | ≥1 |

### 8.2.1.2.3 Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS)

The requirements are specified in Table 8.2.1.2.3-2, with the addition of parameters in Table 8.2.1.2.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Table 8.2.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.1.2.3-1: Test Parameters for Transmit diversity Performance (FRC)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th>Cell 2</th></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td>-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (Note 1)</td><td>-3</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td>N/A</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-102 (Note 2)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 3)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-94.8 (Note 4)</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc2}$</td><td>dB</td><td>Reference Value in Table 8.2.1.2.3-2</td><td>6</td></tr>
<tr><td colspan="2">$BW_{Channel}$</td><td>MHz</td><td>10</td><td>10</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td>Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>μs</td><td colspan="2">2.5 (synchronous cells)</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td>0</td><td>1</td></tr>
<tr><td colspan="2">ABS pattern (Note 5)</td><td></td><td>N/A</td><td>11000100<br>11000000<br>11000000<br>11000000<br>11000000</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 6)</td><td></td><td>10000000<br>10000000<br>10000000<br>10000000<br>10000000</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note7)</td><td>$C_{CSI,0}$</td><td></td><td>11000100<br>11000000<br>11000000<br>11000000<br>11000000</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>00111011<br>00111111<br>00111111<br>00111111<br>00111111</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td>2</td><td>2</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>2</td><td>N/A</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="5">Note 1: $P_B = 1$.<br>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.<br>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS<br>Note 5: ABS pattern as defined in [9].<br>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]<br>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.<br>Note 9: SIB-1 will not be transmitted in Cell2 in this test.</td></tr>
</table>

**Table 8.2.1.2.3-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) (Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11-4 FDD (Note 4) | OP.1 FDD | OP.1 FDD | EVA5 | EVA 5 | 2x2 Medium | 70 | 3.4 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\widehat{E}_s / N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.

##### 8.2.1.2.3A Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.2.1.2.3A-2, with the addition of parameters in Table 8.2.1.2.3A-1. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cells with CRS assistance information. In Table 8.2.1.2.3A-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.1.2.3A-1: Test Parameters for Transmit diversity Performance (FRC)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th>Cell 2</th><th>Cell 3</th></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (Note 1)</td><td>-3 (Note 1)</td><td>-3 (Note 1)</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-98 (Note 2)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 3)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-93 (Note 4)</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc2}$</td><td>dB</td><td>Reference Value in Table8.2.1.2.3A-2</td><td>12</td><td>10</td></tr>
<tr><td colspan="2">BW<sub>Channel</sub></td><td>MHz</td><td>10</td><td>10</td><td>10</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td>Non-MBSFN</td><td>Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>μs</td><td>N/A</td><td>3</td><td>-1</td></tr>
<tr><td colspan="2">Frequency shift between Cells</td><td>Hz</td><td>N/A</td><td>300</td><td>-100</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td>0</td><td>126</td><td>1</td></tr>
<tr><td colspan="2">ABS pattern (Note 5)</td><td></td><td>N/A</td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 6)</td><td></td><td>10000000<br>10000000<br>10000000<br>10000000<br>10000000</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note7)</td><td>$C_{CSI,0}$</td><td></td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>00111111<br>00111111<br>00111111<br>00111111<br>00111111</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td>2</td><td>Note 8</td><td>Note 8</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>2</td><td>Note 9</td><td>Note 9</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="6">Note 1: $P_B = 1$.<br>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.<br>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS<br>Note 5: ABS pattern as defined in [9].<br>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]<br>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.<br>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.<br>Note 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.<br>Note 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</td></tr>
</table>

**Table 8.2.1.2.3A-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11-4 FDD Note 4 | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | EVA5 | 2x2 Medium | 70 | 3.4 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.

#### 8.2.1.2.4 Enhanced Performance Requirement Type A - 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.2.1.2.4-2, with the addition of parameters in Table 8.2.1.2.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.2.1.2.4-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.4-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 | -3 |
| | σ | dB | 0 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| DIP (Note 2) | | dB | N/A | -2.23 | -8.06 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 2 |
| Number of control OFDM symbols | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 2 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.5.2 | As specified in clause B.5.2 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | % | N/A | 80 | 80 |
| | Rank 2 | % | N/A | 20 | 20 |
| Reporting interval | | ms | 5 | N/A | N/A |
| Reporting mode | | | PUCCH 1-0 | N/A | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 5) | N/A | N/A |
| cqi-pmi-ConfigurationIndex | | | 2 | N/A | N/A |

Note 1: $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.

Note 4: Cell 2 transmission is delayed with respect to Cell 1 by 0.33 ms and Cell 3 transmission is delayed with respect to Cell 1 by 0.67 ms.

Note 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 and #0.

**Table 8.2.1.2.4-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.46 FDD | OP.1 FDD | N/A | N/A | EVA70 | EVA70 | EVA70 | 2x2 Low | 70 | -1.1 | ≥1 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SINR corresponds to $\hat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.1.3 Open-loop spatial multiplexing performance

#### 8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier the requirements are specified in Table 8.2.1.3.1-2, with the addition of the parameters in Table 8.2.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.1.3.1-4, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| 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 | | | 3 |
| Note 1: $P_B = 1$.<br>Note 2: Void<br>Note 3: Void | | | |

**Table 8.2.1.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test num | Bandwidth | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | 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 |
| 2 | 10 MHz | R.35 FDD | OP.1 FDD | EVA200 | 2x2 Low | 70 | 20.2 | ≥2 |
| 3 | 10 MHz | R.35-4 FDD | OP.1 FDD | ETU300 | 2x2 Low | 70 | 19.7 | ≥2 |
| Note 1: Void.<br>Note 2: Test 1 may not be executed for UE-s for which Test 1 or 2 in Table 8.2.1.3.1-4 is applicable. | | | | | | | | |

**Table 8.2.1.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter | | Unit | Test 1-3 |
|---|---|---|---|
| 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 | | | 3 |
| Note 1: $P_B = 1$.<br>Note 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK.<br>Note 3: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.1.3.1-4: Minimum performance Large Delay CDD (FRC) for CA**

| Test num. | Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE cate-gory |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum Throughput (%) | SNR (dB) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 2x10 MHz | R.11 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.7 | ≥3 |
| 2 | 2x20 MHz | R.30 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.2 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: Void.<br>Note 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

### 8.2.1.3.1A Soft buffer management test

For CA the requirements are specified in Table 8.2.1.3.1A-2, with the addition of the parameters in Table 8.2.1.3.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.2.1.3.1A-3.

**Table 8.2.1.3.1A-1: Test Parameters for soft buffer management test (FRC) for CA**

| Parameter | | Unit | Test 1-7 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$.<br>Note 2: For CA test cases, PUCCH format 1b with channel selection is used to feedback ACK/NACK.<br>Note 3: For CA test cases, the same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.1.3.1A-2: Minimum performance soft buffer management test (FRC) for CA**

| Test num | Bandwidth | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum Throughput (%) | SNR (dB) |
| 1 | 2x20 MHz | R.30 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.2 |
| 2 | 15MHz + 10MHz | R.35-2 FDD for 15MHz CC | OP.1 FDD (Note 1) | EVA5 | 2x2 Low | 70 | 15.1 |
| | | R.35-3 FDD for 10MHz CC | OP.1 FDD (Note 1) | | | 70 | 15.1 |
| 3 | 20MHz + 10MHz | R.30 FDD for 20MHz CC | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.5 |
| | | R.11 FDD for 10MHz CC | OP.1 FDD (Note 1) | | | 70 | 13.5 |
| 4 | 20MHz + 15MHz | R.30 FDD for 20MHz CC | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.5 |
| | | R.30-1 FDD for 15MHz CC | OP.1 FDD (Note 1) | | | 70 | 13.5 |
| 5 | 2x20 MHz | R.35-1 FDD | OP.1 FDD (Note 1) | EVA5 | 2x2 Low | 70 | 15.8 |
| 6 | 20MHz + 10MHz | R.35-1 FDD for 20MHz CC | OP.1 FDD (Note 1) | EVA5 | 2x2 Low | 70 | 15.9 |
| | | R.35-3 FDD for 10MHz CC | OP.1 FDD (Note 1) | | | 70 | 15.9 |
| 7 | 20MHz + 15MHz | R.35-1 FDD for 20MHz CC | OP.1 FDD (Note 1) | EVA5 | 2x2 Low | 70 | 15.9 |
| | | R.35-2 FDD for 15MHz CC | OP.1 FDD (Note 1) | | | 70 | 15.9 |
| Note 1: For CA test cases, the OCNG pattern applies for each CC.<br>Note 2: For Test 2, 3, 4, 6, 7 the Fraction of maximum Throughput applies to each CC.<br>Note 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | |

**Table 8.2.1.3.1A-3: Test points for soft buffer management tests for CA**

| UE category | Bandwidth combination with maximum aggregated bandwidth (Note 1) | | | |
|---|---|---|---|---|
| | 2x20MHz | 15MHz+10MHz | 20MHz+10MHz | 20MHz+15MHz |
| 3 | 1 | 2 | 3 | 4 |
| 4 | 5 | N/A | 6 | 7 |
| Note 1: Maximum over all supported CA configurations and bandwidth combination sets according to Table 5.6A.1-1and Table 5.6A.1-2. | | | | |

## 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) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$ | | | |

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

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.14 FDD | OP.1 FDD | EVA70 | 4x2 Low | 70 | 14.3 | ≥2 |

#### 8.2.1.3.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

The requirements for non-MBSFN ABS are specified in Table 8.2.1.3.3-2, with the addition of parameters in Table 8.2.1.3.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The requirements for MBSFN ABS are specified in Table 8.2.1.3.3-4, with the addition of parameters in Table 8.2.1.3.3-3 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Tables 8.2.1.3.3-1 and 8.2.1.3.3-3, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.1.3.3-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 |
| | σ | dB | 0 | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -102 (Note 2) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -94.8 (Note 4) | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.2.1.3.3-2 | 6 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | 1 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| ABS pattern (Note 5) | | | N/A | 11000100, 11000000, 11000000, 11000000, 11000000 |
| RLM/RRM Measurement Subframe Pattern(Note 6) | | | 10000000 10000000 10000000 10000000 10000000 | N/A |
| CSI Subframe Sets (Note 7) | $C_{CSI,0}$ | | 11000100 11000000 11000000 11000000 11000000 | N/A |
| | $C_{CSI,1}$ | | 00111011 00111111 00111111 00111111 00111111 | N/A |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | 3 | N/A |
| Cyclic prefix | | | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 5: ABS pattern as defined in [9].
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 9: SIB-1 will not be transmitted in Cell2 in this test.

**Table 8.2.1.3.3-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) (Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11 FDD (Note 4) | OP.1 FDD | OP.1 FDD | EVA 5 | EVA 5 | 2x2 Low | 70 | 13.3 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\widehat{E}_s / N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.

**Table 8.2.1.3.3-3: Test Parameters for Large Delay CDD (FRC) – MBSFN ABS**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th>Cell 2</th></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td>-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (Note 1)</td><td>-3</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td>N/A</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-102 (Note 2)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 3)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-94.8 (Note 4)</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc2}$</td><td>dB</td><td>Reference Value in Table 8.2.1.3.3-4</td><td>6</td></tr>
<tr><td colspan="2">$BW_{Channel}$</td><td>MHz</td><td>10</td><td>10</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td>Non-MBSFN</td><td>MBSFN</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td>0</td><td>126</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>μs</td><td colspan="2">2.5 (synchronous cells)</td></tr>
<tr><td colspan="2">ABS pattern (Note 5)</td><td></td><td>N/A</td><td>0001000000<br>0100000010<br>0000001000<br>0000000000</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 6)</td><td></td><td>0001000000<br>0100000010<br>0000001000<br>0000000000</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 7)</td><td>$C_{CSI,0}$</td><td></td><td>0001000000<br>0100000010<br>0000001000<br>0000000000</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>1110111111<br>1011111101<br>1111110111<br>1111111111</td><td>N/A</td></tr>
<tr><td colspan="2">MBSFN Subframe Allocation (Note 10)</td><td></td><td>N/A</td><td>001000<br>100001<br>000100<br>000000</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td>2</td><td>2</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>3</td><td>N/A</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="5">Note 1: $P_B = 1$.<br>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbol #0 of a subframe overlapping with the aggressor ABS.<br>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.<br>Note 5: ABS pattern as defined in [9]. The 4th, 12th, 19th and 27th subframes indicated by ABS pattern are MBSFN ABS subframes.<br>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].<br>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.<br>Note 9: SIB-1 will not be transmitted in Cell2 in this test.<br>Note 10: MBSFN Subframe Allocation as defined in [7], four frames with 24 bits is chosen for MBSFN subframe allocation.<br>Note 11: The maximum number of uplink HARQ transmission is ≤ 2 so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test.</td></tr>
</table>

**Table 8.2.1.3.3-4: Minimum Performance Large Delay CDD (FRC) – MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 2) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) (Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11 FDD (Note 4) | OP.1 FDD | OP.1 FDD | EVA 5 | EVA 5 | 2x2 Low | 70 | 12.0 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 4 subframes, averaged over 40ms.

#### 8.2.1.3.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements for non-MBSFN ABS are specified in Table 8.2.1.3.4-2, with the addition of parameters in Table 8.2.1.3.4-1. The purpose is to verify the performance of large delay CDD with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cells with CRS assistance information. In Table 8.2.1.3.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 ad Cell3.

**Table 8.2.1.3.4-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th>Cell 2</th><th>Cell 3</th></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (Note 1)</td><td>-3 (Note 1)</td><td>-3 (Note 1)</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-98 (Note 2)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 3)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-93 (Note 4)</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{E}_s / N_{oc2}$</td><td>dB</td><td>Reference Value in Table 8.2.1.3.4-2</td><td>Reference Value in Table 8.2.1.3.4-2</td><td>Reference Value in Table 8.2.1.3.4-2</td></tr>
<tr><td colspan="2">$BW_{Channel}$</td><td>MHz</td><td>10</td><td>10</td><td>10</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td>Non-MBSFN</td><td>Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>µs</td><td>N/A</td><td>3</td><td>-1</td></tr>
<tr><td colspan="2">Frequency shift between Cells</td><td>Hz</td><td>N/A</td><td>300</td><td>-100</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td>0</td><td>1</td><td>126</td></tr>
<tr><td colspan="2">ABS pattern (Note 5)</td><td></td><td>N/A</td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 6)</td><td></td><td>10000000<br>10000000<br>10000000<br>10000000<br>10000000</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note7)</td><td>$C_{CSI,0}$</td><td></td><td>11000000<br>11000000<br>11000000<br>11000000<br>11000000</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>00111111<br>00111111<br>00111111<br>00111111<br>00111111</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td>2</td><td>Note 8</td><td>Note 8</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>3</td><td>Note 9</td><td>Note 9</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="6">Note 1: $P_B = 1$.<br>Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.<br>Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS<br>Note 5: ABS pattern as defined in [9].<br>Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]<br>Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.<br>Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.<br>Note 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.<br>Note 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.</td></tr>
</table>

**Table 8.2.1.3.4-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | $\hat{E}_s/N_{oc2}$ | | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11 FDD Note 4 | 9 | 7 | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 13.9 | ≥2 |
| 2 | R.35 FDD Note 4 | 9 | 1 | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 22.6 | ≥2 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.<br>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.<br>Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms. | | | | | | | | | | | | | |

## 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) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 6 | 50 |
| PMI delay (Note 2) | | ms | 8 | 8 |
| Reporting interval | | ms | 1 | 1 |
| Reporting mode | | | PUSCH 1-2 | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap | | | 001111 | 001111 |
| PDSCH transmission mode | | | 4 | 4 |
| Note 1: $P_B = 1$.<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). | | | | |

**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 |
| 2 | 10 MHz | R.10 FDD | OP.1 FDD | EPA5 | 2x2 High | 70 | -2.3 | ≥1 |

### 8.2.1.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.4.1A-2, with the addition of the parameters in Table 8.2.1.4.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.1.4.1A-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| 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<br>0000000000000000<br>0000000000000000<br>1111111111111111 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$.<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). | | | |

**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 |

### 8.2.1.4.1B Enhanced Performance Requirement Type A - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.1.4.1B-2, with the addition of the parameters in Table 8.2.1.4.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.2.1.4.1B-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.4.1B-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 | -3 |
| | σ | dB | 0 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| DIP (Note 2) | | dB | N/A | -1.73 | -8.66 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 2 |
| Number of control OFDM symbols | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 6 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | % | N/A | 80 | 80 |
| | Rank 2 | % | N/A | 20 | 20 |
| Precoding granularity | | PRB | 50 | 6 | 6 |
| PMI delay (Note 4) | | ms | 8 | N/A | N/A |
| Reporting interval | | ms | 5 | N/A | N/A |
| Reporting mode | | | PUCCH 1-1 | N/A | N/A |
| CodeBookSubsetRestriction bitmap | | | 1111 | N/A | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 6) | N/A | N/A |
| cqi-pmi-ConfigurationIndex | | | 2 | N/A | N/A |

Note 1: $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.

Note 4: If the UE reports in an available uplink reporting instance at 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 5: All cells are time-synchronous.

Note 6: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5 and #0.

**Table 8.2.1.4.1B-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.47 FDD | OP.1 FDD | N/A | N/A | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 0.8 | ≥1 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | |
| Note 2: SINR corresponds to $\hat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

#### 8.2.1.4.1C Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.2.1.4.1C-2, with the addition of parameters in Table 8.2.1.4.1C-1. The purpose is to verify the closed loop rank-one performance with wideband precoding if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.1.4.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.1.4.1C-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.2.1.4.1C-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 5) | | | N/A | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 11000000<br>11000000<br>11000000<br>11000000<br>11000000 | N/A | N/A |
| | $C_{CSI,1}$ | | 00111111<br>00111111<br>00111111<br>00111111<br>00111111 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| PDSCH transmission mode | | | 6 | Note 9 | Note 9 |
| Precoding granularity | | PRB | 50 | N/A | N/A |
| PMI delay (Note 10) | | ms | 8 | N/A | N/A |
| Reporting interval | | ms | 1 | N/A | N/A |
| Peporting mode | | | PUSCH 3-1 | N/A | N/A |
| CodeBookSubsetRestriction bitmap | | | 1111 | N/A | N/A |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | $P_B = 1$. |
| Note 2: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 4: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 5: | ABS pattern as defined in [9]. |
| Note 6: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 7: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 8: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern. |
| Note 9: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5. |
| Note 10: | If the UE reports in an available uplink reporting instance at 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 11: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same. |
| Note 12: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test. |

**Table 8.2.1.4.1C-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)– Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11 FDD Note 4 | OP.1 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | EPA5 | 2x2 High | 70 | 6.1 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 9 subframes, averaged over 40ms.

#### 8.2.1.4.2 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: $P_B = 1$.<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). | | | |

**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 |
| 2 | 10 MHz | R.11 FDD | OP.1 FDD | ETU70 | 2x2 Low | 70 | 14.3 | ≥2 |

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

For single carrier the requirements are specified in Table 8.2.1.4.3-2, with the addition of the parameters in Table 8.2.1.4.3-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.1.4.3-4, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | 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 | | 0000000000000000000000000<br>000000011111111111111100<br>00000000000000 |
| PDSCH transmission mode | | 4 |
| Note 1: $P_B = 1$.<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: Void.<br>Note 4: Void.<br>Note 5: Void. | | |

**Table 8.2.1.4.3-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)**

| Test num. | Band-width | Referencechannel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE cate-gory |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.36 FDD | OP.1 FDD | EPA5 | 4x2 Low | 70 | 14.7 | ≥2 |
| Note 1: Void | | | | | | | | |

**Table 8.2.1.4.3-3: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 | -6 |
| | $\rho_B$ | dB | -6 (Note 1) | -6 (Note 1) |
| | σ | dB | 3 | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 6 | 8 |
| PMI delay (Note 2) | | ms | 8 | 8 |
| Reporting interval | | ms | 1 | 1 |
| Reporting mode | | | PUSCH 1-2 | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000<br>0000000000000<br>0000001111111<br>1111111110000<br>000000000000 | 0000000000000<br>0000000000000<br>0000001111111<br>1111111110000<br>000000000000 |
| CSI request field (Note 3) | | | '10' | |
| PDSCH transmission mode | | | 4 | |
| Note 1: $P_B = 1$.<br>Note 2: If the UE reports in an available uplink reporting instance at 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: Multiple CC-s under test are configured as the 1st set of serving cells by higher layers.<br>Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. | | | | |

**Table 8.2.1.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA**

| Test num. | Band-width | Referencechannel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE cate-gory |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | 2x10 MHz | R.14 FDD | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.8 | ≥3 |
| 2 | 2x20 MHz | R.14-3 FDD | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.9 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

### 8.2.1.5 MU-MIMO

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

### 8.2.1.7 Carrier aggregation with power imbalance

The requirements in this section verify the ability of an intraband adjancent carrier aggregation UE to demodulate the signal transmitted by the PCell in the presence of a stronger SCell signal on an adjacent frequency. Throughput is measured on the PCell only.

#### 8.2.1.7.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.1.7.1-2, with the addition of the parameters in Table 8.2.1.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.7.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | 0 |
| $\hat{E}_{s\_PCell}$ at antenna port of PCell | | dBm/15kHz | -85 |
| $\hat{E}_{s\_SCell}$ at antenna port of Scell | | dBm/15kHz | -79 |
| $N_{oc}$ at antenna port | | dBm/15kHz | Off (Note 2) |
| Symbols for unused PRBs | | | OCNG (Note 3) |
| Modulation | | | 64 QAM |
| Maximum number of HARQ transmission | | | 1 |
| Redundancy version coding sequence | | | {0} |
| PDSCH transmission mode of PCell | | | 1 |
| PDSCH tramsmission mode of SCell | | | 3 |

Note 1: $P_B = 0$.
Note 2: No external noise sources are applied
Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated. pseudo random data.
Note 4: Void.

**Table 8.2.1.7.1-2: Minimum performance (FRC) for CA**

| Test Number | Band-width | Reference Channel | | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna | | Reference value Fraction of Maximum Throughput (%) | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PCell | SCell | PCell | SCell | PCell | SCell | PCell | SCell | PCell | SCell | |
| 1 | 2x20MHz | R.49 FDD | NA | OP.1 FDD | OP.5 FDD | Clause B.1 | Clause B.1 | 1x2 | 2x2 | 85% | NA | ≥5 |

Note 1: The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH.
Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

## 8.2.1.8 Intra-band non-contiguous carrier aggregation with timing offset

The requirements in this section verify the ability of an intraband non-contiguous carrier aggregation UE to demodulate the signal transmitted by the PCell and SCell in the presence of timing offset between the cells. Throughput is measured on both cells.

### 8.2.1.8.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.1.8.1-2, with the addition of the parameters in Table 8.2.1.8.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.8.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Modulation | | | 64 QAM |
| Maximum number of HARQ transmission | | | 4 |
| Redundancy version coding sequence | | | {0,0,1,2} |
| PDSCH transmission mode of PCell | | | 3 |
| PDSCH tramsmission mode of SCell | | | 3 |
| Note 1: $P_B = 1$.<br>Note 2: The OCNG pattern is used to fill unused control channel and PDSCH. | | | |

**Table 8.2.1.8.1-2: Minimum performance (FRC) for CA**

| Test Number | Cell | Band-width | Reference Channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and Antenna | Refence value | | Timing relative to PCell (μs) | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | | |
| 1 | PCell | 10MHz | R.60 FDD | OP.1 FDD | EPA200 | 2x2 Low | 70 | 21.15 | N/A | ≥3 |
| | SCell | 10MHz | R.35-3 FDD | | EPA200 | 2x2 Low | 60 | 15.18 | -30.26 | |
| Note 1: The EPA200 propagation channels applied to PCell and SCell are statistically independent.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | | | |

## 8.2.2 TDD (Fixed Reference Channel)

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

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

| Parameter | Unit | Value |
|---|---|---|
| Uplink downlink configuration (Note 1) | | 1 |
| Special subframe configuration (Note 2) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 7 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cross carrier scheduling | | Not configured |
| 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

For single carrier the requirements are specified in Table 8.2.2.1.1-2, with the addition of the parameters in Table 8.2.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.2.1.1-4, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.2.2.1.1-1: Test Parameters**

| Parameter | | Unit | Test 1- 5 | Test 6- 8 | Test 9- 15 | Test 16- 18 | Test 19 |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | σ | dB | 0 | 0 | 0 | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) | OCNG (Note 2) |
| Modulation | | | QPSK | 16QAM | 64QAM | 16QAM | QPSK |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing | Multiplexing | Multiplexing | Multiplexing |
| PDSCH transmission mode | | | 1 | 1 | 1 | 1 | 1 |

Note 1: $P_B = 0$
Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
Note 3: Void.
Note 4: Void.

**Table 8.2.2.1.1-2: Minimum performance (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.2 | ≥1 |
| 2 | 10 MHz | R.2 TDD | OP.1 TDD | ETU70 | 1x2 Low | 70 | -0.6 | ≥1 |
| 3 | 10 MHz | R.2 TDD | OP.1 TDD | ETU300 | 1x2 Low | 70 | -0.2 | ≥1 |
| 4 | 10 MHz | R.2 TDD | OP.1 TDD | HST | 1x2 | 70 | -2.6 | ≥1 |
| 5 | 1.4 MHz | R.4 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 0.0 | ≥1 |
| 6 | 10 MHz | R.3 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 6.7 | ≥2 |
| | 5 MHz | R.3-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 6.7 | 1 |
| 7 | 10 MHz | R.3 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 1.4 | ≥2 |
| | 5 MHz | R.3-1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 1.4 | 1 |
| 8 | 10 MHz | R.3 TDD | OP.1 TDD | ETU300 | 1x2 High | 70 | 9.3 | ≥2 |
| | 5 MHz | R.3-1 TDD | OP.1 TDD | ETU300 | 1x2 High | 70 | 9.3 | 1 |
| 9 | 3 MHz | R.5 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥1 |
| 10 | 5 MHz | R.6 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥2 |
| | 5 MHz | R.6-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 1 |
| 11 | 10 MHz | R.7 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥2 |
| | 10 MHz | R.7-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.6 | 1 |
| 12 | 10 MHz | R.7 TDD | OP.1 TDD | ETU70 | 1x2 Low | 70 | 19.1 | ≥2 |
| | 10 MHz | R.7-1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 70 | 19.1 | 1 |
| 13 | 10 MHz | R.7 TDD | OP.1 TDD | EVA5 | 1x2 High | 70 | 19.1 | ≥2 |
| | 10 MHz | R.7-1 TDD | OP.1 TDD | EVA5 | 1x2 High | 70 | 19.1 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 14 | 15 MHz | R.8 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.8 | ≥2 |
| | 15 MHz | R.8-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.8 | 1 |
| 15 | 20 MHz | R.9 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | ≥3 |
| | 20 MHz | R.9-2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | 2 |
| | 20 MHz | R.9-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | 17.7 | 1 |
| 16 | 3 MHz | R.0 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1 | ≥1 |
| 17 | 10 MHz | R.1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.0 | ≥1 |
| 18 | 20 MHz | R.1 TDD | OP.1 TDD | ETU70 | 1x2 Low | 30 | 2.1 | ≥1 |
| 19 | 10 MHz | R.41 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -5.3 | ≥1 |
| Note 1: Void | | | | | | | | |

**Table 8.2.2.1.1-3: Test Parameters for CA**

| Parameter | | Unit | 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 unused PRBs | | | OCNG (Note 2) |
| Modulation | | | QPSK |
| ACK/NACK feedback mode | | | PUCCH format 1b with channel selection |
| PDSCH transmission mode | | | 1 |
| Note 1: $P_B = 0$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 3: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.2.1.1-4: Minimum performance (FRC) for CA**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20MHz | R.42 TDD | OP.1 TDD (Note 1) | EVA5 | 1x2 Low | 70 | -1.2 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

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

**Table 8.2.2.1.4-2: Minimum performance 1PRB (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.29 TDD | OP.3 TDD | ETU70 | 1x2 Low | 30 | 2.0 | ≥1 |

## 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 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 |

### 8.2.2.2.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.2.2.2-2, with the addition of the parameters in Table 8.2.2.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC-FSTD) with 4 transmitter antennas.

**Table 8.2.2.2.2-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | Multiplexing |
| PDSCH transmission mode | | | 2 |
| Note 1: $P_B = 1$ | | | |

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

| Test number | 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 |
| 2 | 10 MHz | R.13 TDD | OP.1 TDD | ETU70 | 4x2 Low | 70 | -0.5 | ≥1 |

### 8.2.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

The requirements are specified in Table 8.2.2.2.3-2, with the addition of parameters in Table 8.2.2.2.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Table 8.2.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.2.2.3-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -102 (Note 2) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -94.8 (Note 4) | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.2.2.2.3-2 | 6 |
| BW<sub>Channel</sub> | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 1 |
| ABS pattern (Note 5) | | | N/A | 0000010001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A |
| CSI Subframe Sets (Note 7) | $C_{CSI,0}$ | | 0000010001 0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100101000 1100111000 | N/A |
| Number of control OFDM symbols | | | 2 | 2 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PDSCH transmission mode | | | 2 | N/A |
| Cyclic prefix | | | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.
Note 5: ABS pattern as defined in [9].
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 9: SIB-1 will not be transmitted in Cell2 in this test.

**Table 8.2.2.2.3-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) (Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11-4 TDD (Note 4) | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | 2x2 Medium | 70 | 3.8 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\widehat{E}_s / N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

#### 8.2.2.2.3A Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.2.2.2.3A-2, with the addition of parameters in Table 8.2.2.2.3A-1. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.2.3A-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.2.3A-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.2.2.2.3A-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 5) | | | N/A | 0000000001 0000000001 | 0000000001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 0000000001 0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000 1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| PDSCH transmission mode | | | 2 | Note 9 | Note 9 |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: $P_B = 1$.

Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.

Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.

Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS

Note 5: ABS pattern as defined in [9].

Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]

Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].

Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.

Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.

Note 10: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.

Note 11: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.

**Table 8.2.2.2.3A-2: Minimum Performance Transmit Diversity (FRC)**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11-4 TDD Note 4 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Medium | 70 | 3.5 | ≥2 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3..<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.<br>Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.<br>Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms. | | | | | | | | | | | |

#### 8.2.2.2.4 Enhanced Performance Requirement Type A – 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.2.2.2.4-2, with the addition of parameters in Table 8.2.2.2.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.2.2.2.4-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.4-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 | -3 |
| | σ | dB | 0 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| DIP (Note 2) | | dB | N/A | -1.73 | -8.66 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 2 |
| Number of control OFDM symbols | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 2 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.5.2 | As specified in clause B.5.2 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | % | N/A | 80 | 80 |
| | Rank 2 | % | N/A | 20 | 20 |
| Reporting interval | | ms | 5 | N/A | N/A |
| Reporting mode | | | PUCCH 1-0 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 5) | N/A | N/A |
| cqi-pmi-ConfigurationIndex | | | 4 | N/A | N/A |

Note 1: $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.

Note 4: All cells are time-synchronous.

Note 5: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.

**Table 8.2.2.2.4-2: Enhanced Performance Requirement Type A, Transmit Diversity (FRC) with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.46 TDD | OP.1 TDD | N/A | N/A | EVA70 | EVA70 | EVA70 | 2x2 Low | 70 | -1.4 | ≥1 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.

Note 2: SINR corresponds to $\hat{E}_s/N_{oc}'$ of Cell 1 as defined in clause 8.1.1.

Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.2.3 Open-loop spatial multiplexing performance

#### 8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier the requirements are specified in Table 8.2.2.3.1-2, with the addition of the parameters in Table 8.2.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.2.3.1-4, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas. The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| 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 | | | Bundling |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$<br>Note 2: Void.<br>Note 3: Void. | | | |

**Table 8.2.2.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.11-1 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.1 | ≥2 |
| 2 | 10 MHz | R.35 TDD | OP.1 TDD | EVA200 | 2x2 Low | 70 | 20.3 | ≥2 |
| 3 | 10 MHz | R.35-2 TDD | OP.1 TDD | ETU300 | 2x2 Low | 70 | 20.3 | ≥2 |
| Note 1: Void | | | | | | | | |

**Table 8.2.2.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| 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 | | | PUCCH format 1b with channel selection |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$<br>Note 2: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.2.3.1-4: Minimum performance Large Delay CDD (FRC) for CA**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 2x20 MHz | R.30-1 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.7 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

### 8.2.2.3.1A Soft buffer management test

For CA the requirements are specified in Table 8.2.2.3.1A-2, with the addition of the parameters in Table 8.2.2.3.1A-1 and the downlink physical channel setup according toAnnex C.3.2. The purpose is to verify UE performance with proper instantaneous buffer implementation.

**Table 8.2.2.3.1A-1: Test Parameters for soft buffer management test (FRC) for CA**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | - (Note 2) |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$<br>Note 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK.<br>Note 3: For CA test cases, the same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.2.3.1A-2: Minimum performance soft buffer management test (FRC) for CA**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20 MHz | R.30-2 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.2 | 3 |
| 2 | 2x20 MHz | R.35-1 TDD | OP.1 TDD (Note 1) | EVA5 | 2x2 Low | 70 | 15.7 | 4 |
| Note 1: For CA test cases, the OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

### 8.2.2.3.2 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) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | Bundling |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$. | | | |

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

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

### 8.2.2.3.3 Minimum Requirement 2Tx antenna port (demodulation subframe overlaps with aggressor cell ABS)

The requirements for non-MBSFN ABS are specified in Table 8.2.2.3.3-2, with the addition of parameters in Table 8.2.2.3.3-1 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The requirements for MBSFN ABS are specified in Table 8.2.2.3.3-4, with the addition of parameters in Table 8.2.2.3.3-3 and the downlink physical channel setup according to Annex C.3.2 and Annex C.3.3.

The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell. In Tables 8.2.2.3.3-1 and 8.2.2.3.3-3, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.2.2.3.3-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -102 (Note 2) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -94.8 (Note 4) | N/A |
| $\hat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.2.2.3.3-2 | 6 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | 1 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| ABS pattern (Note 5) | | | N/A | 0000010001, 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001, 0000000001 | N/A |
| CSI Subframe Sets (Note 7) | $C_{CSI,0}$ | | 0000010001, 0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100101000 1100111000 | N/A |
| Number of control OFDM symbols | | | 2 | 2 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PDSCH transmission mode | | | 3 | N/A |
| Cyclic prefix | | | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.
Note 5: ABS pattern as defined in [9].
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 9: SIB-1 will not be transmitted in Cell2 in this test.

**Table 8.2.2.3.3-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) (Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11 TDD (Note 4) | OP.1 TDD | OP.1 TDD | EVA 5 | EVA 5 | 2x2 Low | 70 | 14.0 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\widehat{E}_s / N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

**Table 8.2.2.3.3-3: Test Parameters for Large Delay CDD (FRC) – MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -102 (Note 2) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -94.8 (Note 4) | N/A |
| $\hat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.2.2.3.3-4 | 6 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN |
| Cell Id | | | 0 | 126 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| ABS pattern (Note 5) | | | N/A | 0000000001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A |
| CSI Subframe Sets (Note 7) | $C_{CSI,0}$ | | 0000000001 0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100111000 1100111000 | N/A |
| MBSFN Subframe Allocation (Note 10) | | | N/A | 000010 |
| Number of control OFDM symbols | | | 2 | 2 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PDSCH transmission mode | | | 3 | N/A |
| Cyclic prefix | | | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10,#11, #12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbol #0 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS.
Note 5: ABS pattern as defined in [9]. The 10th and 20th subframes indicated by ABS pattern are MBSFN ABS subframes.
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 9: SIB-1 will not be transmitted in Cell2 in this test.
Note 10: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.

**Table 8.2.2.3.3-4: Minimum Performance Large Delay CDD (FRC) – MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) Note 5) | SNR (dB) (Note 2) | |
| 1 | R.11 TDD (Note 4) | OP.1 TDD | OP.1 TDD | EVA 5 | EVA 5 | 2x2 Low | 70 | 12.2 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

#### 8.2.2.3.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements for non-MBSFN ABS are specified in Table 8.2.2.3.4-2, with the addition of parameters in Table 8.2.2.3.4-1. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.3.4-1, Cell 1 is the serving cell, and Cell 2 and Cell3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.3.4-1: Test Parameters for Large Delay CDD (FRC) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.2.2.3.4-2 | Reference Value in Table 8.2.2.3.4-2 | Reference Value in Table 8.2.2.3.4-2 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 1 | 126 |
| ABS pattern (Note 5) | | | N/A | 0000000001 0000000001 | 0000000001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 0000000001 0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000 1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| PDSCH transmission mode | | | 3 | Note 9 | Note 9 |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 5: ABS pattern as defined in [9].
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.
Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.
Note 10: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.
Note 11: SIB-1 will not be transmitted in Cell2 and Cell 3 in this test.

**Table 8.2.2.3.4-2: Minimum Performance Large Delay CDD (FRC) – Non-MBSFN ABS**

| Test Number | Reference Channel | $\widehat{E}_s/N_{oc2}$ | | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11 TDD Note 4 | 9 | 7 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 14.2 | ≥2 |
| 2 | R.35 TDD Note 4 | 9 | 1 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 22.7 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\widehat{E}_s/N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

## 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) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 6 | 50 |
| PMI delay (Note 2) | | ms | 10 or 11 | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap | | | 001111 | 001111 |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| PDSCH transmission mode | | | 4 | 4 |

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at subrame SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).
Note 3: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.

**Table 8.2.2.4.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.10 TDD | OP.1 TDD | EVA5 | 2x2 Low | 70 | -3.1 | ≥1 |
| 2 | 10 MHz | R.10 TDD | OP.1 TDD | EPA5 | 2x2 High | 70 | -2.8 | ≥1 |

### 8.2.2.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| 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 | | | 0000000000000000<br>0000000000000000<br>0000000000000111<br>1111111111111 |
| 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 |

### 8.2.2.4.1B Enhanced Performance Requirement Type A – Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.2.4.1B-2, with the addition of the parameters in Table 8.2.2.4.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 4 interference model defined in clause B.5.3. In Table 8.2.2.4.1B-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.4.1B-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 | -3 |
| | σ | dB | 0 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| DIP (Note 2) | | dB | N/A | -1.73 | -8.66 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 2 |
| Number of control OFDM symbols | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 6 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.5.3 | As specified in clause B.5.3 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | % | N/A | 80 | 80 |
| | Rank 2 | % | N/A | 20 | 20 |
| Precoding granularity | | PRB | 50 | 6 | 6 |
| PMI delay (Note 4) | | ms | 10 or 11 | N/A | N/A |
| Reporting interval | | ms | 5 | N/A | N/A |
| Reporting mode | | | PUCCH 1-1 | N/A | N/A |
| CodeBookSubsetRestriction bitmap | | | 1111 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 6) | N/A | N/A |
| cqi-pmi-ConfigurationIndex | | | 4 | N/A | N/A |

Note 1: $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.

Note 4: If the UE reports in an available uplink reporting instance at 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 5: All cells are time-synchronous.

Note 6: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.

**Table 8.2.2.4.1B-2: Enhanced Performance Requirement Type A, Single-Layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.47 TDD | OP.1 TDD | N/A | N/A | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 1.1 | ≥1 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | |
| Note 2: SINR corresponds to $\widehat{E}_s/N_{oc}'$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

#### 8.2.2.4.1C Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.2.2.4.1C-2, with the addition of parameters in Table 8.2.2.4.1C-1. The purpose is to verify the closed loop rank-one performance with wideband precoding if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.2.2.4.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.2.2.4.1C-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.2.2.4.1C-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 5) | | | N/A | 0000000001 0000000001 | 0000000001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 0000000001 0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000 1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| ACK/NACK feeback mode | | | Multiplexing | N/A | N/A |
| PDSCH transmission mode | | | 6 | Note 9 | Note 9 |
| Precoding granularity | | PRB | 50 | N/A | N/A |
| PMI delay (Note 10) | | ms | 10 or 11 | N/A | N/A |
| Reporting interval | | ms | 1 or 4 (Note 11) | N/A | N/A |
| Peporting mode | | | PUSCH 3-1 | N/A | N/A |
| CodeBookSubsetRestriction bitmap | | | 1111 | N/A | N/A |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: $P_B = 1$.
Note 2: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 5: ABS pattern as defined in [9].
Note 6: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 7: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.
Note 9: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.
Note 10: 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 11: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.
Note 12: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.
Note 13: SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test.

**Table 8.2.2.4.1C-2: Minimum Performance Single-Layer Spatial Multiplexing (FRC)– Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11 TDD Note 4 | OP.1 TDD | OP.1 FDD | OP.1 TDD | EPA5 | EPA5 | EPA5 | 2x2 High | 70 | 6.4 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

### 8.2.2.4.2 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 |
| 2 | 10 MHz | R.11-1 TDD | OP.1 TDD | ETU70 | 2x2 Low | 70 | 13.9 | ≥2 |

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

For single carrier the requirements are specified in Table 8.2.2.4.3-2, with the addition of the parameters in Table 8.2.2.4.3-1 and the downlink physical channel setup according to Annex C.3.2. For CA the requirements are specified in Table 8.2.2.4.3-4, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | 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 | | | 0000000000000000000000000000000111111111111111110000000000000000 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$.<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: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Void.<br>Note 5: Void.<br>Note 6: Void. | | | |

**Table 8.2.2.4.3-2: Minimum performance Multi-Layer Spatial Multiplexing (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.36 TDD | OP.1 TDD | EPA5 | 4x2 Low | 70 | 15.7 | ≥2 |
| Note 1: Void | | | | | | | | |

**Table 8.2.2.4.3-3: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter | | Unit | 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 | 8 |
| PMI delay (Note 2) | ms | 10 or 11 |
| Reporting interval | ms | 1 or 4 (Note 3) |
| Reporting mode | | PUSCH 1-2 |
| ACK/NACK feedback mode | | PUCCH format 1b with channel selection |
| CodeBookSubsetRestriction bitmap | | 000000000000000000000000000<br>0000111111111111111100000000<br>00000000 |
| CSI request field (Note 4) | | '10' |
| PDSCH transmission mode | | 4 |
| Note 1: $P_B = 1$.<br>Note 2: If the UE reports in an available uplink reporting instance at 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: For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms.<br>Note 4: Multiple CC-s under test are configured as the 1st set of serving cells by high layers.<br>Note 5: The same PDSCH transmission mode is applied to each component carrier. | | |

**Table 8.2.2.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Cat |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20 MHz | R.43 TDD | OP.1 TDD (Note 1) | EVA5 | 4x2 Low | 70 | 11.1 | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

### 8.2.2.5 MU-MIMO

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

### 8.2.2.7 Carrier aggregation with power imbalance

The requirements in this section verify the ability of an intraband adjancent carrier aggregation UE to demodulate the signal transmitted by the PCell in the presence of a stronger SCell signal on an adjacent frequency. Throughput is measured on the PCell only.

#### 8.2.2.7.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.2.7.1-2, with the addition of the parameters in Table 8.2.2.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.7.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | 0 |
| $\hat{E}_{s\_PCell}$ at antenna port of PCell | | dBm/15kHz | -85 |
| $\hat{E}_{s\_SCell}$ at antenna port of Scell | | dBm/15kHz | -79 |
| $N_{oc}$ at antenna port | | dBm/15kHz | Off (Note 2) |
| Symbols for unused PRBs | | | OCNG (Note 3) |
| Modulation | | | 64 QAM |
| Maximum number of HARQ transmission | | | 1 |
| Redundancy version coding sequence | | | {0} |
| PDSCH transmission mode of PCell | | | 1 |
| PDSCH transmission mode of SCell | | | 3 |
| Note 1: $P_B = 0$.<br>Note 2: No external noise sources are applied.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data.<br>Note 4: Void. | | | |

**Table 8.2.2.7.1-2: Minimum performance (FRC) for CA**

| Test Number | Band-width | Reference Channel | | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna | | Reference value Fraction of Maximum Throughput (%) | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PCell | SCell | PCell | SCell | PCell | SCell | PCell | SCell | PCell | SCell | |
| 1 | 2x20MHz | R.49 TDD | NA | OP.1 TDD | OP.5 TDD | Clause B.1 | Clause B.1 | 1x2 | 2x2 | 85% | NA | ≥5 |
| Note 1: The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | | | | | |

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

## 8.3.1 FDD

The parameters specified in Table 8.3.1-1 are valid for FDD unless otherwise stated.

**Table 8.3.1-1: Common Test Parameters for User-specific Reference Symbols**

| Parameter | Unit | Value |
|---|---|---|
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 2 |
| Precoder update granularity | | Frequency domain: 1 PRG for Transmission mode 9 and 10<br>Time domain: 1 ms |
| Note 1: Void.<br>Note 2: Void. | | |

### 8.3.1.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.1.1-1 and 8.3.1.1-2, with the addition of the parameters in Table 8.3.1.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.3.1.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

<table>
<tr><th colspan="2">parameter</th><th>Unit</th><th>Test 1</th><th>Test 2</th></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>0</td><td>0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>0 (Note 1)</td><td>0 (Note 1)</td></tr>
<tr><td>σ</td><td>dB</td><td>-3</td><td>-3</td></tr>
<tr><td colspan="2">Beamforming model</td><td></td><td>Annex B.4.1</td><td>Annex B.4.1</td></tr>
<tr><td colspan="2">Cell-specific reference signals</td><td></td><td colspan="2">Antenna ports 0,1</td></tr>
<tr><td colspan="2">CSI reference signals</td><td></td><td>Antenna ports 15,…,18</td><td>Antenna ports 15,…,18</td></tr>
<tr><td colspan="2">CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$</td><td>Subframes</td><td>5 / 2</td><td>5 / 2</td></tr>
<tr><td colspan="2">CSI reference signal configuration</td><td></td><td>0</td><td>3</td></tr>
<tr><td colspan="2">Zero-power CSI-RS configuration $I_{\text{CSI-RS}}$ / ZeroPowerCSI-RS bitmap</td><td>Subframes / bitmap</td><td>3 / 0001000000000000</td><td>3 / 0001000000000000</td></tr>
<tr><td colspan="2">$N_{oc}$ at antenna port</td><td>dBm/15kHz</td><td>-98</td><td>-98</td></tr>
<tr><td colspan="2">Symbols for unused PRBs</td><td></td><td>OCNG (Note 4)</td><td>OCNG (Note 4)</td></tr>
<tr><td colspan="2">Number of allocated resource blocks (Note 2)</td><td>PRB</td><td>50</td><td>50</td></tr>
<tr><td colspan="2">Simultaneous transmission</td><td></td><td>No</td><td>Yes (Note 3, 5)</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>9</td><td>9</td></tr>
<tr><td colspan="5">Note 1: $P_B = 1$.<br>Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.<br>Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.<br>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 5: The two UEs' scrambling identities $n_{\text{SCID}}$ are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.</td></tr>
</table>

**Table 8.3.1.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

<table>
<tr><th rowspan="2">Test number</th><th rowspan="2">Bandwidth and MCS</th><th rowspan="2">Reference Channel</th><th rowspan="2">OCNG Pattern</th><th rowspan="2">Propagation Condition</th><th rowspan="2">Correlation Matrix and Antenna Configuration</th><th colspan="2">Reference value</th><th rowspan="2">UE Category</th></tr>
<tr><th>Fraction of Maximum Throughput (%)</th><th>SNR (dB)</th></tr>
<tr><td>1</td><td>10 MHz QPSK 1/3</td><td>R.43 FDD</td><td>OP.1 FDD</td><td>EVA5</td><td>2x2 Low</td><td>70</td><td>-1</td><td>≥1</td></tr>
</table>

**Table 8.3.1.1-3: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 2 | 10 MHz 64QAM 1/2 | R.50 FDD | OP.1 FDD | EPA5 | 2x2 Low | 70 | 21.9 | ≥2 |
| Note 1: The reference channel applies to both the input signal under test and the interfering signal. | | | | | | | | |

### 8.3.1.1A Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.1.1A-2, with the addition of the parameters in Table 8.3.1.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.3.1.1A-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2, respectively.

**Table 8.3.1.1A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model**

| parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 | N/A |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 2 | N/A |
| CSI reference signal configuration | | | 0 | N/A |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A |
| DIP (Note 2) | | dB | N/A | -1.73 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal |
| Cell Id | | | 0 | 126 |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | 9 | N/A |
| Beamforming model | | | As specified in clause B.4.3 (Note 4, 5) | N/A |
| Interference model | | | N/A | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | | N/A | 70 |
| | Rank 2 | | N/A | 30 |
| Precoder update granularity | | PRB | 50 | 6 |
| PMI delay (Note 5) | | Ms | 8 | N/A |
| Reporting interval | | Ms | 5 | N/A |
| Reporting mode | | | PUCCH 1-1 | N/A |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111 | N/A |
| Symbols for unused PRBs | | | OCNG (Note 6) | N/A |
| Simultaneous transmission | | | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 8) | N/A |
| cqi-pmi-ConfigurationIndex | | | 5 | N/A |

Note 1: $P_B = 1$
Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.
Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.

| | |
|---|---|
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI. |
| Note 5: | If the UE reports in an available uplink reporting instance at 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 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |
| Note 7: | All cells are time-synchronous. |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |

**Table 8.3.1.1A-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.48 FDD | OP.1 FDD | N/A | EVA5 | EVA5 | 4x2 Low | 70 | -1.1 | ≥1 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. | | | | | | | | | |
| Note 2: SINR corresponds to $\widehat{E}_s/N_{oc}{}'$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. | | | | | | | | | |

#### 8.3.1.1B Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.3.1.1B-2, with the addition of parameters in Table 8.3.1.1B-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.3.1.1B-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.1.1B-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 |
| | $\rho_B$ | dB | 0 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | -3 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.3.1.1B-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 1 | 126 |
| Cell-specific reference signals | | | Antenna ports 0,1 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 2 | N/A | N/A |
| CSI reference signal configuration | | | 8 | N/A | N/A |
| Zero-power CSI-RS configuration ICSI-RS / ZeroPowerCSI-RS bitmap | | Subframes / bitmap | 3 / 0010000000000000 | N/A | N/A |
| ABS pattern (Note 5) | | | N/A | 11000000 11000000 11000000 11000000 11000000 | 11000000 11000000 11000000 11000000 11000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 10000000 10000000 10000000 10000000 10000000 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 11000000 11000000 11000000 11000000 11000000 | N/A | N/A |
| | $C_{CSI,1}$ | | 00111111 00111111 00111111 00111111 00111111 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| PDSCH transmission mode | | | TM9-1layer | Note 9 | Note 9 |
| Precoding granularity | | | Frequency domain: 1 PRG Time domain: 1 ms | N/A | N/A |
| Beamforming model | | | Annex B.4.1 | N/A | N/A |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | $P_B = 1$. |
| Note 2: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 4: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 5: | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 6: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]. |
| Note 7: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 8: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern. |
| Note 9: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5. |
| Note 10: | If the UE reports in an available uplink reporting instance at 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 11: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same. |
| Note 12: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test. |
| Note 13: | The modulation symbols of the signal under test are mapped onto antenna port 7 or 8. |

**Table 8.3.1.1B-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.51 FDD | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | | | 2x2 Low | 70 | 7.8 | ≥2 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | |
| Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |
| Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | | | |

### 8.3.1.2 Dual-Layer Spatial Multiplexing

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.1.2-2, with the addition of the parameters in Table 8.3.1.2-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.3.1.2-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter | | Unit | Test 1 | |
|---|---|---|---|---|
| | | | Cell 1 | Cell 2 |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| | PDSCH_RA | dB | 4 | NA |
| | PDSCH_RB | dB | 4 | NA |

| | | | |
|---|---|---|---|
| Cell-specific reference signals | | Antenna ports 0 and 1 | Antenna ports 0 and 1 |
| Cell ID | | 0 | 126 |
| CSI reference signals | | Antenna ports 15,16 | NA |
| Beamforming model | | Annex B.4.2 | NA |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | 5 / 2 | NA |
| CSI reference signal configuration | | 8 | NA |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | Subframes / bitmap | 3 / 0010000000000000 | NA |
| $N_{oc}$ at antenna port | dBm/15kHz | -98 | -98 |
| $\hat{E}_s/N_{oc}$ | | Reference Value in Table 8.3.1.2-2 | 7.25dB |
| Symbols for unused PRBs | | OCNG (Note 2) | NA |
| Number of allocated resource blocks (Note 2) | PRB | 50 | NA |
| Simultaneous transmission | | No | NA |
| PDSCH transmission mode | | 9 | Blanked |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.1.2-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | | Propagation Condition | | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.51 FDD | OP.1 FDD | N/A | ETU5 | ETU5 | 2x2 Low | 70 | 14.2 | 2-8 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. | | | | | | | | | | |

### 8.3.1.3 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

#### 8.3.1.3.1 Minimum requirement with Same Cell ID (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.1.3.1-3, with the additional parameters in Table 8.3.1.3.1-1 and Table 8.3.1.3.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' (PQI) signalling defined in [6], configured according to Table

8.3.1.3.1-2. In Table 8.3.1.3.1-1 and 8.3.1.3.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | (Note 2) |
| CSI-RS 0 antenna ports | | | NA | Port {15,16} |
| *qcl-CSI-RS-ConfigNZPId-r11,* CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | Subframes | NA | 5/2 |
| *qcl-CSI-RS-ConfigNZPId-r11,* CSI-RS 0 configuration | | | NA | 8 |
| *csi-RS-ConfigZPId-r11,* Zero-power CSI-RS 0 configuration $I_{\text{CSI-RS}}$ / *ZeroPower CSI-RS* bitmap | | | NA | 2/ 0000010000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| $\hat{E}_s/N_{oc}$ | | dB | Reference point in Table 8.3.1.3.1-3 | Reference point in Table 8.3.1.3.1-3 |
| $BW_{\text{Channel}}$ | | MHz | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal |
| Cell Id | | | 0 | 0 |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | Blanked | 10 |
| Number of allocated PRB | | PRB | NA | 50 |
| *qcl-Operation, '*PDSCH RE Mapping and Quasi-Co-Location Indicator' | | | Type B, '00' | |
| Time offset between TPs | | µs | NA | Reference point in Table 8.3.1.3.1-3 |
| Frequency error between TPs | | Hz | NA | 0 |
| Beamforming model | | | NA | Port 7 as specified in clause B.4.1 |
| Symbols for unused PRBs | | | NA | OCNG (Note 3) |
| Note 1: $P_B = 1$<br>Noet 2: REs for antenna ports 0 and 1 have zero transmission power.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | |

**Table 8.3.1.3.1-2 Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |

| | | | | |
|---|---|---|---|---|
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | Blanked | PDSCH |

**Table 8.3.1.3.1-3: Minimum performance for quasi co-location type B: same Cell ID**

| Test Number | Reference Channel | OGCN pattern | | Time offset between TPs (μs) | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.52 FDD | NA | OP.1 FDD | 2 | EPA5 | EPA5 | 2x2 Low | 70 | 12.1 | ≥2 |
| 2 | R.52 FDD | NA | OP.1 FDD | -0.5 | EPA5 | EPA5 | 2x2 Low | 70 | 12.6 | ≥2 |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 2 as defined in clause 8.1.1. | | | | | | | | | | |

### 8.3.1.3.2 Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources)

The requirements are specified in Table 8.3.1.3.2-3, with the additional parameters in Table 8.3.1.3.2-1 and 8.3.1.3.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' (PQI) signalling defined in [6]. In 8.3.1.3.2-1 and 8.3.1.3.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.1.3.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |

| | | | |
|---|---|---|---|
| Beamforming model | | As specified in clause B.4.1 | As specified in clause B.4.1 |
| Cell-specific reference signals | | Antenna ports 0,1 | (Note 2) |
| CSI reference signals 0 | | Antenna ports {15,16} | N/A |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | 5 / 2 | N/A |
| CSI reference signal 0 configuration | | 0 | N/A |
| CSI reference signals 1 | | N/A | Antenna ports {15,16} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | N/A | 5 / 2 |
| CSI reference signal 1 configuration | | N/A | 8 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmap | Subframes /bitmap | 2/ 0010000000000000 | N/A |
| Zero-power CSI-RS1 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmaps | Subframes /bitmap | N/A | 2/ 0000010000000000 |
| $\hat{E}_s / N_{oc}$ | dB | Reference Value in Table 8.3.1.3.2-3 | Reference Value in Table 8.3.1.3.2-3 |
| $N_{oc}$ at antenna port | dBm/15kHz | -98 | -98 |
| $BW_{Channel}$ | MHz | 10 | 10 |
| Cyclic Prefix | | Normal | Normal |
| Cell Id | | 0 | 0 |
| Number of control OFDM symbols | | 2 | 2 |
| Timing offset between TPs | | N/A | Reference Value in Table 8.3.1.3.2-3 |
| Frequency offset between TPs | Hz | N/A | 0 |
| Number of allocated resource blocks | PRB | 50 | 50 |
| PDSCH transmission mode | | 10 | 10 |
| Probability of occurrence of PDSCH transmission(Note 3) | % | 30 | 70 |
| Symbols for unused PRBs | | OCNG (Note 4) | OCNG (Note 4) |

Note 1: $P_B = 1$

Note 2: REs for antenna ports 0 and 1 have zero transmission power.

Note 3: PDSCH transmission from TPs shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.

Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.1.3.2-2 Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | PDSCH | Blanked |
| PQI set 1 | CSI-RS 1 | ZP CSI-RS 1 | Blanked | PDSCH |

**Table 8.3.1.3.2-3 Performance Requirements for timing offset compensation with DPS transmission**

| Test Number | Timing offset(us) | Reference Channel | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | 2 | R.53 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.2 | ≥2 |
| 2 | -0.5 | R.53 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.5 | ≥2 |
| Note 1: The propagation conditions for TP 1and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of both TP 1 and TP 2 as defined in clause 8.1.1. | | | | | | | | | | |

### 8.3.1.3.3 Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.1.3.3-2, with the additional parameters in Table 8.3.1.3.3-1. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission points have different Cell ID and colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference between two transmission points, channel parameters estimation and rate matching behaviour according to the ‘PDSCH RE Mapping and Quasi-Co-Location Indicator’ signalling defined in [6]. In 8.3.1.3.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.3-1 Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |

| | | | |
|---|---|---|---|
| Beamforming model | | N/A | As specified in clause B.4.2 |
| Cell-specific reference signals | | Antenna ports 0,1 | Antenna ports 0,1 |
| CSI reference signals 0 | | N/A | Antenna ports {15,16} |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | N/A | 5 / 2 |
| CSI reference signal 0 configuration | | N/A | 0 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmap | Subframes /bitmap | N/A | 2/ 0010000000000000 |
| $\hat{E}_s/N_{oc}$ | dB | Reference point in Table 8.3.1.3.3-2 + 4dB | Reference Value in Table 8.3.1.3.3-2 |
| $N_{oc}$ at antenna port | dBm/15kHz | -98 | -98 |
| $BW_{Channel}$ | MHz | 10 | 10 |
| Cyclic Prefix | | Normal | Normal |
| Cell Id | | 0 | 126 |
| Number of control OFDM symbols | | 1 | 2 |
| Timing offset between TPs | us | N/A | 0 |
| Frequency offset between TPs | Hz | N/A | 200 |
| *qcl-Operation,* 'PDSCH RE Mapping and Quasi-Co-Location Indicator' | | Type B, '00' | |
| PDSCH transmission mode | | Blank | 10 |
| Number of allocated resource block | | N/A | 50 |
| Symbols for unused PRBs | | N/A | OCNG(Note2) |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.1.3.3-2 Performance Requirements for quasi co-location type B with different Cell ID and Colliding CRS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.54 FDD | N/A | OP.1 FDD | EPA5 | ETU5 | 2x2 Low | 70 | 14.4 | ≥2 |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of TP 2 as defined in clause 8.1.1. | | | | | | | | | |

## 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 |
| Precoder update granularity | | Frequency domain: 1 PRB for Transmission mode 8, 1 PRG for Transmission mode 9 and 10Time domain: 1 ms |
| ACK/NACK feedback mode | | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4] | | |

### 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: $P_B = 0$.<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | | | |

**Table 8.3.2.1-2: 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 |
| 2 | 10 MHz 16QAM 1/2 | R.26 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 7.0 | ≥2 |
| | 5MHz 16QAM 1/2 | R.26-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 7.0 | 1 |
| 3 | 10 MHz 64QAM 3/4 | R.27 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.0 | ≥2 |
| | 10 MHz 64QAM 3/4 | R.27-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.0 | 1 |
| 4 | 10 MHz 16QAM 1/2 | R.28 TDD | OP.1 TDD | EPA5 | 2x2 Low | 30 | 1.7 | ≥1 |

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2B, the requirements are specified in Table 8.3.2.1-4 and 8.3.2.1-5, with the addition of the parameters in Table 8.3.2.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port.

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

| Parameter | | Unit | Test 1 | Test 2 | Test 3 | Test 4 | Test 5 |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | -3 | -3 | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna port 0 and antenna port 1 | | | | |
| Beamforming model | | | Annex B.4.1 | | | | |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) |
| Simultaneous transmission | | | No | No | No | Yes (Note 3, 5) | Yes (Note 3, 5) |
| PDSCH transmission mode | | | 8 | 8 | 8 | 8 | 8 |
| Note 1: $P_B = 1$.<br>Note 2: The modulation symbols of the signal under test is mapped onto antenna port 7 or 8.<br>Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.<br>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.<br>Note 5: The two UEs' scrambling identities $n_{\mathrm{SCID}}$ 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 |
| 2 | 10 MHz 16QAM 1/2 | R.32 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 7.7 | ≥2 |
| | 5MHz 16QAM 1/2 | R.32-1 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 7.7 | 1 |
| 3 | 10 MHz 64QAM 3/4 | R.33 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.7 | ≥2 |
| | 10 MHz 64QAM 3/4 | R.33-1 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 17.7 | 1 |

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

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

### 8.3.2.1A Single-layer Spatial Multiplexing (with multiple CSI-RS configurations)

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.1A-2 and 8.3.2.1A-3, with the addition of the parameters in Table 8.3.2.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8 with and without a simultaneous transmission on the other antenna port, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.3.2.1A-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter | | Unit | Test 1 | Test 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 signals | | | Antenna ports 0,1 | |
| CSI reference signals | | | Antenna ports 15,…,22 | Antenna ports 15,…,18 |
| Beamforming model | | | Annex B.4.1 | Annex B.4.1 |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | Subframes | 5 / 4 | 5 / 4 |
| CSI reference signal configuration | | | 1 | 3 |
| Zero-power CSI-RS configuration $I_{\text{CSI-RS}}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 4 / 0010000100000000 | 4 / 0010000000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) |
| Number of allocated resource blocks (Note 2) | | PRB | 50 | 50 |
| Simultaneous transmission | | | No | Yes (Note 3, 5) |
| PDSCH transmission mode | | | 9 | 9 |

Note 1: $P_B = 1$.
Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.
Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.
Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
Note 5: The two UEs' scrambling identities $n_{\text{SCID}}$ are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.

**Table 8.3.2.1A-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.50 TDD | OP.1 TDD | EVA5 | 2x2 Low | 70 | -0.6 | ≥1 |

**Table 8.3.2.1A-3: Minimum performance for CDM-multiplexed DM RS with interfering simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 2 | 10 MHz 64QAM 1/2 | R.44 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 22.1 | ≥2 |
| Note 1: The reference channel applies to both the input signal under test and the interfering signal. | | | | | | | | |

### 8.3.2.1B Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.2.1B-2, with the addition of the parameters in Table 8.3.2.1B-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed-loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.5.4. In 8.3.2.1B-1, Cell 1 is the serving cell, and Cell 2 is the interfering cell. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1and Cell 2, respectively.

**Table 8.3.2.1B-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM9 interference model**

| parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 | N/A |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 4 | N/A |
| CSI reference signal configuration | | | 0 | N/A |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A |
| DIP (Note 2) | | dB | N/A | -1.73 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal |
| Cell Id | | | 0 | 126 |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | 9 | N/A |
| Beamforming model | | | As specified in clause B.4.3 (Note 4, 5) | N/A |
| Interference model | | | N/A | As specified in clause B.5.4 |
| Probability of occurrence of transmission rank in interfering cells | Rank 1 | | N/A | 70 |
| | Rank 2 | | N/A | 30 |
| Precoder update granularity | | PRB | 50 | 6 |
| PMI delay (Note 5) | | ms | 10 or 11 | N/A |
| Reporting interval | | ms | 5 | N/A |
| Reporting mode | | | PUCCH 1-1 | N/A |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000<br>0000000000000000<br>0000000000000000<br>1111111111111111 | N/A |
| Symbols for unused PRBs | | | OCNG (Note 6) | N/A |
| Simultaneous transmission | | | No simultaneous transmission on the other antenna port in (7 or 8) not used for the input signal under test | N/A |
| Physical channel for CQI reporting | | | PUSCH(Note 8) | N/A |
| cqi-pmi-ConfigurationIndex | | | 4 | N/A |

Note 1: $P_B = 1$

Note 2: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 3: The modulation symbols of the signal under test in Cell 1 are mapped onto antenna port 7 or 8.

| | |
|---|---|
| Note 4: | The precoder in clause B.4.3 follows UE recommended PMI. |
| Note 5: | If the UE reports in an available uplink reporting instance at 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 6: | These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. |
| Note 7: | All cells are time-synchronous. |
| Note 8: | To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |

**Table 8.3.2.1B-2: Enhanced Performance Requirement Type A, CDM-multiplexed DM RS with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna Configuration (Note 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) | SINR (dB) (Note 2) | |
| 1 | R.48 TDD | OP.1 TDD | N/A | EVA5 | EVA5 | 4x2 Low | 70 | -1.0 | ≥1 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. | | | | | | | | | |
| Note 2: SINR corresponds to $\widehat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2. | | | | | | | | | |

### 8.3.2.1C Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

The requirements are specified in Table 8.3.2.1C-2, with the addition of parameters in Table 8.3.2.1C-1. The purpose is to verify the performance of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell if the PDSCH transmission in the serving cell takes place in subframes that overlap with ABS [9] of the aggressor cell with CRS assistance information. In Table 8.3.2.1C-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] includes Cell 2 and Cell 3.

**Table 8.3.2.1C-1: Test parameters of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 |
| | $\rho_B$ | dB | 0 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | -3 | N/A | N/A |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 3) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 4) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.3.2.1C-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 1 | 126 |
| Cell-specific reference signals | | | Antenna ports 0,1 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 4 | N/A | N/A |
| CSI reference signal configuration | | | 8 | N/A | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 4 / 0010000000000000 | N/A | N/A |
| ABS pattern (Note 5) | | | N/A | 0000000001 0000000001 | 0000000001 0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0000000001 0000000001 | N/A | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 0000000001 0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000 1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| PDSCH transmission mode | | | TM9-1layer | Note 9 | Note 9 |
| Precoding granularity | | | Frequency domain: 1 PRG Time domain: 1 ms | N/A | N/A |
| Beamforming model | | | Annex B.4.1 | N/A | N/A |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | $P_B = 1$. |
| Note 2: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 4: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 5: | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 6: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]. |
| Note 7: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 8: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern. |
| Note 9: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5. |
| Note 10: | If the UE reports in an available uplink reporting instance at 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 11: | For Uplink - downlink configuration 1 the reporting interval will alternate between 1ms and 4ms. |
| Note 12: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same. |
| Note 13: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test. |
| Note 14: | The modulation symbols of the signal under test are mapped onto antenna port 7 or 8. |

**Table 8.3.2.1C-2: Minimum Performance of TM9-Single-Layer (2 CSI-RS ports) – Non-MBSFN ABS**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.51 TDD | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | | | 2x2 Low | 70 | 8.5 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.

### 8.3.2.2 Dual-Layer Spatial Multiplexing

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

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

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) |
| | 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: $P_B = 1$.<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | | |

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

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

### 8.3.2.3 Dual-Layer Spatial Multiplexing (with multiple CSI-RS configurations)

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.3-2, with the addition of the parameters in Table 8.3.2.3-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.3.2.3-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter | | Unit | Test 1 | |
|---|---|---|---|---|
| | | | Cell 1 | Cell 2 |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| | PDSCH_RA | dB | 4 | NA |
| | PDSCH_RB | dB | 4 | NA |

| | | | |
|---|---|---|---|
| Cell-specific reference signals | | Antenna ports 0 and 1 | Antenna ports 0 and 1 |
| Cell ID | | 0 | 126 |
| CSI reference signals | | Antenna ports 15,16 | NA |
| Beamforming model | | Annex B.4.2 | NA |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | 5 / 4 | NA |
| CSI reference signal configuration | | 8 | NA |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | Subframes / bitmap | 4 / 0010000000000000 | NA |
| $N_{oc}$ at antenna port | dBm/15kHz | -98 | -98 |
| $\hat{E}_s/N_{oc}$ | | Reference Value in Table 8.3.2.3-2 | Test specific, 7.25dB |
| Symbols for unused PRBs | | OCNG (Note 2) | NA |
| Number of allocated resource blocks (Note 2) | PRB | 50 | NA |
| Simultaneous transmission | | No | NA |
| PDSCH transmission mode | | 9 | Blanked |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.2.3-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | | Propagation Condition | | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.51 TDD | OP.1 TDD | N/A | ETU5 | ETU5 | 2x2 Low | 70 | 14.8 | 2-8 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of Cell 1 and Cell 2.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. | | | | | | | | | | |

## 8.3.2.4 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

### 8.3.2.4.1 Minimum requirement with Same Cell ID (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.2.4.1-3, with the additional parameters in Table 8.3.2.4.1-1 and Table 8.3.2.4.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' (PQI) signalling defined in [6], configured according to Table

8.3.2.4.1-2. In Table 8.3.2.4.1-1 and 8.3.2.4.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | (Note 2) |
| CSI-RS 0 antenna ports | | | NA | Port {15,16} |
| *qcl-CSI-RS-ConfigNZPId-r11,* CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | NA | 5/4 |
| *qcl-CSI-RS-ConfigNZPId-r11,* CSI-RS 0 configuration | | | NA | 8 |
| *csi-RS-ConfigZPId-r11,* Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmap | | | NA | 4/ 0000010000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| $\hat{E}_s/N_{oc}$ | | dB | Reference point in Table 8.3.2.4.1-3 | Reference point in Table 8.3.2.4.1-3 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal |
| Cell Id | | | 0 | 0 |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | Blanked | 10 |
| Number of allocated PRB | | PRB | NA | 50 |
| *qcl-Operation, '*PDSCH RE Mapping and Quasi-Co-Location Indicator' | | | Type B, '00' | |
| Time offset between TPs | | μs | NA | Reference point in Table 8.3.2.4.1-3 |
| Frequency error between TPs | | Hz | NA | 0 |
| Beamforming model | | | NA | Port 7 as specified in clause B.4.1 |
| Symbols for unused PRBs | | | NA | OCNG (Note 3) |

Note 1: $P_B = 1$
Noet 2: REs for antenna ports 0 and 1 have zero transmission power.
Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.2.4.1-2 Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | Blanked | PDSCH |

**Table 8.3.2.4.1-3: Minimum performance for quasi co-location type B: same Cell ID**

| Test Number | Reference Channel | OGCN pattern | | Time offset between TPs (μs) | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.52 TDD | NA | OP.1 TDD | 2 | EPA5 | EPA5 | 2x2 Low | 70 | 12 | ≥2 |
| 2 | R.52 TDD | NA | OP.1 TDD | -0.5 | EPA5 | EPA5 | 2x2 Low | 70 | 12.4 | ≥2 |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 2 as defined in clause 8.1.1. | | | | | | | | | | |

### 8.3.2.4.2 Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources)

The requirements are specified in Table 8.3.2.4.2-3, with the additional parameters in Table 8.3.2.4.2-1 and 8.3.2.4.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission point share the same Cell ID. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the timing difference between two transmission points, channel parameters estimation and rate matching according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' (PQI) signalling defined in [6]. In8.3.2.4.2-1 and 8.3.2.4.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.2.4.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| Beamforming model | | | As specified in clause B.4.1 | As specified in clause B.4.1 |
| Cell-specific reference signals | | | Antenna ports 0,1 | (Note 2) |
| CSI reference signals 0 | | | Antenna ports {15,16} | N/A |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 4 | N/A |
| CSI reference signal 0 configuration | | | 0 | N/A |
| CSI reference signals 1 | | | N/A | Antenna ports {15,16} |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | N/A | 5 / 4 |
| CSI reference signal 1 configuration | | | N/A | 8 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmap | | Subframes /bitmap | 4/ 0010000000000000 | N/A |
| Zero-power CSI-RS1 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmaps | | Subframes /bitmap | N/A | 4/ 0000010000000000 |
| $\hat{E}_s/N_{oc}$ | | dB | Reference Value in Table 8.3.2.4.2-3 | Reference Value in Table 8.3.2.4.2-3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal |
| Cell Id | | | 0 | 0 |
| Number of control OFDM symbols | | | 2 | 2 |
| Timing offset between TPs | | | N/A | Reference Value in Table 8.3.2.4.2-3 |
| Frequency offset between TPs | | Hz | N/A | 0 |
| Number of allocated resource blocks | | PRB | 50 | 50 |
| PDSCH transmission mode | | | 10 | 10 |
| Probability of occurrence of PDSCH transmission(Note 3) | | % | 30 | 70 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) |

Note 1: $P_B = 1$
Note 2: REs for antenna ports 0 and 1 have zero transmission power.
Note 3: PDSCH transmission from TPs shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified. Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.3.2.4.2-2 Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | PDSCH | Blanked |
| PQI set 1 | CSI-RS 1 | ZP CSI-RS 1 | Blanked | PDSCH |

**Table 8.3.2.4.2-3 Performance Requirements for timing offset compensation with DPS transmission**

| Test Number | Timing offset(us) | Reference Channel | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | 2 | R.53 TDD | OP.1 TDD | OP.1 TDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.3 | ≥2 |
| 2 | -0.5 | R.53 TDD | OP.1 TDD | OP.1 TDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.5 | ≥2 |

Note 1: The propagation conditions for TP 1and TP 2 are statistically independent.
Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.
Note 3: SNR corresponds to $\widehat{E}_s/N_{oc}$ of both TP 1 and TP 2 as defined in clause 8.1.1.

### 8.3.2.4.3 Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.2.4.3-2, with the additional parameters in Table 8.3.2.4.3-1. The purpose of this test is to verify the UE capability of supporting non quasi-colocated antenna ports when the UE receives DCI format 2D in a scenario where the two transmission points have different Cell ID and colliding CRS. In particular the test verifies that the UE, configured with quasi co-location type B, performs correct tracking and compensation of the frequency difference between two transmission points, channel parameters estimation and rate matching behaviour according to the 'PDSCH RE Mapping and Quasi-Co-Location Indicator' signalling defined in [6]. In 8.3.2.4.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.3-1 Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |

| | | | |
|---|---|---|---|
| Beamforming model | | N/A | As specified in clause B.4.2 |
| Cell-specific reference signals | | Antenna ports 0,1 | Antenna ports 0,1 |
| CSI reference signals 0 | | N/A | Antenna ports {15,16} |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | Subframes | N/A | 5 / 4 |
| CSI reference signal 0 configuration | | N/A | 0 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPower CSI-RS* bitmap | Subframes /bitmap | N/A | 4/ 0010000000000000 |
| $\widehat{E}_s/N_{oc}$ | dB | Reference point in Table 8.3.2.4.3-2 + 4dB | Reference Value in Table 8.3.2.4.3-2 |
| $N_{oc}$ at antenna port | dBm/15kHz | -98 | -98 |
| $BW_{Channel}$ | MHz | 10 | 10 |
| Cyclic Prefix | | Normal | Normal |
| Cell Id | | 0 | 126 |
| Number of control OFDM symbols | | 1 | 2 |
| Timing offset between TPs | us | N/A | 0 |
| Frequency offset between TPs | Hz | N/A | 200 |
| *qcl-Operation,* 'PDSCH RE Mapping and Quasi-Co-Location Indicator' | | Type B, '00' | |
| PDSCH transmission mode | | Blank | 10 |
| Number of allocated resource block | | N/A | 50 |
| Symbols for unused PRBs | | N/A | OCNG(Note2) |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.2.4.3-2 Performance Requirements for quasi co-location type B with different Cell ID and Colliding CRS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.54 TDD | N/A | OP.1 TDD | EPA5 | ETU5 | 2x2 Low | 70 | 14.7 | ≥2 |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.<br>Note 3: SNR corresponds to $\widehat{E}_s/N_{oc}$ of TP 2 as defined in clause 8.1.1. | | | | | | | | | |

## 8.4 Demodulation of PDCCH/PCFICH

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

### 8.4.1 FDD

The parameters specified in Table 8.4.1-1 are valid for all FDD tests unless otherwise stated.

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

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Single antenna port</th><th>Transmit diversity</th></tr>
<tr><td colspan="2">Number of PDCCH symbols</td><td>symbols</td><td>2</td><td>2</td></tr>
<tr><td colspan="2">PHICH Ng (Note 1)</td><td></td><td>1</td><td>1</td></tr>
<tr><td colspan="2">PHICH duration</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="2">Unused RE-s and PRB-s</td><td></td><td>OCNG</td><td>OCNG</td></tr>
<tr><td colspan="2">Cell ID</td><td></td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">Downlink power allocation</td><td>PDCCH_RA<br>PHICH_RA<br>OCNG_RA</td><td>dB</td><td>0</td><td>-3</td></tr>
<tr><td>PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB</td><td>dB</td><td>0</td><td>-3</td></tr>
<tr><td colspan="2">$N_{oc}$ at antenna port</td><td>dBm/15kHz</td><td>-98</td><td>-98</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="5">Note 1: According to Clause 6.9 in TS 36.211 [4].</td></tr>
</table>

#### 8.4.1.1 Single-antenna port performance

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

**Table 8.4.1.1-1: Minimum performance PDCCH/PCFICH**

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

#### 8.4.1.2 Transmit diversity performance

##### 8.4.1.2.1 Minimum Requirement 2 Tx Antenna Port

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

**Table 8.4.1.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 4 CCE | R.16 FDD | OP.1 FDD | EVA70 | 2 x 2 Low | 1 | -0.6 |

#### 8.4.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.1.2.2-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 5 MHz | 2 CCE | R.17 FDD | OP.1 FDD | EPA5 | 4 x 2 Medium | 1 | 6.3 |

#### 8.4.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters for non-MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.4.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

For the parameters for MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-4. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.4.1.2.3-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\widehat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.4.1.2.3-2 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 1 |
| ABS pattern (Note 4) | | | N/A | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 | N/A |
| | $C_{CSI,1}$ | | 11111011<br>11111011<br>11111011<br>10111011<br>11111011 | N/A |
| Number of control OFDM symbols | | | 3 | 3 |
| PHICH Ng (Note 9) | | | 1 | N/A |
| PHICH duration | | | Extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7];
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7];
Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 8: SIB-1 will not be transmitted in Cell2 in the test.
Note 9: According to Clause 6.9 in TS 36.211 [4].

**Table 8.4.1.2.3-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-dsg (%) | SNR (dB) (Note 2) |
| 1 | 8 CCE | R15-1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | 2x2 Low | 1 | -3.9 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. | | | | | | | | | |
| Note 2: SNR corresponds to $\widehat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | | |

**Table 8.4.1.2.3-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.1.2.3-4 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 126 |
| ABS pattern (Note 4) | | | N/A | 0001000000<br>0100000010<br>0000001000<br>0000000000 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A |
| | $C_{CSI,1}$ | | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A |
| MBSFN Subframe Allocation (Note 9) | | | N/A | 001000<br>100001<br>000100<br>000000 |
| Number of control OFDM symbols | | | 3 | 3 |
| PHICH Ng (Note 11) | | | 1 | N/A |
| PHICH duration | | | extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

| | |
|---|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 2: | This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 4: | ABS pattern as defined in [9]. The $4^{th}$, $12^{th}$, $19^{th}$ and $27^{th}$ subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]. |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 7: | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same. |
| Note 8: | SIB-1 will not be transmitted in Cell2 in this test. |
| Note 9: | MBSFN Subframe Allocation as defined in [7], four frames with 24 bits is chosen for MBSFN subframe allocation. |
| Note 10: | The maximum number of uplink HARQ transmission is ≤ 2 so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test. |
| Note 11: | According to Clause 6.9 in TS 36.211 [4]. |

**Table 8.4.1.2.3-4: Minimum performance PDCCH/PCHICH – MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-dsg (%) | SNR (dB) (Note 2) |
| 1 | 8 CCE | R15-1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | 2x2 Low | 1 | -4.2 |
| Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent. | | | | | | | | | |
| Note 2: SNR corresponds to $\widehat{E}_s / N_{oc2}$ of cell 1. | | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | | |

### 8.4.1.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

For the parameters for non-MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.4-2.

For the parameters for MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.4-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.4-4.

In Tables 8.4.1.2.4-1 and 8.4.1.2.4-3, Cell 1 is the serving cell, and Cell 2 and Cell3are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.4.1.2.4-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98(Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.4.1.2.4-2 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 4) | | | N/A | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A | N/A |
| | $C_{CSI,1}$ | | 11111011<br>11111011<br>11111011<br>11111011<br>11111011 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 7 | Note 7 |
| PHICH Ng (Note 10) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 2: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 4: | ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]; |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]; |
| Note 7: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern. |
| Note 8: | The number of the CRS ports in Cell1, Cell2 and Cell 3is the same. |
| Note 9: | SIB-1 will not be transmitted in Cell2 and Cell 3 in the test. |
| Note 10: | According to Clause 6.9 in TS 36.211 [4]. |

**Table 8.4.1.2.4-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell3 | | Pm-dsg (%) | SNR (dB) (Note 3) |
| 1 | 8 CCE | R.15-2 FDD | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 1 | -2.2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.

**Table 8.4.1.2.4-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98(Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.1.2.4-4 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN | MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 4) | | | N/A | 0001000000<br>0100000010<br>0000001000<br>0000000000 | 0001000000<br>0100000010<br>0000001000<br>0000000000 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A | N/A |
| | $C_{CSI,1}$ | | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A | N/A |
| MBSFN Subframe Allocation (Note 7) | | | N/A | 001000<br>100001<br>000100<br>000000 | 001000<br>100001<br>000100<br>000000 |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| PHICH Ng (Note 12) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 2: | This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS. |
| Note 3: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 4: | ABS pattern as defined in [9]. The 4th, 12th, 19th and 27th subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]. |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 7: | MBSFN Subframe Allocation as defined in [7], four frames with 24 bits are chosen for MBSFN subframe allocation. |
| Note 8: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern. |
| Note 9: | The maximum number of uplink HARQ transmission is ≤ 2 so that each PHICH channel transmission is in a subframe protected by MBSFN ABS in this test. |
| Note 10: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same. |
| Note 11: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in this test. |
| Note 12: | According to Clause 6.9 in TS 36.211 [4]. |

**Table 8.4.1.2.4-4: Minimum performance PDCCH/PCFICH – MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell3 | | Pm-dsg (%) | SNR (dB) (Note 3) |
| 1 | 8 CCE | R.15-2 FDD | OP.1 FDD | OP.1 FDD | OP.1 FDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 1 | -2.0 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | | | |

## 8.4.2 TDD

The parameters specified in Table 8.4.2-1 are valid for all TDD tests unless otherwise stated.

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

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Uplink downlink configuration (Note 1) | | | 0 | 0 |
| Special subframe configuration (Note 2) | | | 4 | 4 |
| Number of PDCCH symbols | | symbols | 2 | 2 |
| PHICH Ng (Note 3) | | | 1 | 1 |
| PHICH duration | | | Normal | Normal |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | 0 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | 0 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4].<br>Note 3: According to Clause 6.9 in TS 36.211 [4] | | | | |

### 8.4.2.1 Single-antenna port performance

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

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

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

### 8.4.2.2 Transmit diversity performance

#### 8.4.2.2.1 Minimum Requirement 2 Tx Antenna Port

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

**Table 8.4.2.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 4 CCE | R.16 TDD | OP.1 TDD | EVA70 | 2 x 2 Low | 1 | 0.1 |

#### 8.4.2.2.2 Minimum Requirement 4 Tx Antenna Port

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

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

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 5 MHz | 2 CCE | R.17 TDD | OP.1 TDD | EPA5 | 4 x 2 Medium | 1 | 6.5 |

#### 8.4.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters for non-MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3.. In Table 8.4.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

For the parameters for MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.3-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.3-4. The downlink physical channel setup for Cell 1 is according to Annex C3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.4.2.2.3-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.2.2.3-2 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 1 |
| ABS pattern (Note 4) | | | N/A | 0000010001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern(Note 5) | | | 0000000001<br>0000000001 | N/A |
| CSI Subframe Sets(Note 6) | $C_{CSI,0}$ | | 0000010001<br>0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100101000<br>1100111000 | N/A |
| Number of control OFDM symbols | | | 3 | 3 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PHICH Ng (Note 9) | | | 1 | N/A |
| PHICH duration | | | extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 8: SIB-1 will not be transmitted in Cell2 in the test.
Note 9: According to Clause 6.9 in TS 36.211 [4].

**Table 8.4.2.2.3-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-dsg (%) | SNR (dB) (Note 2) |
| 1 | 8 CCE | R15-1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | 2x2 Low | 1 | -3.9 |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.

Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.

Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.

**Table 8.4.2.2.3-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\widehat{E}_s / N_{oc2}$ | | dB | Reference Value in Table 8.4.2.2.3-4 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 126 |
| ABS pattern (Note 4) | | | N/A | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern(Note 5) | | | 0000000001<br>0000000001 | N/A |
| CSI Subframe Sets(Note 6) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | N/A |
| MBSFN Subframe Allocation (Note 9) | | | N/A | 000010 |
| Number of control OFDM symbols | | | 3 | 3 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PHICH Ng (Note 10) | | | 1 | N/A |
| PHICH duration | | | extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.
Note 2: This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. The $10^{th}$ and $20^{th}$ subframes indicated by ABS pattern are MBSFN ABS subframes.PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 8: SIB-1 will not be transmitted in Cell2 in this test.
Note 9: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.
Note 10: According to Clause 6.9 in TS 36.211 [4].

**Table 8.4.2.2.3-4: Minimum performance PDCCH/PCFICH – MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | Propagation Conditions(Note 1) | | Correlation Matrix and Antenna Configuration | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-dsg (%) | SNR (dB) (Note 2) |
| 1 | 8 CCE | R15-1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | 2x2 Low | 1 | -4.1 |

Note 1: The propagation conditions for Cell 1 and Cell2 are statistically independent.
Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.
Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2.

#### 8.4.2.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

For the parameters for non-MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.4-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.4-2.

For the parameters for MBSFN ABS specified in Table 8.4.2-1 and Table 8.4.2.2.4-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.2.2.4-4.

In Tables 8.4.2.2.4-1 and 8.4.2.2.4-3, Cell 1 is the serving cell, and Cell 2 and Cell 3are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.4.2.2.4-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98(Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.2.2.4-2 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 4) | | | N/A | 0000000001<br>0000000001 | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0000000001<br>0000000001 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 7 | Note 7 |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| PHICH Ng (Note 10) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10, #12, #13 of a subframe overlapping with the aggressor ABS.
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PDCCH/PCFICH other than that associated with SIB1/Paging are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7];
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7];
Note 7: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.
Note 8: The number of the CRS ports in Cell1, Cell2 and Cell 3is the same.
Note 9: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.
Note 10: According to Clause 6.9 in TS 36.211 [4].

**Table 8.4.2.2.4-2: Minimum performance PDCCH/PCFICH – Non-MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell3 | | Pm-dsg (%) | SNR (dB) (Note 3) |
| 1 | 8 CCE | R.15-2 TDD | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 1 | -2.0 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.

**Table 8.4.2.2.4-3: Test Parameters for PDCCH/PCFICH – MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98(Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.2.2.4-4 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN | MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 4) | | | N/A | 0000000001<br>0000000001 | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0000000001<br>0000000001 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | N/A | N/A |
| MBSFN Subframe Allocation (Note 7) | | | N/A | 000010 | 000010 |
| Number of control OFDM symbols | | | 2 | Note 8 | Note 8 |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| PHICH Ng (Note 11) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13 of a subframe overlapping with the aggressor ABS.
Note 2: This noise is applied in OFDM symbols #0 of a subframe overlapping with the aggressor ABS.
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. The 10th and 20th subframes indicated by ABS pattern are MBSFN ABS subframes. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the MBSFN ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 7: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.
Note 8: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern.
Note 9: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 10: SIB-1 will not be transmitted in Cell2 in this test.
Note 11: According to Clause 6.9 in TS 36.211 [4].

**Table 8.4.2.2.4-4: Minimum performance PDCCH/PCFICH – MBSFN ABS**

| Test Number | Aggregation Level | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell3 | | Pm-dsg (%) | SNR (dB) (Note 3) |
| 1 | 8 CCE | R.15-2 TDD | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 1 | -1.8 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | | | |

# 8.5 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

The parameters specified in Table 8.5.1-1 are valid for all FDD tests unless otherwise stated.

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

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | 0 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | 0 | -3 |
| PHICH duration | | | Normal | Normal |
| PHICH Ng (Note 1) | | | Ng = 1 | Ng = 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| Note 1: according to Clause 6.9 in TS 36.211 [4] | | | | |

### 8.5.1.1 Single-antenna port performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (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 |

#### 8.5.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.3-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.5.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.5.1.2.3-1: Test Parameters for PHICH**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.5.1.2.3-2 | 1.5 |
| BW$_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 1 |
| ABS pattern (Note 4) | | | N/A | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A |
| CSI Subframe Sets (Note 6) | C$_{CSI,0}$ | | 00000100<br>00000100<br>00000100<br>01000100<br>00000100 | N/A |
| | C$_{CSI,1}$ | | 11111011<br>11111011<br>11111011<br>10111011<br>11111011 | N/A |
| Number of control OFDM symbols | | | 3 | 3 |
| PHICH Ng (Note 9) | | | 1 | N/A |
| PHICH duration | | | extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in the 26$^{th}$ subframe indicated by the ABS pattern.
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]
Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 8: SIB-1 will not be transmitted in Cell2 in the test.
Note 9: According to Clause 6.9 in TS 36.211 [4].

**Table 8.5.1.2.3-2: Minimum performance PHICH**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Antenna Configuration and Correlation Matrix | Reference Value | |
|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-an (%) | SNR (dB) (Note 2) |
| 1 | R.19 | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | 2x2 Low | 0.1 | 4.6 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. | | | | | | | | |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | |

#### 8.5.1.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

For the parameters specified in Table 8.5.1-1 and Table 8.5.1.2.4-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.1.2.4-2. In Table 8.5.1.2.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.5.1.2.4-1: Test Parameters for PHICH**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.5.1.2.4-2 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | N/A | N/A |
| ABS pattern (Note 4) | | | N/A | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A | N/A |
| | $C_{CSI,1}$ | | 11111011<br>11111011<br>11111011<br>11111011<br>11111011 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 7 | Note 7 |
| PHICH Ng (Note 10) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS |
| Note 2: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS |
| Note 3: | This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 4: | ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in the 26th subframe indicated by the ABS pattern. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 7: | The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by “0” of ABS pattern. |
| Note 8: | The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same. |
| Note 9: | SIB-1 will not be transmitted in Cell 2 and Cell 3 in the test. |
| Note 10: | According to Clause 6.9 in TS 36.211 [4]. |

**Table 8.5.1.2.4-2: Minimum performance PHICH**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Pm-an (%) | SNR (dB) (Note 3) |
| 1 | R.19 | OP.1 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EVA5 | EVA5 | 2x2 Low | 0.1 | 5.0 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of Cell 1.

## 8.5.2 TDD

The parameters specified in Table 8.5.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.5.2-1: Test Parameters for PHICH**

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Uplink downlink configuration (Note 1) | | | 1 | 1 |
| Special subframe configuration (Note 2) | | | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | 0 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | 0 | -3 |
| PHICH duration | | | Normal | Normal |
| PHICH Ng (Note 3) | | | Ng = 1 | Ng = 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| ACK/NACK feedback mode | | | Multiplexing | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4]<br>Note 3: according to Clause 6.9 in TS 36.211 [4] | | | | |

### 8.5.2.1 Single-antenna port performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.5.2.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | 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 |

#### 8.5.2.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.3-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3, In Table 8.5.2.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.5.2.2.3-1: Test Parameters for PHICH**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 |
| Special subframe configuration | | | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.5.2.2.3-2 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | |
| Cell Id | | | 0 | 1 |
| ABS pattern (Note 4) | | | N/A | 0000010001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0000000001<br>0000000001 | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0000010001<br>0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100101000<br>1100111000 | N/A |
| Number of control OFDM symbols | | | 3 | 3 |
| ACK/NACK feedback mode | | | Multiplexing | N/A |
| PHICH Ng (Note 9) | | | 1 | N/A |
| PHICH duration | | | extended | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in subframe 5
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]
Note 7: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same.
Note 8: SIB-1 will not be transmitted in Cell2 in the test.
Note 9: According to Clause 6.9 in TS 36.211 [4].

**Table 8.5.2.2.3-2: Minimum performance PHICH**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Antenna Configuration and Correlation Matrix | Reference Value | |
|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | | Pm-an (%) | SNR (dB) (Note 2) |
| 1 | R.19 | OP.1 TDD | OP.1 TDD | EPA5 | EPA5 | 2x2 Low | 0.1 | 4.6 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent. | | | | | | | | |
| Note 2: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | |

#### 8.5.2.2.4 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.4-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.4-2. In Table 8.5.2.2.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.5.2.2.4-1: Test Parameters for PHICH**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.5.2.2.4-2 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| PDCCH Content | | | UL Grant should be included with the proper information aligned with A.3.6. | N/A | N/A |
| ABS pattern (Note 4) | | | N/A | 0000000001<br>0000000001 | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 5) | | | 0000000001<br>0000000001 | N/A | N/A |
| CSI Subframe Sets (Note 6) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 2 | Note 7 | Note 7 |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| PHICH Ng (Note 10) | | | 1 | N/A | N/A |
| PHICH duration | | | Normal | N/A | N/A |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS
Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS
Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 4: ABS pattern as defined in [9]. PHICH is transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell but not in subframe 5
Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]
Note 7: The number of control OFDM symbols is not available for ABS and is 2 for the subframe indicated by "0" of ABS pattern.
Note 8: The number of the CRS ports in Cell 1, Cell 2 and Cell 3 is the same.
Note 9: SIB-1 will not be transmitted in Cell 2 and Cell 3 in the test.
Note 10: According to Clause 6.9 in TS 36.211 [4].

**Table 8.5.2.2.4-2: Minimum performance PHICH**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions (Note 1) | | | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Pm-an (%) | SNR (dB) (Note 3) |
| 1 | R.19 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EPA5 | EVA5 | EVA5 | 2x2 Low | 0.1 | 5.7 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc2}$ of Cell 1. | | | | | | | | | | |

# 8.6 Demodulation of PBCH

The receiver characteristics of the PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$\mathrm{Pm-bch} = 1 - \frac{A}{B}.$$

Where A is the number of correctly decoded MIB PDUs and B is the Number of transmitted MIB PDUs (Redundancy versions for the same MIB are not counted separately).

## 8.6.1 FDD

**Table 8.6.1-1: Test Parameters for PBCH**

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| | | | | |
| Downlink power allocation | PBCH_RA | dB | 0 | -3 |
| | PBCH_RB | dB | 0 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| Cell ID | | | 0 | 0 |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4] | | | | |

### 8.6.1.1 Single-antenna port performance

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detecting PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Pm-bch (%) | SNR (dB) |
| 1 | 1.4 MHz | R.21 | ETU70 | 1 x 2 Low | 1 | -6.1 |

### 8.6.1.2 Transmit diversity performance

#### 8.6.1.2.1 Minimum Requirement 2 Tx Antenna Port

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Pm-bch (%) | SNR (dB) |
| 1 | 1.4 MHz | R.22 | EPA5 | 2 x 2 Low | 1 | -4.8 |

#### 8.6.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.6.1.2.2-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Pm-bch (%) | SNR (dB) |
| 1 | 1.4 MHz | R.23 | EVA5 | 4 x 2 Medium | 1 | -3.5 |

#### 8.6.1.2.3 Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information

For the parameters specified in Table 8.6.1.2.3-1 and Table 8.6.1.2.3-2, the averaged probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.1.2.3-2. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, repectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.6.1.2.3-1: Test Parameters for PBCH**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | PBCH_RA OCNG_RA | dB | -3 | -3 | -3 |
| | PBCH_RB OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| $\frac{\hat{E}_s}{N_{oc}}$ | | dB | Reference Value in Table 8.6.1.2.3-2 | 4 | 2 |
| $BW_{Channel}$ | | MHz | 1.4 | 1.4 | 1.4 |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS Pattern (Note 4) | | | N/A | 01000000 01000000 01000000 01000000 01000000 | 01000000 01000000 01000000 01000000 01000000 |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.
Note 2: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.
Note 3: The PBCH transmission from Cell 1, Cell 2 and Cell 3 overlap. The same PBCH transmission redundancy version is used for Cell 1, Cell 2 and Cell 3.
Note 4: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.

**Table 8.6.1.2.3-2: Minimum performance PBCH**

| Test Number | Reference Channel | Propagation Conditions (Note 1) | | | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | | Pm-bch (%) | SNR (dB) (Note 3) |
| 1 | R.22 | ETU30 | ETU30 | ETU30 | 2x2 Low | 1 | -3.0 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s/N_{oc}$ of cell 1.

### 8.6.2 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].<br>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 |

#### 8.6.2.2.3 Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information

For the parameters specified in Table 8.6.2.2.3-1 and Table 8.6.2.2.3-2, the averaged probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.6.2.2.3-2. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.6.2.2.3-1: Test Parameters for PBCH**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | PBCH_RA OCNG_RA | dB | -3 | -3 | -3 |
| | PBCH_RB OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A | N/A |
| $\frac{\hat{E}_s}{N_{oc}}$ | | dB | Reference Value in Table 8.6.2.2.3-2 | 4 | 2 |
| $BW_{Channel}$ | | MHz | 1.4 | 1.4 | 1.4 |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS Pattern (Note 4) | | | N/A | 0000000001 0000000001 | 0000000001 0000000001 |
| Unused RE-s and PRB-s | | | OCNG | OCNG | OCNG |
| Cyclic prefix | | | Normal | Normal | Normal |

Note 1: The number of the CRS ports in Cell1, Cell2 and Cell 3is the same.
Note 2: SIB-1 will not be transmitted in Cell2 and Cell 3 in the test.
Note 3: The PBCH transmission from Cell 1, Cell 2 and Cell 3 overlap. The same PBCH transmission redundancy version is used for Cell 1, Cell 2 and Cell 3.
Note 4: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.

**Table 8.6.2.2.3-2: Minimum performance PBCH**

| Test Number | Reference Channel | Propagation Conditions (Note 1) | | | Antenna Configuration and Correlation Matrix (Note 2) | Reference Value | |
|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | | Pm-bch (%) | SNR (dB) (Note 3) |
| 1 | R.22 | ETU30 | ETU30 | ETU30 | 2x2 Low | 1 | -3.0 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of cell 1.

# 8.7 Sustained downlink data rate provided by lower layers

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum number of DL-SCH transport block bits received within a TTI for the UE category indicated. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement. The size of the TB per TTI corresponds to the largest possible DL-SCH transport block for each UE category using the maximum number of layers for spatial multiplexing. Transmission modes 1 and 3 are used with radio conditions resembling a scenario where sustained maximum data rates are available. Test case is selected according to table 8.7-1 depending on UE capability for CA and EPDCCH.

**Table 8.7-1: SDR test applicability**

| | Single carrier UE not supporting EPDCCH | CA UE not supporting EPDCCH | Single carrier UE supporting EPDCCH | CA UE supporting EPDCCH |
|---|---|---|---|---|
| FDD | 8.7.1 | 8.7.1 | 8.7.3 | 8.7.1, 8.7.3 |
| TDD | 8.7.2 | 8.7.2 | 8.7.4 | 8.7.2, 8.7.4 |

## 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 per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |

The requirements are specified in Table 8.7.1-3, with the addition of the parameters in Table 8.7.1-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.1-4. The TB success rate shall be sustained during at least 300 frames.

The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | | |
| 1 | 10 | 1 | 1 x 2 | N/A | 0 | 0 | 0 | -85 | OP.6 FDD |
| 2 | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 3,4,6 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 3A | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 3B, 4A | 2x10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 3C, 4B | 15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 6A | 2x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 6B | 10+15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 6C | 10+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 6D | 15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| Note 1: For CA test cases, PUCCH format 1b with channel selection is used to feedback ACK/NACK. | | | | | | | | | |

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

| Test | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value |
|---|---|---|---|
| | | | TB success rate [%] |
| 1 | 10296 | R.31-1 FDD | 95 |
| 2 | 25456 | R.31-2 FDD | 95 |
| 3 | 51024 | R.31-3 FDD | 95 |
| 3A | 36696 (Note 2) | R.31-3A FDD | 85 |
| 3B | 25456 | R.31-2 FDD | 95 |
| 3C | 51024 | R.31-3C FDD | 85 |
| 4 | 75376 (Note 3) | R.31-4 FDD | 85 |
| 4A | 36696 (Note 2) | R.31-3A FDD | 85 |
| 4B | 55056 (Note 5) | R.31-4B FDD | 85 |
| 6 | 75376 (Note 3) | R.31-4 FDD | 85 |
| 6A | 75376 (Note 3) | R.31-4 FDD | 85 |
| 6B | 36696 (Note 2) for 10MHz CC<br>55056 for 15MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC | 85 |
| 6C | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 6D | 55056 for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.<br>Note 2: 35160 bits for sub-frame 5.<br>Note 3: 71112 bits for sub-frame 5.<br>Note 4: 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.<br>Note 5: 52752bits for sub-frame 5. | | | |

**Table 8.7.1-4: Test points for sustained data rate (FRC)**

| **CA config** | Maximum supported **Bandwidth/ Bandwidth combination (MHz)** | **Category 1** | **Category 2** | **Category 3** | **Category 4** | **Category 6** | **Category 7** |
|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | 3A | 3A | - | - |
| | 15 | - | - | 3C | 4B | - | - |
| | 20 | - | - | 3 | 4 | 6 | 6 |
| CA with 2CCs | 10+10 | - | - | 3B | 4A | 4A | 4A |
| | 10+15 | - | - | 3B | 4A | 6B | 6B |
| | 10+20 | - | - | 3B | 4A | 6C | 6C |
| | 15+20 | - | - | 3B | 4A | 6D | 6D |
| | 20+20 | - | - | 3B or 3 (Note 4) | 4A or 4 (Note 4) | 6A | 6A |
| Note 1: Void.<br>Note 2: For non-CA UE, test is selected for maximum supported bandwidth.<br>Note 3: Void.<br>Note 4: If the intra-band contiguous CA is the only CA configuration supported by category 3 or 4 UE, the single carrier test is selecte, i.e., Test 3 for UE category 3 and Test 4 for UE category 4. Otherwise, Test 3B applies for category 3 UE and Test 4A applies for category 4 UE.<br>Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | |

## 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 per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |
| Note 1: as specified in Table 4.2-1 in TS 36.211 [4]. | | |

The requirements are specified in Table 8.7.2-3, with the addition of the parameters in Table 8.7.2-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.2-4. The TB success rate shall be sustained during at least 300 frames.

The test coverage for different number of component carriers is defined in 8.1.2.4.

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

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | ACK/NACK feedback mode | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | | | |
| 1 | 10 | 1 | 1 x 2 | N/A | 0 | 0 | 0 | -85 | Bundling | OP.6 TDD |
| 2 | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | Bundling | OP.1 TDD |
| 3 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | Bundling | OP.1 TDD |
| 3A | 15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | Muliplexing | OP.2 TDD |
| 4,6 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | Multiplexing | OP.1 TDD |
| 6A | 2x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | - (Note 1) | OP.1 TDD |
| Note 1: PUCCH format 1b with channel selection is used to feedback ACK/NACK. | | | | | | | | | | |

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

| Test | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel | Reference value<br>TB success rate [%] |
|---|---|---|---|
| 1 | 10296/0 | R31-1 TDD | 95 |
| 2 | 25456/0 | R31-2 TDD | 95 |
| 3 | 51024/0 | R31-3 TDD | 95 |
| 3A | 51024/0 | R31-3A TDD | 85 |
| 4 | 75376/0 (Note 2) | R31-4 TDD | 85 |
| 6 | 75376/0 (Note 2) | R.31-4 TDD | 85 |
| 6A | 75376/0 (Note 2) | R.31-4 TDD | 85 |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.<br>Note 2: 71112 bits for sub-frame 5.<br>Note 3: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. | | | |

**Table 8.7.2-4: Test points for sustained data rate (FRC)**

| CA config | Bandwidth/ Bandwidth combination (MHz) | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | - | - | - | - |
| | 15 | - | - | 3A | 3A | - | - |
| | 20 | - | - | 3 | 4 | 6 | 6 |
| CA with 2CCs | 20+20 | | - | 3 (Note 4) | 4 (Note 4) | 6A | 6A |
| Note 1: Void.<br>Note 2: For non-CA UE, test is selected for maximum supported bandwidth.<br>Note 3: Void.<br>Note 4: If the intra-band contiguous CA is the only CA configuration supported by category 3 or 4 UE, single carrier test is selected.<br>Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | |

## 8.7.3 FDD (EPDCCH scheduling)

The parameters specified in Table 8.7.3-1 are valid for all FDD tests unless otherwise stated.

**Table 8.7.3-1: Common test parameters (FDD)**

| Parameter | Unit | Value |
|---|---|---|
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Number of EPDCCH sets | | 1 |
| EPDCCH transmission type | | Localized |
| Number of PRB per EPDCCH set and EPDCCH PRB pair allocation | | 2 PRB pairs<br>10MHz BW: Resource blocks $n_{PRB}$ = 48, 49<br>15MHz BW: Resource blocks $n_{PRB}$ = 70, 71<br>20MHz BW: Resource blocks $n_{PRB}$ = 98, 99 |
| EPDCCH Starting Symbol | | Derived from CFI (i.e. default behaviour) |
| ECCE Aggregation Level | | 2 ECCEs |
| Number of EREGs per ECCE | | 4 |
| EPDCCH scheduling | | EPDCCH candidate is randomly assigned in each subframe |
| EPDCCH precoder (Note 1) | | Fixed PMI 0 |
| EPDCCH monitoring SF pattern | | 1111111111 0000000000<br>1111111111 0000000000 |
| Timing advance | μs | 100 |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |
| Note 1: EPDCCH precoder parameters are defined for tests with 2 x 2 antenna configuration | | |

The requirements are specified in Table 8.7.3-3, with the addition of the parameters in Table 8.7.3-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.3-4. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.3-2: Test parameters for SDR test for PDSCH scheduled by EPDCCH (FDD)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | δ | | |
| 1 | 10 | 1 | 1 x 2 | N/A | 0 | 0 | 0 | 0 | -85 | OP.6 FDD |
| 2 | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 FDD |
| 3,4,6 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 FDD |
| 3A | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 FDD |
| 3C, 4B | 15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 FDD |

**Table 8.7.3-3: Minimum requirement (FDD)**

| Test | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value |
|---|---|---|---|
| | | | TB success rate [%] |
| 1 | 10296 | R.31E-1 FDD | 95 |
| 2 | 25456 | R.31E-2 FDD | 95 |
| 3 | 51024 | R.31E-3 FDD | 95 |
| 3A | 36696 (Note 2) | R.31E-3A FDD | 85 |
| 3C | 51024 | R.31E-3C FDD | 85 |
| 4 | 75376 (Note 3) | R.31E-4 FDD | 85 |
| 4B | 55056 (Note 5) | R.31E-4B FDD | 85 |
| 6 | 75376 (Note 3) | R.31E-4 FDD | 85 |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.<br>Note 2: 35160 bits for sub-frame 5.<br>Note 3: 71112 bits for sub-frame 5.<br>Note 4: 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.<br>Note 5: 52752 bits for sub-frame 5. | | | |

**Table 8.7.3-4: Test points for sustained data rate (FRC)**

| CA config | Bandwidth (MHz) | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | 3A | 3A | - | - |
| | 15 | - | - | 3C | 4B | - | - |
| | 20 | - | - | 3 | 4 | 6 | 6 |
| Note 1: The test is selected for maximum supported bandwidth. | | | | | | | |

## 8.7.4 TDD (EPDCCH scheduling)

The parameters specified in Table 8.7.4-1 are valid for all TDD tests unless otherwise stated.

**Table 8.7.4-1: Common test parameters (TDD)**

| Parameter | Unit | Value |
|---|---|---|
| Special subframe configuration (Note 1) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Number of EPDCCH sets | | 1 |
| EPDCCH transmission type | | Localized |
| Number of PRB per EPDCCH set and EPDCCH PRB pair allocation | | 2 PRB pairs<br>10MHz BW: Resource blocks $n_{PRB}$ = 48, 49<br>15MHz BW: Resource blocks $n_{PRB}$ = 70, 71<br>20MHz BW: Resource blocks $n_{PRB}$ = 98, 99 |
| EPDCCH Starting Symbol | | Derived from CFI (i.e. default behaviour) |
| ECCE Aggregation Level | | 2 ECCEs |
| Number of EREGs per ECCE | | 4 for normal subframe and 8 for special subframe |
| EPDCCH scheduling | | EPDCCH candidate is randomly assigned in each subframe |
| EPDCCH precoder (Note 2) | | Fixed PMI 0 |
| EPDCCH monitoring SF pattern | | UL-DL configuration 1: 1101111111 0000000000<br>UL-DL configuration 5: 1100111001 0000000000 |
| Timing advance | μs | 100 |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |
| Note 1: As specified in Table 4.2-1 in TS 36.211 [4].<br>Note 2: EPDCCH precoder parameters are defined for tests with 2 x 2 antenna configuration | | |

The requirements are specified in Table 8.7.4-3, with the addition of the parameters in Table 8.7.4-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category, CA capability and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.4-4. The TB success rate shall be sustained during at least 300 frames.

**Table 8.7.4-2: Test parameters for SDR test for PDSCH scheduled by EPDCCH (TDD)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs | ACK/NACK feedback mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | δ | | | |
| 1 | 10 | 1 | 1 x 2 | N/A | 0 | 0 | 0 | 0 | -85 | OP.6 TDD | Bundling |
| 2 | 10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 TDD | Bundling |
| 3 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 TDD | Bundling |
| 3A | 15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.2 TDD | Multiplexing |
| 4,6 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | 3 | -85 | OP.1 TDD | Multiplexing |

**Table 8.7.4-3: Minimum requirement (TDD)**

| Test | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel | Reference value TB success rate [%] |
|---|---|---|---|
| 1 | 10296/0 | R.31E-1 TDD | 95 |
| 2 | 25456/0 | R.31E-2 TDD | 95 |
| 3 | 51024/0 | R.31E-3 TDD | 95 |
| 3A | 51024/0 | R.31E-3A TDD | 85 |
| 4 | 75376/0 (Note 2) | R.31E-4 TDD | 85 |
| 6 | 75376/0 (Note 2) | R.31E-4 TDD | 85 |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.<br>Note 2: 71112 bits for sub-frame 5.<br>Note 3: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. | | | |

**Table 8.7.4-4: Test points for sustained data rate (FRC)**

| CA config | Bandwidth/ Bandwidth combination (MHz) | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | - | - | - | - |
| | 15 | - | - | 3A | 3A | - | - |
| | 20 | - | - | 3 | 4 | 6 | 6 |
| Note 1: The test is selected for maximum supported bandwidth. | | | | | | | |

# 8.8 Demodulation of EPDCCH

The receiver characteristics of the EPDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). For the distributed transmission tests in 8.8.1, EPDCCH and PCFICH are tested jointly, i.e. a miss detection of PCFICH implies a miss detection of EPDCCH. For other tests, EPDCCH and PCFICH are not tested jointly.

## 8.8.1 Distributed Transmission

### 8.8.1.1 FDD

The parameters specified in Table 8.8.1.1-1 are valid for all FDD distributed EPDCCH tests unless otherwise stated.

**Table 8.8.1.1-1: Test Parameters for Distributed EPDCCH**

| Parameter | | Unit | Value |
|---|---|---|---|
| Number of PDCCH symbols | | symbols | 2 (Note 1) |
| PHICH duration | | | Normal |
| Unused RE-s and PRB-s | | | OCNG |
| Cell ID | | | 0 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | σ | dB | 0 |
| | δ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15 kHz | -98 |
| Cyclic prefix | | | Normal |
| Subframe Configuration | | | Non-MBSFN |
| Precoder Update Granularity | | PRB | 1 |
| | | ms | 1 |
| Beamforming Pre-Coder | | | Annex B. 4.4 |
| Cell Specific Reference Signal | | | Port 0 and 1 |
| Number of EPDCCH Sets Configured | | | 2 (Note 2) |
| Number of PRB per EPDCCH Set | | | 4 (1st Set)<br>8 (2nd Set) |
| EPDCCH Subframe Monitoring | | | NA |
| PDSCH TM | | | TM3 |
| DCI Format | | | 2A |
| Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling *epdcch-StartSymbol-r11* is not configured.<br>Note 2: The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured. | | | |

For the parameters specified in Table 8.8.1.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.1.1-2. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.1.1-2: Minimum performance Distributed EPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 4 ECCE | R.55 FDD | OP.7 FDD | EVA5 | 2 x 2 Low | 1 | 2.60 |
| 2 | 10 MHZ | 16 ECCE | R.56 FDD | OP.7 FDD | EVA70 | 2 x 2 Low | 1 | -3.20 |

#### 8.8.1.1.1 Void

**Table 8.8.1.1.1-1: Void**

### 8.8.1.2 TDD

The parameters specified in Table 8.8.1.2-1 are valid for all TDD distributed EPDCCH tests unless otherwise stated.

**Table 8.8.1.2-1: Test Parameters for Distributed EPDCCH**

| Parameter | | Unit | Value |
|---|---|---|---|
| Number of PDCCH symbols | | symbols | 2 (Note 1) |
| PHICH duration | | | Normal |
| Unused RE-s and PRB-s | | | OCNG |
| Cell ID | | | 0 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | σ | dB | 0 |
| | δ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15 kHz | -98 |
| Cyclic prefix | | | Normal |
| Subframe Configuration | | | Non-MBSFN |
| Precoder Update Granularity | | PRB | 1 |
| | | ms | 1 |
| Beamforming Pre-Coder | | | Annex B. 4.4 |
| Cell Specific Reference Signal | | | Port 0 and 1 |
| Number of EPDCCH Sets Configured | | | 2 (Note 2) |
| Number of PRB per EPDCCH Set | | | 4 (1st Set)<br>8 (2nd Set) |
| EPDCCH Subframe Monitoring | | | NA |
| PDSCH TM | | | TM3 |
| DCI Format | | | 2A |
| TDD UL/DL Configuration | | | 0 |
| TDD Special Subframe | | | 1 (Note 3) |
| Note 1: The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling *epdcch-StartSymbol-r11* is not configured.<br>Note 2: The two sets are distributed EPDCCH sets and non-overlapping with PRB = {3, 17, 31, 45} for the first set and PRB = {0, 7, 14, 21, 28, 35, 42, 49} for the second set. EPDCCH is scheduled in the first set for Test 1 and second set for Test 2, respectively. Both sets are always configured.<br>Note 3: Demodulation performance is averaged over normal and special subframe. | | | |

For the parameters specified in Table 8.8.1.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.1.2-2. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.1.2-2: Minimum performance Distributed EPDCCH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 4 ECCE | R.55 TDD | OP.7 TDD | EVA5 | 2 x 2 Low | 1 | 2.8 |
| 2 | 10 MHZ | 16 ECCE | R.56 TDD | OP.7 TDD | EVA70 | 2 x 2 Low | 1 | -3.10 |

#### 8.8.1.2.1 Void

**Table 8.8.1.2.1-1: Void**

## 8.8.2 Localized Transmission with TM9

### 8.8.2.1 FDD

The parameters specified in Table 8.8.2.1-1 are valid for all FDD TM9 localized ePDCCH tests unless otherwise stated.

**Table 8.8.2.1-1: Test Parameters for Localized EPDCCH with TM9**

| Parameter | | Unit | Value |
|---|---|---|---|
| Number of PDCCH symbols | | symbols | 1 (Note 1) |
| EPDCCH starting symbol | | symbols | 2 (Note 1) |
| PHICH duration | | | Normal |
| Unused RE-s and PRB-s | | | OCNG |
| Cell ID | | | 0 |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | $\sigma$ | dB | -3 |
| | $\delta$ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15 kHz | -98 |
| Cyclic prefix | | | Normal |
| Subframe Configuration | | | Non-MBSFN |
| Precoder Update Granularity | | PRB | 1 |
| | | ms | 1 |
| Beamforming Pre-Coder | | | Annex B.4.5 |
| Cell Specific Reference Signal | | | Port 0 and 1 |
| CSI-RS Reference Signal | | | Port 15 and 16 |
| CSI-RS reference signal resource configuration | | | 0 |
| CSI reference signal subframe configuration $I_{CSI-RS}$ | | | 2 |
| ZP-CSI-RS configuration bitmap | | | 0000010000000000 |
| ZP-CSI-RS subframe configuration $I_{ZP-CSI-RS}$ | | | 2 |
| Number of EPDCCH Sets | | | 2 (Note 2) |
| EPDCCH Subframe Monitoring pattern *subframePatternConfig-r11* | | | 1111111110 1111111101 1111111011 1111110111 (Note 3) |
| PDSCH TM | | | TM9 |
| Note 1: The starting symbol for EPDCCH is signalled with *epdcch-StartSymbol-r11*. However, CFI is set to 1.<br>Note 2: The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests.<br>Note 3: EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by *subframePatternConfig-r11*. Legacy PDCCH is not scheduled. | | | |

For the parameters specified in Table 8.8.2.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.8.2.1-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.2.1-2: Minimum performance Localized EPDCCH with TM9**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 2 ECCE | R.57 FDD | OP.7 FDD | EVA5 | 2 x 2 Low | 1 | 12.2 |
| 2 | 10 MHZ | 8 ECCE | R.58 FDD | OP.7 FDD | EVA5 | 2 x 2 Low | 1 | 2.5 |

#### 8.8.2.1.1 Void

**Table 8.8.2.1.1-1: Void**

#### 8.8.2.1.2 Void

**Table 8.8.2.1.2-1: Void**

**Table 8.8.2.1.2-2: Void**

**Table 8.8.2.1.2-3: Void**

### 8.8.2.2 TDD

The parameters specified in Table 8.8.2.2-1 are valid for all TDD TM9 localized ePDCCH tests unless otherwise stated.

**Table 8.8.2.2-1: Test Parameters for Localized EPDCCH with TM9**

| Parameter | | Unit | Value |
|---|---|---|---|
| Number of PDCCH symbols | | symbols | 1 (Note 1) |
| EPDCCH starting symbol | | symbols | 2 (Note 1) |
| PHICH duration | | | Normal |
| Unused RE-s and PRB-s | | | OCNG |
| Cell ID | | | 0 |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | $\sigma$ | dB | -3 |
| | $\delta$ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15 kHz | -98 |
| Cyclic prefix | | | Normal |
| Subframe Configuration | | | Non-MBSFN |
| Precoder Update Granularity | | PRB | 1 |
| | | ms | 1 |
| Beamforming Pre-Coder | | | Annex B.4.5 |
| Cell Specific Reference Signal | | | Port 0 and 1 |
| CSI-RS Reference Signal | | | Port 15 and 16 |
| CSI-RS reference signal resource configuration | | | 0 |
| CSI reference signal subframe configuration $I_{CSI-RS}$ | | | 0 |
| ZP-CSI-RS configuration bitmap | | | 0000010000000000 |
| ZP-CSI-RS subframe configuration $I_{ZP-CSI-RS}$ | | | 0 |
| Number of EPDCCH Sets | | | 2 (Note 2) |
| EPDCCH Subframe Monitoring pattern *subframePatternConfig-r11* | | | 1100011000 1100010000 1100011000 1100001000 1100011000 1000011000 1100011000 (Note 3) |
| PDSCH TM | | | TM9 |
| TDD UL/DL Configuration | | | 0 |
| TDD Special Subframe | | | 1 (Note 4) |
| Note 1: The starting symbol for EPDCCH is signalled with *epdcch-StartSymbol-r11*. However, CFI is set to 1.<br>Note 2: The first set is distributed transmission with PRB = {0, 49} and the second set is localized transmission with PRB = {0, 7, 14, 21, 28, 35, 42, 49}. ePDCCH is scheduled in the second set for all tests.<br>Note 3: EPDCCH is scheduled in every SF. UE is required to monitor ePDCCH for UE-specific search space only in SFs configured by *subframePatternConfig-r11*. Legacy PDCCH is not scheduled.<br>Note 4: Demodulation performance is averaged over normal and special subframe. | | | |

For the parameters specified in Table 8.8.2.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.2.2.2-2. EPDCCH subframe monitoring is configured and the subframe monitoring requirement in EPDCCH restricted subframes is statDTX of 99.9%.

The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.2.2-2: Minimum performance Localized EPDCCH with TM9**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 2 ECCE | R.57 TDD | OP.7 TDD | EVA5 | 2 x 2 Low | 1 | 12.8 |
| 2 | 10 MHZ | 8 ECCE | R.58 TDD | OP.7 TDD | EVA5 | 2 x 2 Low | 1 | 2.0 |

#### 8.8.2.2.1 Void

**Table 8.8.2.2.1-1: Void**

#### 8.8.2.2.2 Void

**Table 8.8.2.2.2-1: Void**

**Table 8.8.2.2.2-2: Void**

**Table 8.8.2.2.2-3: Void**

## 8.8.3 Localized transmission with TM10 Type B quasi co-location type

### 8.8.3.1 FDD

For the parameters specified in Table 8.8.3.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified values in Table 8.8.3.1-2. In Table 8.8.3.1-1, transmission point 1 (TP 1) is the serving cell. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.3.1-1: Test Parameters for Localized Transmission TM10 Type B quasi co-location type**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | TP 1 | TP 2 | TP 1 | TP 2 |
| PHICH duration | | | Normal | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $\sigma$ | dB | -3 | | | |
| | $\delta$ | dB | 0 | | | |
| $\hat{E}_s/N_{oc}$ | | dB | 0dB power imbalance is considered between TP 1 and TP 2, | Reference value in Table 8.8.3.1-2 | Reference value in Table 8.8.3.1-2 | Reference value in Table 8.8.3.1-2 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | | |
| Bandwidth | | MHz | 10 | 10 | 10 | 10 |
| Number of configured EPDCCH Sets | | | 2 (Note 1) | | 2 (Note1) | |
| EPDCCH-PRB-Set ID (setConfigId) | | | 0 | 1 | 0 | 1 |
| Transmission type of EPDCCH-PRB-set | | | Localized | Localized | Localized | Localized |
| Number of PRB pair per EPDCCH-PRB-set | | PRB | 8 | 8 | 8 | 8 |
| EPDCCH beamforming model | | | Annex B.4.5 | Annex B.4.5 | Annex B.4.5 | Annex B.4.5 |
| PDSCH transmission mode | | | TM10 | TM10 | TM10 | TM10 |
| PDSCH transmission scheduling | | | Blanked in all the subframes | Transmit in all the subframes | Probability of occurrence of PDSCH transmission is 30% (Note 3) | Probability of occurrence of PDSCH transmission is 70% (Note 3) |
| Non-zero power CSI reference signal (NZPId=1) | CSI reference signal configuration | | N/A | 0 | N/A | 0 |
| | CSI reference signal subframe configuration $I_{CSI-RS}$ | | N/A | 2 | N/A | 2 |
| Non-zero power CSI reference signal (NZPId=2) | CSI reference signal configuration | | N/A | N/A | 10 | N/A |
| | CSI reference signal subframe configuration $I_{CSI-RS}$ | | N/A | N/A | 2 | N/A |
| Zero power CSI reference signal (ZPId=1) | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap) | Bitmap | N/A | 0000010000000000 | N/A | 1000010000000000 |
| | CSI-RS subframe configuration $I_{CSI-RS}$ | | N/A | 2 | N/A | 2 |
| Zero power CSI reference signal (ZPId=2) | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap) | Bitmap | N/A | N/A | 1000010000000000 | N/A |
| | CSI-RS subframe configuration $I_{CSI-RS}$ | | N/A | N/A | 2 | N/A |
| PQI set 0 (Note 4) | Non-Zero power CSI RS Identity (NZPId) | | N/A | 1 | N/A | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Zero power CSI RS Identity (ZPId) | | N/A | 1 | N/A | 1 |
| PQI set 1 (Note 4) | Non-Zero power CSI RS Identity (NZPId) | | N/A | N/A | 2 | N/A |
| | Zero power CSI RS Identity (ZPId) | | N/A | N/A | 2 | N/A |
| Number of PDCCH symbols | | Symbols | 1 (Note 2) | | | |
| EPDCCH starting position | | | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) |
| Subframe configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time offset between TPs | | μs | N/A | 2 | N/A | 2 |
| Frequency shift between TPs | | Hz | N/A | 200 | N/A | 200 |
| Cell ID | | | 0 | 126 | 0 | 126 |
| Note 1: Resource blocks $n_{PRB}$ =0, 7, 14, 21, 28, 35, 42, 49 are allocated for both the first set and the second set.<br>Note 2: The starting OFDM symbol for EPDCCH is determined from the higher layer signalling pdsch-Start-r11. And CFI is set to 1.<br>Note 3: The TP from which PDSCH is transmitted shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TP 1 and TP 2 are specified.<br>Note 4: For PQI set 0, PDSCH and EPDCCH are transmitted from TP 2. For PQI set 1, PDSCH and EPDCCH are transmitted from TP1. EPDCCH and PDSCH are transmitted from same TP. | | | | | | |

**Table 8.8.3.1-2: Minimum Performance**

| Test number | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 2 ECCE | R.59 FDD | OP.7 FDD | EVA5 | 2 x 2 Low | 1 | 13.4 |
| 2 | 2 ECCE | R.59 FDD | OP.7 FDD | EVA5 | 2 x 2 Low | 1 | 13.4 |

### 8.8.3.2 TDD

For the parameters specified in Table 8.8.3.2-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified values in Table 8.8.3.2-2. In Table 8.8.3.2-1, transmission point 1 (TP1) is the serving cell. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.8.3.2-1: Test Parameters for Localized Transmission TM10 Type B quasi co-location type**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | TP 1 | TP 2 | TP 1 | TP 2 |
| PHICH duration | | | Normal | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $\sigma$ | dB | -3 | | | |
| | $\delta$ | dB | 0 | | | |
| $\hat{E}_s/N_{oc}$ | | dB | 0dB power imbalance is considered between TP 1 and TP 2, | Reference value in Table 8.8.3.2-2 | Reference value in Table 8.8.3.2-2 | Reference value in Table 8.8.3.2-2 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | | |
| Bandwidth | | MHz | 10 | 10 | 10 | 10 |
| Number of EPDCCH Sets | | | 2 (Note 1) | | 2 (Note1) | |
| EPDCCH-PRB-Set ID (setConfigId) | | | 0 | 1 | 0 | 1 |
| Transmission type of EPDCCH-PRB-set | | | Localized | Localized | Localized | Localized |
| Number of PRB pair per EPDCCH-PRB-set | | PRB | 8 | 8 | 8 | 8 |
| EPDCCH beamforming model | | | Annex B.4.5 | Annex B.4.5 | Annex B.4.5 | Annex B.4.5 |
| PDSCH transmission mode | | | TM10 | TM10 | TM10 | TM10 |
| PDSCH transmission scheduling | | | Blanked in all the subframes | Transmit in all the subframes | Probability of occurrence of PDSCH transmission is 30% (Note 3) | Probability of occurrence of PDSCH transmission is 70% (Note 3) |
| CSI reference signal configurations | | | Antenna ports 15,16 | Antenna ports 15,16 | Antenna ports 15,16 | Antenna ports 15,16 |
| Non-zero power CSI reference signal (NZPId=1) | CSI reference signal configuration | | N/A | 0 | N/A | 0 |
| | CSI reference signal subframe configuration $I_{CSI-RS}$ | | N/A | 0 | N/A | 0 |
| Non-zero power CSI reference signal (NZPId=2) | CSI reference signal configuration | | N/A | N/A | 10 | N/A |
| | CSI reference signal subframe configuration $I_{CSI-RS}$ | | N/A | N/A | 0 | N/A |
| Zero power CSI reference signal (ZPId=1) | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap) | Bitmap | N/A | 0000010000000000 | N/A | 1000010000000000 |
| | CSI-RS subframe configuration $I_{CSI-RS}$ | | N/A | 0 | N/A | 0 |
| Zero power CSI reference signal (ZPId=2) | CSI-RS Configuration list (ZeroPowerCSI-RS bitmap) | Bitmap | N/A | N/A | 1000010000000000 | N/A |
| | CSI-RS subframe configuration $I_{CSI-RS}$ | | N/A | N/A | 0 | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| PQI set 0 (Note 4) | Non-Zero power CSI RS Identity (NZPId) | | N/A | 1 | N/A | 1 |
| | Zero power CSI RS Identity (ZPId) | | N/A | 1 | N/A | 1 |
| PQI set 1 (Note 4) | Non-Zero power CSI RS Identity (NZPId) | | N/A | N/A | 2 | N/A |
| | Zero power CSI RS Identity (ZPId) | | N/A | N/A | 2 | N/A |
| Number of PDCCH symbols | | Symbols | 1 (Note 2) | | | |
| EPDCCH starting position | | | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) | pdsch-Start-r11=2 (Note 2) |
| Subframe configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time offset between TPs | | μs | N/A | 2 | N/A | 2 |
| Frequency shift between TPs | | Hz | N/A | 200 | N/A | 200 |
| Cell ID | | | 0 | 126 | 0 | 126 |
| TDD UL/DL configuration | | | 0 | | | |
| TDD special subframe | | | 1 | | | |
| Note 1: Resource blocks $n_{PRB}$ = 0, 7, 14, 21, 28, 35, 42, 49 are allocated for both the first set and the second set.<br>Note 2: The starting OFDM symbol for EPDCCH is determined from the higher layer signalling pdsch-Start-r11. And CFI is set to 1.<br>Note 3: The TP from which PDSCH is transmitted shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TP 1 and TP 2 are specified.<br>Note 4: For PQI set 0, PDSCH and EPDCCH are transmitted from TP 2. For PQI set 1, PDSCH and EPDCCH are transmitted from TP1. EPDCCH and PDSCH are transmitted from same TP. | | | | | | |

**Table 8.8.3.2-2: Minimum Performance**

| Test number | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 2 ECCE | R.59 TDD | OP.7 TDD | EVA5 | 2 x 2 Low | 1 | 13.6 |
| 2 | 2 ECCE | R.59 TDD | OP.7 TDD | EVA5 | 2 x 2 Low | 1 | 13.6 |

# 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, where $SNR = \frac{\sum \hat{I}_{or}^{(j)}}{\sum N_{oc}^{(j)}}$.

### 9.1.1 Applicability of requirements

#### 9.1.1.1 Applicability of requirements for different channel bandwidths

In Clause 9 the test cases may be defined with different channel bandwidth to verify the same CSI requirement.

### 9.1.1.2 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA CQI tests in Clause 9 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CCs in Table 9.1.1.2-1. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set. The definition of CA capability is specified in 8.1.2.2.

**Table 9.1.1.2-1: Applicability and test rules for CA UE CQI tests with 2 DL CCs**

| Tests | CA capability where the tests apply | CA configuration from the selected CA capbility where the tests apply | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 2CCs in Clause 9.6.1.1 | Any of one of the supported CA capabilities | Any one of the supported FDD CA configurations | 10+10 MHz, 20+20 MHz |
| CA tests with 2CCs in Clause 9.6.1.2 | Any of one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is one. | | | |

## 9.2 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 36.213 [6]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

### 9.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbols)

#### 9.2.1.1 FDD

The following requirements apply to UE Category ≥1. 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)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="4">1</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td colspan="2">Propagation condition and antenna configuration</td><td></td><td colspan="4">AWGN (1 x 2)</td></tr>
<tr><td colspan="2">SNR (Note 2)</td><td>dB</td><td>0</td><td>1</td><td>6</td><td>7</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-98</td><td>-97</td><td>-92</td><td>-91</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Physical channel for CQI reporting</td><td></td><td colspan="4">PUCCH Format 2</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">$N_{pd}$ = 5</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex</td><td></td><td colspan="4">6</td></tr>
<tr><td colspan="7">Note 1: Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.4 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2.<br>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.</td></tr>
</table>

#### 9.2.1.2 TDD

The following requirements apply to UE Category ≥1. For the parameters specified in Table 9.2.1.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1 TDD in Table A.4-1 shall be in the range of ±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)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td colspan="4">2</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td colspan="4">4</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td colspan="2">Propagation condition and antenna configuration</td><td></td><td colspan="4">AWGN (1 x 2)</td></tr>
<tr><td colspan="2">SNR (Note 2)</td><td>dB</td><td>0</td><td>1</td><td>6</td><td>7</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-98</td><td>-97</td><td>-92</td><td>-91</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Physical channel for CQI reporting</td><td></td><td colspan="4">PUSCH (Note 3)</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">$N_{pd}$ = 5</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex</td><td></td><td colspan="4">3</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td colspan="4">Multiplexing</td></tr>
<tr><td colspan="7">Note 1: Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, except for category 1 UE use RC.4 TDD with two sided dynamic OCNG Pattern OP.2 TDD as described in Annex A.5.2.2.<br>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.<br>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.</td></tr>
</table>

### 9.2.1.3 FDD (CSI measurements in case two CSI subframe sets are configured)

The following requirements apply to UE Category ≥1. For the parameters specified in Table 9.2.1.3-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C.3.3-1 for Cell 2 and C.3.2-2, the reported CQI value according to RC.2 FDD / RC.6 FDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1. The value of the median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ minus the median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ shall be larger than or equal to 2 and less than or equal to 5 in Test 1 and shall be larger than or equal to 0 and less than or equal to 1 in Test 2.

**Table 9.2.1.3-1: PUCCH 1-0 static test (FDD)**

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Test 1</th><th colspan="3">Test 2</th></tr>
<tr><th colspan="2">Cell 1</th><th>Cell 2</th><th colspan="2">Cell 1</th><th>Cell 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="3">10</td><td colspan="3">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="2">2</td><td>Note 10</td><td colspan="2">2</td><td>Note 10</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">Propagation condition and antenna configuration</td><td></td><td colspan="3">Clause B.1 (2x2)</td><td colspan="3">Clause B.1 (2x2)</td></tr>
<tr><td colspan="2">$\widehat{E}_s / N_{oc2}$ (Note 1)</td><td>dB</td><td>4</td><td>5</td><td>6</td><td>4</td><td>5</td><td>-12</td></tr>
<tr><td rowspan="3">$N_{oc}^{(j)}$ at antenna port</td><td>$N_{oc1}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-102 (Note 7)</td><td>N/A</td><td colspan="2">-98(Note 7)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 8)</td><td>N/A</td><td colspan="2">-98(Note 8)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-94.8 (Note 9)</td><td>N/A</td><td colspan="2">-98(Note 9)</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-94</td><td>-93</td><td>-92</td><td>-94</td><td>-93</td><td>-110</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td colspan="2">0</td><td>1</td><td colspan="2">0</td><td>1</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>µs</td><td colspan="3">2.5 (synchronous cells)</td><td colspan="3">2.5 (synchronous cells)</td></tr>
<tr><td colspan="2">ABS pattern (Note 2)</td><td></td><td colspan="2">N/A</td><td>01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td colspan="2">N/A</td><td>01010101<br>01010101<br>01010101<br>01010101<br>01010101</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 4)</td><td></td><td colspan="2">00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td><td colspan="2">00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 3)</td><td>$C_{CSI,0}$</td><td></td><td colspan="2">01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td>N/A</td><td colspan="2">01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td colspan="2">10101010<br>10101010<br>10101010<br>10101010<br>10101010</td><td>N/A</td><td colspan="2">10101010<br>10101010<br>10101010<br>10101010<br>10101010</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td colspan="3">3</td><td colspan="3">3</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,0}$ CQI reporting</td><td></td><td colspan="3">PUCCH Format 2</td><td colspan="3">PUCCH Format 2</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,1}$ CQI reporting</td><td></td><td colspan="3">PUSCH (Note 12)</td><td colspan="3">PUSCH (Note 12)</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="3">4</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>Ms</td><td colspan="3">$N_{pd} = 5$</td><td colspan="3">$N_{pd} = 5$</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex $C_{CSI,0}$ (Note 13)</td><td rowspan="2"></td><td colspan="2">6</td><td>N/A</td><td colspan="2">6</td><td>N/A</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex2 $C_{CSI,1}$ (Note 14)</td><td colspan="2">5</td><td>N/A</td><td colspan="2">5</td><td>N/A</td></tr>
</table>

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 for UE Cateogry 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, and RC.6 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP. 1/2 FDD as described in Annex A.5.1.1 and A.5.1.2. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |
| Note 13: | *cqi-pmi-ConfigurationIndex* is applied for $C_{CSI,0.}$ |
| Note 14: | *cqi-pmi-ConfigurationIndex2* is applied for $C_{CSI,1.}$ |

### 9.2.1.4 TDD (CSI measurements in case two CSI subframe sets are configured)

The following requirements apply to UE Category ≥1. For the parameters specified in Table 9.2.1.4-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C3.3-1 for Cell 2 and C.3.2-2, the reported CQI value according to RC.2 TDD / RC.6 TDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1. The value of the median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ minus the median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ shall be larger than or equal to 2 and less than or equal to 5 in Test 1 and shall be larger than or equal to 0 and less than or equal to 1 in Test 2.

**Table 9.2.1.4-1: PUCCH 1-0 static test (TDD)**

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Test 1</th><th colspan="3">Test 2</th></tr>
<tr><th colspan="2">Cell 1</th><th>Cell 2</th><th colspan="2">Cell 1</th><th>Cell 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="3">10</td><td colspan="3">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="2">2</td><td>Note 10</td><td colspan="2">2</td><td>Note 10</td></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td colspan="3">4</td><td colspan="3">4</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">Propagation condition and antenna configuration</td><td></td><td colspan="3">Clause B.1 (2x2)</td><td colspan="3">Clause B.1 (2x2)</td></tr>
<tr><td colspan="2">$\widehat{E}_s/N_{oc2}$ (Note 1)</td><td>dB</td><td>4</td><td>5</td><td>6</td><td>4</td><td>5</td><td>-12</td></tr>
<tr><td rowspan="3">$N_{oc}^{(j)}$ at antenna port</td><td>$N_{oc1}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-102 (Note 7)</td><td>N/A</td><td colspan="2">-98 (Note 7)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 8)</td><td>N/A</td><td colspan="2">-98 (Note 8)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-94.8 (Note 9)</td><td>N/A</td><td colspan="2">-98 (Note 9)</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-94</td><td>-93</td><td>-92</td><td>-94</td><td>-93</td><td>-110</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td colspan="2">0</td><td>1</td><td colspan="2">0</td><td>1</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>µs</td><td colspan="3">2.5 (synchronous cells)</td><td colspan="3">2.5 (synchronous cells)</td></tr>
<tr><td colspan="2">ABS pattern (Note 2)</td><td></td><td colspan="2">N/A</td><td>0100010001<br>0100010001</td><td colspan="2">N/A</td><td>0100010001<br>0100010001</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 4)</td><td></td><td colspan="2">0000000001<br>0000000001</td><td>N/A</td><td colspan="2">0000000001<br>0000000001</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 3)</td><td>$C_{CSI,0}$</td><td></td><td colspan="2">0100010001<br>0100010001</td><td>N/A</td><td colspan="2">0100010001<br>0100010001</td><td>N.A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td colspan="2">1000101000<br>1000101000</td><td>N/A</td><td colspan="2">1000101000<br>1000101000</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td colspan="3">3</td><td colspan="3">3</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,0}$ CQI reporting</td><td></td><td colspan="3">PUCCH Format 2</td><td colspan="3">PUCCH Format 2</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,1}$ CQI reporting</td><td></td><td colspan="3">PUSCH (Note 12)</td><td colspan="3">PUSCH</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="3">4</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="3">$N_{pd}$ = 5</td><td colspan="3">$N_{pd}$ = 5</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex $C_{CSI,0}$ (Note 13)</td><td rowspan="2"></td><td colspan="2">3</td><td>N/A</td><td colspan="2">3</td><td>N/A</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex2 $C_{CSI,1}$ (Note 14)</td><td colspan="2">4</td><td>N/A</td><td colspan="2">4</td><td>N/A</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td colspan="3">Multiplexing</td><td colspan="3">Multiplexing</td></tr>
</table>

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell1 and Cell2 is the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 for UE Category ≥2 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, and RC.6 TDD according to Table A.4-1 for Category 1 with one/two sided dynami OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1 and Annex A.5.2.2. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |
| Note 13: | *cqi-pmi-ConfigurationIndex* is applied for $C_{CSI,0}$. |
| Note 14: | *cqi-pmi-ConfigurationIndex2* is applied for $C_{CSI,1}$. |

#### 9.2.1.5 FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

The following requirements apply to UE Category ≥2. For the parameters specified in Table 9.2.1.5-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C.3.3-2 for Cell 2 and Cell 3, and C.3.2-2, the reported CQI value according to RC.2 FDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time.

For test 1 and test 2, if the PDSCH BLER in ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ is less than or equal to 0.1, the BLER in ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

For test 2, if the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 2) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.2.1.5-1: PUCCH 1-0 static test (FDD)**

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Test 1</th><th colspan="3">Test 2</th></tr>
<tr><th colspan="2">Cell 1</th><th>Cell 2 and 3</th><th colspan="2">Cell 1</th><th>Cell 2 and 3</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="3">10</td><td colspan="3">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="2">2</td><td>Note 10</td><td colspan="2">2</td><td>Note 10</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="3">-3</td><td colspan="3">-3</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">Propagation condition and antenna configuration</td><td></td><td colspan="3">Clause B.1 (2x2)</td><td colspan="3">Clause B.1 (2x2)</td></tr>
<tr><td colspan="2">$\widehat{E}_s/N_{oc2}$ (Note 1)</td><td>dB</td><td>4</td><td>5</td><td>Cell 2: 12<br>Cell 3: 10</td><td>13</td><td>14</td><td>Cell 2: 12<br>Cell 3: 10</td></tr>
<tr><td rowspan="3">$N_{oc}^{(j)}$ at antenna port</td><td>$N_{oc1}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 7)</td><td>N/A</td><td colspan="2">-98 (Note 7)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 8)</td><td>N/A</td><td colspan="2">-98 (Note 8)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-93 (Note 9)</td><td>N/A</td><td colspan="2">-93 (Note 9)</td><td>N/A</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td colspan="2">0</td><td>Cell 2: 6<br>Cell 3: 1</td><td colspan="2">0</td><td>Cell 2: 6<br>Cell 3: 1</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>µs</td><td colspan="3">Cell 2: 3 usec<br>Cell 3: -1usec</td><td colspan="3">Cell 2: 3 usec<br>Cell 3: -1usec</td></tr>
<tr><td colspan="2">Frequency Shift between Cells</td><td>Hz</td><td colspan="3">Cell 2: 300Hz<br>Cell 3: -100Hz</td><td colspan="3">Cell 2: 300Hz<br>Cell 3: -100Hz</td></tr>
<tr><td colspan="2">ABS pattern (Note 2)</td><td></td><td colspan="2">N/A</td><td>01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td colspan="2">N/A</td><td>01010101<br>01010101<br>01010101<br>01010101<br>01010101</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 4)</td><td></td><td colspan="2">00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td><td colspan="2">00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 3)</td><td>$C_{CSI,0}$</td><td></td><td colspan="2">01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td>N/A</td><td colspan="2">01010101<br>01010101<br>01010101<br>01010101<br>01010101</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td colspan="2">10101010<br>10101010<br>10101010<br>10101010<br>10101010</td><td>N/A</td><td colspan="2">10101010<br>10101010<br>10101010<br>10101010<br>10101010</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td colspan="3">3</td><td colspan="3">3</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,0}$ CQI reporting</td><td></td><td colspan="3">PUCCH Format 2</td><td colspan="3">PUCCH Format 2</td></tr>
<tr><td colspan="2">Physical channel for $C_{CSI,1}$ CQI reporting</td><td></td><td colspan="3">PUSCH (Note 12)</td><td colspan="3">PUSCH (Note 12)</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="3">4</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>Ms</td><td colspan="3">$N_{pd} = 5$</td><td colspan="3">$N_{pd} = 5$</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex $C_{CSI,0}$ (Note 13)</td><td rowspan="2"></td><td colspan="2">6</td><td>N/A</td><td colspan="2">6</td><td>N/A</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex2 $C_{CSI,1}$ (Note 14)</td><td colspan="2">5</td><td>N/A</td><td colspan="2">5</td><td>N/A</td></tr>
</table>

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 are the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |
| Note 13: | *cqi-pmi-ConfigurationIndex* is applied for $C_{CSI,0}$. |
| Note 14: | *cqi-pmi-ConfigurationIndex2* is applied for $C_{CSI,1}$. |

#### 9.2.1.6 TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

The following requirements apply to UE Category ≥2. For the parameters specified in Table 9.2.1.6-1, and using the downlink physical channels specified in tables C.3.2-1 for Cell 1, C3.3-2 for Cell 2 and Cell 3, and C.3.2-2, the reported CQI value according to RC.2 TDD in Table A.4-1 in subframes overlapping with aggressor cell ABS and non-ABS subframes shall be in the range of ±1 of the reported median more than 90% of the time.

For test 1 and test 2, if the PDSCH BLER in ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ is less than or equal to 0.1, the BLER in ABS subframes using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER in ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

For test 2, if the PDSCH BLER in non-ABS subframes using the transport format indicated by median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ is less than or equal to 0.1, the BLER in non-ABS subframes using the transport format indicated by the (median CQI + 2) shall be greater than 0.1. If the PDSCH BLER in non-ABS subframes using the transport format indicated by the median CQI is greater than 0.1, the BLER in non-ABS subframes using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.2.1.6-1: PUCCH 1-0 static test (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | **Cell 1** | **Cell 2 and 3** | **Cell 1** | **Cell 2 and 3** |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 2 | Note 10 | 2 | Note 10 |
| Uplink downlink configuration | | | 1 | | 1 | |
| Special subframe configuration | | | 4 | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | -3 | |
| | $\rho_B$ | dB | -3 | | -3 | |
| | σ | dB | 0 | | 0 | |
| Propagation condition and antenna configuration | | | Clause B.1 (2x2) | | Clause B.1 (2x2) | |
| $\widehat{E}_s/N_{oc2}$ (Note 1) | | dB | 4 5 | Cell 2: 12<br>Cell 3: 10 | 13 14 | Cell 2: 12<br>Cell 3: 10 |
| $N_{oc}^{(j)}$ at antenna port | $N_{oc1}^{(j)}$ | dBm/15kHz | -98 (Note 7) | N/A | -98 (Note 7) | N/A |
| | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8) | N/A | -98 (Note 8) | N/A |
| | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9) | N/A | -93 (Note 9) | N/A |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | Cell 2: 6<br>Cell 3: 1 | 0 | Cell 2: 6<br>Cell 3: 1 |
| Time Offset between Cells | | μs | Cell 2: 3 usec<br>Cell 3: -1usec | | Cell 2: 3 usec<br>Cell 3: -1usec | |
| Frequency shift between Cells | | Hz | Cell 2: 300Hz<br>Cell 3: -100Hz | | Cell 2: 300Hz<br>Cell 3: -100Hz | |
| ABS pattern (Note 2) | | | N/A | 0100010001<br>0100010001 | N/A | 0100010001<br>0100010001 |
| RLM/RRM Measurement Subframe Pattern (Note 4) | | | 0000000001<br>0000000001 | N/A | 0000000001<br>0000000001 | N/A |
| CSI Subframe Sets (Note 3) | $C_{CSI,0}$ | | 0100010001<br>0100010001 | N/A | 0100010001<br>0100010001 | N.A |
| | $C_{CSI,1}$ | | 1000101000<br>1000101000 | N/A | 1000101000<br>1000101000 | N/A |
| Number of control OFDM symbols | | | 3 | | 3 | |
| Max number of HARQ transmissions | | | 1 | | 1 | |
| Physical channel for $C_{CSI,0}$ CQI reporting | | | PUCCH Format 2 | | PUCCH Format 2 | |
| Physical channel for $C_{CSI,1}$ CQI reporting | | | PUSCH (Note 12) | | PUSCH (Note 12) | |
| PUCCH Report Type | | | 4 | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | $N_{pd}$ = 5 | |
| *cqi-pmi-ConfigurationIndex* $C_{CSI,0}$ (Note 13) | | | 3 | N/A | 3 | N/A |
| *cqi-pmi-ConfigurationIndex*2 $C_{CSI,1}$ (Note 14) | | | 4 | N/A | 4 | N/A |
| ACK/NACK feedback mode | | | Multiplexing | | Multiplexing | |

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 is the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |
| Note 13: | *cqi-pmi-ConfigurationIndex* is applied for $C_{CSI,0}$. |
| Note 14: | *cqi-pmi-ConfigurationIndex2* is applied for $C_{CSI,1}$. |

## 9.2.2 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

### 9.2.2.1 FDD

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.2.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband $CQI_1$ 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 | $N_{pd}$ = 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. 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 | $N_{pd}$ = 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.

## 9.2.3 Minimum requirement PUCCH 1-1 (CSI Reference Symbols)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

### 9.2.3.1 FDD

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.3.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband $CQI_1$ 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 9.2.3.1-1: PUCCH 1-1 static test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 9 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | -3 | | | |
| | σ | dB | -3 | | | |
| Cell-specific reference signals | | | Antenna ports 0, 1 | | | |
| CSI reference signals | | | Antenna ports 15,…,18 | | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | | |
| CSI reference signal configuration | | | 0 | | | |
| Propagation condition and antenna configuration | | | Clause B.1 (4 x 2) | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0100 0000 | | | |
| SNR (Note 2) | | dB | 7 | 8 | 13 | 14 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -91 | -90 | -85 | -84 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note3) | | | |
| PUCCH Report Type for CQI/PMI | | | 2 | | | |
| Physical channel for RI reporting | | | PUCCH Format 2 | | | |
| PUCCH Report Type for RI | | | 3 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| CQI delay | | ms | 8 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 2 | | | |
| *ri-ConfigIndex* | | | 1 | | | |

Note 1: Reference measurement channel RC.7 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.

Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.

### 9.2.3.2 TDD

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.3.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband $CQI_1$ 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 9.2.3.2-1: PUCCH 1-1 submode 1 static test (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 9 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | -6 | | | |
| | σ | dB | -3 | | | |
| CRS reference signals | | | Antenna ports 0, 1 | | | |
| CSI reference signals | | | Antenna ports 15,…,22 | | | |
| CSI-RS periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | | 5/ 3 | | | |
| CSI reference signal configuration | | | 0 | | | |
| Propagation condition and antenna configuration | | | Clause B.1 (8 x 2) | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0020 0000 0000 0001 0000 | | | |
| SNR (Note 2) | | dB | 4 | 5 | 10 | 11 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -88 | -87 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | | | |
| PUCCH Report Type for CQI/second PMI | | | 2b | | | |
| Physical channel for RI reporting | | | PUSCH | | | |
| PUCCH Report Type for RI/ first PMI | | | 5 | | | |
| Reporting periodicity | | ms | $N_{\text{pd}}$ = 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| *ri-ConfigIndex* | | | 805 (Note 4) | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

Note 1: Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.
Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 3: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.
Note 4: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification.

## 9.2.4 Minimum requirement PUCCH 1-1 (With Single CSI Process)

The minimum requirements for dual codeword transmission are defined in terms of a reporting spread of the wideband CQI value for codeword #1, and their BLER performance using the transport format indicated by the reported CQI median of codeword #0 and codeword #1. The precoding used at the transmitter is a fixed precoding matrix specified by the bitmap parameter *codebookSubsetRestriction*. The propagation condition assumed for the minimum performance requirement is defined in subclause B.1.

### 9.2.4.1 FDD

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.4.1-1, and using the downlink physical channels specified in tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband $CQI_1$ 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 9.2.4.1-1: PUCCH 1-1 static test (FDD)**

| Parameter | | Unit | Test 1 | | | Test 2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | TP1 | TP2 | | TP1 | TP2 | |
| Bandwidth | | MHz | 10 | | | | | |
| PDSCH transmission mode | | | 10 | | | | | |
| Downlink power allocation (Note 1) | $\rho_A$ | dB | 0 | 0 | | 0 | 0 | |
| | $\rho_B$ | dB | 0 | 0 | | 0 | 0 | |
| | $P_c$ | dB | -3 | -3 | | -3 | -3 | |
| | σ | dB | -3 | N/A | | -3 | N/A | |
| Cell ID | | | 0 | | | 0 | | |
| Cell-specific reference signals | | | Antenna ports 0, 1 | (Note 2) | | Antenna ports 0, 1 | (Note 2) | |
| CSI reference signals | | | Antenna ports 15,…,18 | N/A | | Antenna ports 15,…,18 | N/A | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | N/A | | 5/1 | N/A | |
| CSI-RS configuration | | | 0 | N/A | | 0 | N/A | |
| Zero-Power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 1 / 0010000000000000 | 1 / 1000000000000000 | | 1 / 0010000000000000 | 1 / 1000000000000000 | |
| CSI-IM configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 1 / 0010000000000000 | N/A | | 1 / 0010000000000000 | N/A | |
| CSI process configuration Signal/Interference/Reporting mode | | | CSI-RS/CSI-IM/PUCCH 1-1 | | | CSI-RS/CSI-IM/PUCCH 1-1 | | |
| Propagation condition and antenna configuration | | | Clause B.1 (4 x 2) | Clause B.1 (2 x 2) | | Clause B.1 (4 x 2) | Clause B.1 (2 x 2) | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0100 0000 | 100000 | | 0x0000 0000 0100 0000 | 100000 | |
| SNR (Note 3) | | dB | 20 | 6 | 7 | 20 | 14 | 15 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -78 | -92 | -91 | -78 | -84 | -83 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | | -98 | | |
| Modulation / Information bit payload | | | (Note4) | QPSK / 4392 | | (Note4) | QPSK / 4392 | |
| Max number of HARQ transmissions | | | 1 | N/A | | 1 | N/A | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note5) | N/A | | PUSCH (Note5) | N/A | |
| PUCCH Report Type for CQI/PMI | | | 2 | N/A | | 2 | N/A | |
| PUCCH Report Type for RI | | | 3 | N/A | | 3 | N/A | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | | $N_{pd}$ = 5 | N/A | |
| CQI Delay | | ms | 8 | N/A | | 8 | N/A | |
| *cqi-pmi-ConfigurationIndex* | | | 2 | N/A | | 2 | N/A | |
| *ri-ConfigIndex* | | | 1 | N/A | | 1 | N/A | |
| PDSCH scheduled sub-frames | | | 1,2,3,4,6,7,8,9 | | | 1,2,3,4,6,7,8,9 | | |
| Timing offset between TPs | | us | 0 | | | 0 | | |
| Frequency offset between TPs | | Hz | 0 | | | 0 | | |

Note1: Reference measurement channel RC.10 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
Note 2: REs for antenna ports 0 and 1 CRS have zero transmission power.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: Void
Note 5: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.

### 9.2.4.2 TDD

The following requirements apply to UE Category ≥2. For the parameters specified in table 9.2.4.2-1, and using the downlink physical channels specified in tables C.3.4-1 and C.3.4-2, the reported offset level of the wideband spatial differential CQI for codeword #1 (Table 7.2-2 in TS 36.213 [6]) shall be used to determine the wideband CQI index for codeword #1 as

$$\text{wideband } CQI_1 = \text{wideband } CQI_0 - \text{Codeword 1 offset level}$$

The wideband $CQI_1$ 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 9.2.4.2-1: PUCCH 1-1 static test (TDD)**

| Parameter | | Unit | Test 1 | | | Test 2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | TP1 | TP2 | | TP1 | TP2 | |
| Bandwidth | | MHz | 10 | | | | | |
| PDSCH transmission mode | | | 10 | | | | | |
| Uplink downlink configuration | | | 2 | | | | | |
| Special subframe configuration | | | 4 | | | | | |
| Downlink power allocation (Note 1) | $\rho_A$ | dB | 0 | 0 | | 0 | 0 | |
| | $\rho_B$ | dB | 0 | 0 | | 0 | 0 | |
| | $P_c$ | dB | -6 | -6 | | -6 | -6 | |
| | $\sigma$ | dB | -3 | N/A | | -3 | N/A | |
| Cell ID | | | 0 | | | 0 | | |
| Cell-specific reference signals | | | Antenna ports 0, 1 | (Note 2) | | Antenna ports 0, 1 | (Note 2) | |
| CSI reference signals | | | Antenna ports 15,…,22 | N/A | | Antenna ports 15,…,22 | N/A | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | N/A | | 5/3 | N/A | |
| CSI-RS configuration | | | 0 | N/A | | 0 | N/A | |
| Zero-Power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0010000000000000 | 3 / 1000010000000000 | | 3 / 0010000000000000 | 3 / 1000010000000000 | |
| CSI-IM configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0010000000000000 | N/A | | 3 / 0010000000000000 | N/A | |
| CSI process configuration Signal/Interference/Reporting mode | | | CSI-RS/CSI-IM/PUCCH 1-1 | | | CSI-RS/CSI-IM/PUCCH 1-1 | | |
| Propagation condition and antenna configuration | | | Clause B.1 (8 x 2) | Clause B.1 (2 x 2) | | Clause B.1 (8 x 2) | Clause B.1 (2 x 2) | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0020 0000 0000 0001 0000 | 100000 | | 0x0000 0000 0020 0000 0000 0001 0000 | 100000 | |
| SNR (Note 3) | | dB | 17 | 6 | 7 | 17 | 14 | 15 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -81 | -92 | -91 | -81 | -84 | -83 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | | -98 | | |
| Modulation / Information bit payload | | | (Note4) | QPSK / 4392 | | (Note4) | QPSK / 4392 | |
| Max number of HARQ transmissions | | | 1 | N/A | | 1 | N/A | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note5) | N/A | | PUSCH (Note5) | N/A | |
| PUCCH Report Type for CQI/second PMI | | | 2b | N/A | | 2b | N/A | |
| Physical channel for RI reporting | | | PUSCH | N/A | | PUSCH | N/A | |
| PUCCH Report Type for RI/ first PMI | | | 5 | N/A | | 5 | N/A | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | | $N_{pd}$ = 5 | N/A | |
| CQI Delay | | ms | 10 or 11 | N/A | | 10 or 11 | N/A | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | N/A | | 3 | N/A | |
| *ri-ConfigIndex* | | | 805 (Note 6) | N/A | | 805 (Note 6) | N/A | |
| *ACK/NACK feedback mode* | | | Multiplexing | N/A | | Multiplexing | N/A | |
| PDSCH scheduled sub-frames | | | 3,4,8,9 | | | 3,4,8,9 | | |
| Timing offset between TPs | | us | 0 | | | 0 | | |
| Frequency offset between TPs | | Hz | 0 | | | 0 | | |

| | |
|---|---|
| Note1: | Reference measurement channel RC.10 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |
| Note 2: | REs for antenna ports 0 and 1 CRS have zero transmission power. |
| Note 3: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 4: | Void |
| Note 5: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2. |
| Note 6: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |

# 9.3 CQI reporting under fading conditions

## 9.3.1 Frequency-selective scheduling mode

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

### 9.3.1.1 Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbols)

#### 9.3.1.1.1 FDD

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

a) 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 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.

**Table 9.3.1.1.1-2 Minimum requirement (FDD)**

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

### 9.3.1.1.2 TDD

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

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

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

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | 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 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

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

Note 2: Reference measurement channel RC.3 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.

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

**Table 9.3.1.1.2-2 Minimum requirement (TDD)**

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

#### 9.3.1.1.3 FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

For the parameters specified in Table 9.3.1.1.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.3-2 and by the following

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

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

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

**Table 9.3.1.1.3-1 Sub-band test for single antenna transmission (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 and 3 | Cell 1 | Cell 2 and 3 |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 1 | Note 10 | 1 | Note 10 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | 0 | |
| | $\rho_B$ | dB | 0 | | 0 | |
| | σ | dB | 0 | | 0 | |
| Propagation condition | | | Clause B.2.4 with Td = 0.45 us, a = 1, fd = 5 Hz | EVA5 Low antenna correlation | Clause B.2.4 with Td = 0.45 us, a = 1, fd = 5 Hz | EVA5 Low antenna correlation |
| Antenna configuration | | | 1x2 | | 1x2 | |
| $\widehat{E}_s/N_{oc2}$ (Note 1) | | dB | 4<br>5 | Cell 2: 12<br>Cell 3: 10 | 14<br>15 | Cell 2: 12<br>Cell 3: 10 |
| $N_{oc}^{(j)}$ at antenna port | $N_{oc1}^{(j)}$ | dBm/15kHz | -98 (Note 7) | N/A | -98 (Note 7) | N/A |
| | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8) | N/A | -98 (Note 8) | N/A |
| | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9) | N/A | -93 (Note 9) | N/A |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | Cell 2: 6<br>Cell 3: 1 | 0 | Cell 2: 6<br>Cell 3: 1 |
| Time Offset between Cells | | μs | Cell 2: 3 usec<br>Cell 3: -1usec | | Cell 2: 3 usec<br>Cell 3: -1usec | |
| Frequency Shift between Cells | | Hz | Cell 2: 300Hz<br>Cell 3: -100Hz | | Cell 2: 300Hz<br>Cell 3: -100Hz | |
| ABS pattern (Note 2) | | | N/A | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |
| RLM/RRM Measurement Subframe Pattern (Note 4) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | N/A |
| CSI Subframe Sets (Note 3) | $C_{CSI,0}$ | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A |
| | $C_{CSI,1}$ | | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | N/A |
| Number of control OFDM symbols | | | 3 | | 3 | |
| Max number of HARQ transmissions | | | 1 | | 1 | |
| CQI delay | | ms | 8 | | | |
| Reporting interval (Note 13) | | ms | 10 | | | |
| Reporting mode | | | PUSCH 3-0 | | | |
| Sub-band size | | RB | 6 (full size) | | | |

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 are the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2. |
| Note 12: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 13: | The CSI reporting is such that reference subframes belong to $C_{csi,0}$. |

**Table 9.3.1.1.3-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| ε | 0.01 | 0.01 |
| UE Category | ≥1 | ≥1 |

### 9.3.1.1.4 TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

For the parameters specified in Table 9.3.1.1.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.4-2 and by the following

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

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

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

**Table 9.3.1.1.4-1 Sub-band test for single antenna transmission (TDD)**

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Test 1</th><th colspan="3">Test 2</th></tr>
<tr><th colspan="2">Cell 1</th><th>Cell 2 and 3</th><th colspan="2">Cell 1</th><th>Cell 2 and 3</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="3">10</td><td colspan="3">10</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td colspan="2">1</td><td>Note 10</td><td colspan="2">1</td><td>Note 10</td></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td colspan="3">4</td><td colspan="3">4</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="3">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">Propagation condition</td><td></td><td colspan="2">Clause B.2.4 with Td = 0.45 us, a = 1, fd = 5 Hz</td><td>EVA5 Low antenna correlation</td><td colspan="2">Clause B.2.4 with Td = 0.45 us, a = 1, fd = 5 Hz</td><td>EVA5 Low antenna correlation</td></tr>
<tr><td colspan="2">Antenna configuration</td><td></td><td colspan="3">1x2</td><td colspan="3">1x2</td></tr>
<tr><td colspan="2">$\widehat{E}_s / N_{oc2}$ (Note 1)</td><td>dB</td><td>4</td><td>5</td><td>Cell 2: 12<br>Cell 3: 10</td><td>14</td><td>15</td><td>Cell 2: 12<br>Cell 3: 10</td></tr>
<tr><td rowspan="3">$N_{oc}^{(j)}$ at antenna port</td><td>$N_{oc1}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 7)</td><td>N/A</td><td colspan="2">-98 (Note 7)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-98 (Note 8)</td><td>N/A</td><td colspan="2">-98 (Note 8)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}^{(j)}$</td><td>dBm/15kHz</td><td colspan="2">-93 (Note 9)</td><td>N/A</td><td colspan="2">-93 (Note 9)</td><td>N/A</td></tr>
<tr><td colspan="2">Subframe Configuration</td><td></td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td><td colspan="2">Non-MBSFN</td><td>Non-MBSFN</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td colspan="2">0</td><td>Cell 2: 6<br>Cell 3: 1</td><td colspan="2">0</td><td>Cell 2: 6<br>Cell 3: 1</td></tr>
<tr><td colspan="2">Time Offset between Cells</td><td>µs</td><td colspan="3">Cell 2: 3 usec<br>Cell 3: -1usec</td><td colspan="3">Cell 2: 3 usec<br>Cell 3: -1usec</td></tr>
<tr><td colspan="2">Frequency shift between Cells</td><td>Hz</td><td colspan="3">Cell 2: 300Hz<br>Cell 3: -100Hz</td><td colspan="3">Cell 2: 300Hz<br>Cell 3: -100Hz</td></tr>
<tr><td colspan="2">ABS pattern (Note 2)</td><td></td><td colspan="2">N/A</td><td>0100010001<br>0100010001</td><td colspan="2">N/A</td><td>0100010001<br>0100010001</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 4)</td><td></td><td colspan="2">0000000001<br>0000000001</td><td>N/A</td><td colspan="2">0000000001<br>0000000001</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 3)</td><td>$C_{CSI,0}$</td><td></td><td colspan="2">0100010001<br>0100010001</td><td>N/A</td><td colspan="2">0100010001<br>0100010001</td><td>N.A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td colspan="2">1000101000<br>1000101000</td><td>N/A</td><td colspan="2">1000101000<br>1000101000</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td colspan="3">3</td><td colspan="3">3</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="3">1</td><td colspan="3">1</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="6">10</td></tr>
<tr><td colspan="2">Reporting interval (Note 13)</td><td>ms</td><td colspan="6">10</td></tr>
<tr><td colspan="2">Reporting mode</td><td></td><td colspan="6">PUSCH 3-0</td></tr>
<tr><td colspan="2">Sub-band size</td><td>RB</td><td colspan="6">6 (full size)</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td colspan="3">Multiplexing</td><td colspan="3">Multiplexing</td></tr>
</table>

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 is the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.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 12: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 13: | The CSI reporting is such that reference subframes belong to $C_{csi,0}$. |

**Table 9.3.1.1.4-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| ε | 0.01 | 0.01 |
| UE Category | ≥1 | ≥1 |

## 9.3.1.2 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

### 9.3.1.2.1 FDD

For the parameters specified in Table 9.3.1.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.1-2 and by the following

a) 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 ≥ γ;

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

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

**Table 9.3.1.2.1-1 Sub-band test for FDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 9 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 4 | 5 | 11 | 12 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -87 | 86 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | | | |
| Antenna configuration | | | 2x2 | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CRS reference signals | | | Antenna ports 0 | | | |
| CSI reference signals | | | Antenna ports 15, 16 | | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 1 | | | |
| CSI-RS reference signal configuration | | | 4 | | | |
| CodeBookSubsetRestriction bitmap | | | 000001 | | | |
| Reporting interval (Note 4) | | ms | 5 | | | |
| CQI delay | | ms | 8 | | | |
| Reporting mode | | | PUSCH 3-1 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.8 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.

**Table 9.3.1.2.1-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 40 | 40 |
| $\gamma$ | 1.1 | 1.1 |
| UE Category | ≥1 | ≥1 |

### 9.3.1.2.2 TDD

For the parameters specified in Table 9.3.1.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.2-2 and by the following

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

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

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

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

**Table 9.3.1.2.2-1 Sub-band test for TDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 9 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 4 | 5 | 11 | 12 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -87 | -86 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | | | |
| Antenna configuration | | | 2x2 | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CRS reference signals | | | Antenna port 0 | | | |
| CSI reference signals | | | Antenna port 15,16 | | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 3 | | | |
| CSI-RS reference signal configuration | | | 4 | | | |
| CodeBookSubsetRestriction bitmap | | | 000001 | | | |
| Reporting interval (Note 4) | | ms | 5 | | | |
| CQI delay | | ms | 10 | | | |
| Reporting mode | | | PUSCH 3-1 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

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.8 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.

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

Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2 and #7.

**Table 9.3.1.2.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 40 | 40 |
| $\gamma$ | 1.1 | 1.1 |
| UE Category | ≥1 | ≥1 |

## 9.3.2 Frequency non-selective scheduling mode

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

### 9.3.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)

#### 9.3.2.1.1 FDD

For the parameters specified in Table 9.3.2.1.1-1, and 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)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10 MHz</td></tr>
<tr><td colspan="2">Transmission mode</td><td></td><td colspan="4">1 (port 0)</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td colspan="2">SNR (Note 3)</td><td>dB</td><td>6</td><td>7</td><td>12</td><td>13</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-92</td><td>-91</td><td>-86</td><td>-85</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="4">EPA5</td></tr>
<tr><td colspan="2">Correlation and antenna configuration</td><td></td><td colspan="4">High (1 x 2)</td></tr>
<tr><td colspan="2">Reporting mode</td><td></td><td colspan="4">PUCCH 1-0</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">$N_{pd}$ = 2</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="4">8</td></tr>
<tr><td colspan="2">Physical channel for CQI reporting</td><td></td><td colspan="4">PUSCH (Note 4)</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="7">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)<br>Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.<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.<br>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.</td></tr>
</table>

**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 | ≥1 |

#### 9.3.2.1.2 TDD

For the parameters specified in Table 9.3.2.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.1.2-2 and by the following

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

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

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)**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10 MHz</td></tr>
<tr><td colspan="2">Transmission mode</td><td></td><td colspan="4">1 (port 0)</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td colspan="4">2</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">SNR (Note 3)</td><td>dB</td><td>6</td><td>7</td><td>12</td><td>13</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-92</td><td>-91</td><td>-86</td><td>-85</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="4">EPA5</td></tr>
<tr><td colspan="2">Correlation and antenna configuration</td><td></td><td colspan="4">High (1 x 2)</td></tr>
<tr><td colspan="2">Reporting mode</td><td></td><td colspan="4">PUCCH 1-0</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">$N_{pd}$ = 5</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="4">10 or 11</td></tr>
<tr><td colspan="2">Physical channel for CQI reporting</td><td></td><td colspan="4">PUSCH (Note 4)</td></tr>
<tr><td colspan="2">PUCCH Report Type</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex</td><td></td><td colspan="4">3</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td colspan="4">Multiplexing</td></tr>
<tr><td colspan="7">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).<br>Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.<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.<br>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.</td></tr>
</table>

**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 | ≥1 |

### 9.3.2.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

#### 9.3.2.2.1 FDD

For the parameters specified in Table 9.3.2.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.2.1-2 and by the following

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

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

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

**Table 9.3.2.2.1-1 Fading test for FDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 9 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | -3 | | | |
| | σ | dB | -3 | | | |
| SNR (Note 3) | | dB | 2 | 3 | 7 | 8 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -96 | -95 | -91 | -90 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA5 | | | |
| Correlation and antenna configuration | | | ULA High (4 x 2) | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| Cell-specific reference signals | | | Antenna ports 0,1 | | | |
| CSI reference signals | | | Antenna ports 15,…,18 | | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | | |
| CSI-RS reference signal configuration | | | 2 | | | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 0001 | | | |
| Reporting mode | | | PUCCH 1-1 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| CQI delay | | ms | 8 | | | |
| Physical channel for CQI/ PMI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type for CQI/PMI | | | 2 | | | |
| PUCCH channel for RI reporting | | | PUCCH Format 2 | | | |
| PUCCH report type for RI | | | 3 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 2 | | | |
| *ri-ConfigIndex* | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.7 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.

**Table 9.3.2.2.1-2 Minimum requirement (FDD)**

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

### 9.3.2.2.2 TDD

For the parameters specified in Table 9.3.2.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.2.2-2 and by the following

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

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

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

**Table 9.3.2.2.2-1 Fading test for TDD**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10 MHz</td></tr>
<tr><td colspan="2">Transmission mode</td><td></td><td colspan="4">9</td></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td colspan="4">2</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td colspan="4">4</td></tr>
<tr><td rowspan="4">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$P_c$</td><td>dB</td><td colspan="4">-6</td></tr>
<tr><td>$\sigma$</td><td>dB</td><td colspan="4">-3</td></tr>
<tr><td colspan="2">SNR (Note 3)</td><td>dB</td><td>1</td><td>2</td><td>7</td><td>8</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-97</td><td>-96</td><td>-91</td><td>-90</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="4">EPA5</td></tr>
<tr><td colspan="2">Correlation and antenna configuration</td><td></td><td colspan="4">XP High (8 x 2)</td></tr>
<tr><td colspan="2">Beamforming Model</td><td></td><td colspan="4">As specified in Section B.4.3</td></tr>
<tr><td colspan="2">CRS reference signals</td><td></td><td colspan="4">Antenna ports 0, 1</td></tr>
<tr><td colspan="2">CSI reference signals</td><td></td><td colspan="4">Antenna ports 15,…,22</td></tr>
<tr><td colspan="2">CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$</td><td></td><td colspan="4">5/ 3</td></tr>
<tr><td colspan="2">CSI-RS reference signal configuration</td><td></td><td colspan="4">2</td></tr>
<tr><td colspan="2">CodeBookSubsetRestriction bitmap</td><td></td><td colspan="4">0x0000 0000 0000 0020 0000 0000 0001</td></tr>
<tr><td colspan="2">Reporting mode</td><td></td><td colspan="4">PUCCH 1-1 (Sub-mode: 2)</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">$N_{pd}$ = 5</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="4">10</td></tr>
<tr><td colspan="2">Physical channel for CQI/ PMI reporting</td><td></td><td colspan="4">PUSCH (Note 4)</td></tr>
<tr><td colspan="2">PUCCH Report Type for CQI/ PMI</td><td></td><td colspan="4">2c</td></tr>
<tr><td colspan="2">Physical channel for RI reporting</td><td></td><td colspan="4">PUCCH Format 2</td></tr>
<tr><td colspan="2">PUCCH report type for RI</td><td></td><td colspan="4">3</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigurationIndex</td><td></td><td colspan="4">3</td></tr>
<tr><td colspan="2">ri-ConfigIndex</td><td></td><td colspan="4">805 (Note 5)</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td colspan="4">Multiplexing</td></tr>
<tr><td colspan="7">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)<br>Note 2: Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.<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.<br>Note 4: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#2 and #7.<br>Note 5: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available.</td></tr>
</table>

**Table 9.3.2.2.2-2 Minimum requirement (TDD)**

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

## 9.3.3 Frequency-selective interference

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

### 9.3.3.1 Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbol)

#### 9.3.3.1.1 FDD

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

a) 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 |
| | $\sigma$ | 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)<br>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 | ≥1 |

### 9.3.3.1.2 TDD

For the parameters specified in Table 9.3.3.1.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.3.1.2-2 and by the following

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

b) the ratio of the throughput obtained when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected sub-band in set *S* shall be ≥ 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).<br>Note 2: Reference measurement channel RC.3 TDD according to table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2. | | | | |

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

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

#### 9.3.3.2 Void

##### 9.3.3.2.1 Void

##### 9.3.3.2.2 Void

### 9.3.4 UE-selected subband CQI

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

#### 9.3.4.1 Minimum requirement PUSCH 2-0 (Cell-Specific Reference Symbols)

##### 9.3.4.1.1 FDD

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

a) the ratio of the throughput obtained when transmitting on a randomly selected subband among the best M subbands reported by the UE the corresponding TBS and that obtained when transmitting the TBS indicated by the reported wideband CQI median on a randomly selected subband in set *S* shall be ≥ 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 $N_{\mathrm{PRB}}$ 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 | | | |
| | $\sigma$ | dB | 0 | | | |
| SNR (Note 3) | | dB | 9 | 10 | 14 | 15 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -89 | -88 | -84 | -83 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *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)<br>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.<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 9.3.4.1.1-2 Minimum requirement (FDD)**

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

### 9.3.4.1.2 TDD

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

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

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{\mathrm{PRB}}$ 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 | ≥1 |

### 9.3.4.2 Minimum requirement PUCCH 2-0 (Cell-Specific Reference Symbols)

#### 9.3.4.2.1 FDD

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

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

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

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10 MHz</td></tr>
<tr><td colspan="2">Transmission mode</td><td></td><td colspan="4">1 (port 0)</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="4">0</td></tr>
<tr><td colspan="2">SNR (Note 3)</td><td>dB</td><td>8</td><td>9</td><td>13</td><td>14</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-90</td><td>-89</td><td>-85</td><td>-84</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td colspan="2">-98</td><td colspan="2">-98</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="4">Clause B.2.4 with $\tau_d = 0.45\,\mu$s, a = 1, $f_D = 5$ Hz</td></tr>
<tr><td colspan="2">Reporting periodicity</td><td>ms</td><td colspan="4">NP = 2</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="4">8</td></tr>
<tr><td colspan="2">Physical channel for CQI reporting</td><td></td><td colspan="4">PUSCH (Note 4)</td></tr>
<tr><td colspan="2">PUCCH Report Type for wideband CQI</td><td></td><td colspan="4">4</td></tr>
<tr><td colspan="2">PUCCH Report Type for subband CQI</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">Subband size (k)</td><td>RBs</td><td colspan="4">6 (full size)</td></tr>
<tr><td colspan="2">Number of bandwidth parts (J)</td><td></td><td colspan="4">3</td></tr>
<tr><td colspan="2">K</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="2">cqi-pmi-ConfigIndex</td><td></td><td colspan="4">1</td></tr>
<tr><td colspan="7">Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 2: Reference measurement channel RC.3 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.<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.<br>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.<br>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.<br>Note 6: In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report.</td></tr>
</table>

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

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

#### 9.3.4.2.2 TDD

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

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

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{\mathrm{PRB}}$ 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 | ≥1 |

## 9.3.5 Additional requirements for enhanced receiver Type A

The purpose of the test is to verify that the reporting of the channel quality is based on the receiver of the enhanced Type A. Performance requirements are specified in terms of the relative increase of the throughput obtained when the transport format is that indicated by the reported CQI subject to an interference model compared to the case with a white Gaussian noise model, and a requirement on the minimum BLER of the transmitted transport formats indicated by the reported CQI subject to an interference model.

### 9.3.5.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)

#### 9.3.5.1.1 FDD

For the parameters specified in Table 9.3.5.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.5.1.1-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be $\geq \gamma$;

b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.1.1-1 Fading test for single antenna (FDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|
| Bandwidth | MHz | 10 MHz | |
| Transmission mode | | 1 (port 0) | |
| Cyclic Prefix | | Normal | Normal |
| Cell ID | | 0 | 1 |
| SINR (Note 8) | dB | -2 | N/A |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | N/A |
| Propagation channel | | EPA5 | Static (Note 7) |
| Correlation and antenna configuration | | Low (1 x 2) | (1 x 2) |
| DIP (Note 4) | dB | N/A | -0.41 |
| Reference measurement channel | | Note 2 | N/A |
| Reporting mode | | PUCCH 1-0 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 2 | N/A |
| CQI delay | ms | 8 | N/A |
| Physical channel for CQI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type | | 4 | N/A |
| *cqi-pmi-ConfigurationIndex* | | 1 | N/A |
| Max number of HARQ transmissions | | 1 | N/A |

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

Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.

Note 3: 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 4: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Intefering cell is fully loaded.

Note 6: Both cells are time-synchronous.

Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.

Note 8: SINR corresponds to $\widehat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1.

Note 9: Downlink physical channel setup in Cell 2 applies OCNG pattern OP.1 FDD as defined in Annex A.5.1.1.

**Table 9.3.5.1.1-2 Minimum requirement (FDD)**

| | |
|---|---|
| $\gamma$ | 1.8 |
| UE Category | ≥1 |

### 9.3.5.1.2 TDD

For the parameters specified in Table 9.3.5.1.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.5.1.2-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be $\geq \gamma$;

b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.1.2-1 Fading test for single antenna (TDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|
| Bandwidth | MHz | 10 MHz | |
| Transmission mode | | 1 (port 0) | |
| Uplink downlink configuration | | 2 | |
| Special subframe configuration | | 4 | |
| Cyclic Prefix | | Normal | Normal |
| Cell ID | | 0 | 1 |
| SINR (Note 8) | dB | -2 | N/A |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | -98 |
| Propagation channel | | EPA5 | Static (Note 7) |
| Correlation and antenna configuration | | Low (1 x 2) | (1 x 2) |
| DIP (Note 4) | dB | N/A | -0.41 |
| Reference measurement channel | | Note 2 | N/A |
| Reporting mode | | PUCCH 1-0 | N/A |
| Reporting periodicity | ms | $N_{pd} = 5$ | N/A |
| CQI delay | ms | 10 or 11 | N/A |
| Physical channel for CQI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type | | 4 | N/A |
| *cqi-pmi-ConfigurationIndex* | | 3 | N/A |
| Max number of HARQ transmissions | | 1 | N/A |
| ACK/NACK feedback mode | | Multiplexing | N/A |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.
Note 3: 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 4: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.
Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. The number of the CRS ports in both cells is the same. Intefering cell is fully loaded.
Note 6: Both cells are time-synchronous.
Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.
Note 8: SINR corresponds to $\widehat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1.
Note 9: Downlink physical channel setup in Cell 2 applies OCNG pattern OP.1 TDD as defined in Annex A.5.2.1.

**Table 9.3.5.1.2-2 Minimum requirement (TDD)**

| | |
|---|---|
| $\gamma$ | 1.8 |
| UE Category | ≥1 |

### 9.3.5.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

#### 9.3.5.2.1 FDD

For the parameters specified in Table 9.3.5.2.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.5.2.1-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be $\geq \gamma$;

b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.2.1-1 Fading test for single antenna (FDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|
| Bandwidth | MHz | 10 MHz | |
| Transmission mode | | 9 | |
| Cyclic Prefix | | Normal | Normal |
| Cell ID | | 0 | 1 |
| SINR (Note 8) | dB | -2 | N/A |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | N/A |
| Propagation channel | | EPA5 | Static (Note 7) |
| Correlation and antenna configuration | | Low (2 x 2) | (1 x 2) |
| Beamforming Model | | As specified in Section B.4.3 (Note 10, 11) | N/A |
| DIP (Note 4) | dB | N/A | -0.41 |
| Cell-specific reference signals | | Antenna ports 0,1 | Antenna port 0 |
| CSI reference signals | | Antenna ports 15,16 | N/A |
| CSI-RS periodicity and subframe offset | | 5/1 | N/A |
| CSI-RS reference signal configuration | | 2 | N/A |
| Zero-power CSI-RS configuration $I_{\text{CSI-RS}}$ / *ZeroPowerCSI-RS* bitmap | Subframes / bitmap | N/A | 1 / 0010000000000000 |
| CodeBookSubsetRestriction bitmap | | 001111 | N/A |
| Reference measurement channel | | Note 2 | N/A |
| Reporting mode | | PUCCH 1-1 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 5 | N/A |
| CQI delay | ms | 8 | N/A |
| Physical channel for CQI/PMI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type for CQI/PMI | | 2 | N/A |
| PUCCH channel for RI reporting | | PUCCH Format 2 | N/A |
| PUCCH Report Type for RI | | 3 | N/A |
| *cqi-pmi-ConfigurationIndex* | | 2 | N/A |
| *ri-ConfigIndex* | | 1 | N/A |
| Max number of HARQ transmissions | | 1 | N/A |

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

Note 2: Reference measurement channel RC.11 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.

Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5.

Note 4: The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1.

Note 5: Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Intefering cell is fully loaded.

| | |
|---|---|
| Note 6: | Both cells are time-synchronous. |
| Note 7: | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present. |
| Note 8: | SINR corresponds to $\widehat{E}_s / N_{oc}{}'$ of Cell 1 as defined in clause 8.1.1. |
| Note 9: | Downlink physical channel setup in Cell 2 applies OCNG pattern OP.1 FDD as defined in Annex A.5.1.1. |
| Note 10: | The precoder in clause B.4.3 follows UE recommended PMI. |
| Note 11: | If the UE reports in an available uplink reporting instance at 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 9.3.5.2.1-2 Minimum requirement (FDD)**

| | |
|---|---|
| $\gamma$ | 1.8 |
| UE Category | ≥2 |

### 9.3.5.2.2 TDD

For the parameters specified in Table 9.3.5.2.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.5.2.2-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to a white Gaussian noise source shall be $\geq \gamma$;

b) when transmitting the transport format indicated by each reported wideband CQI index subject to an interference source with specified DIP, the average BLER for the indicated transport formats shall be greater than or equal to 2%.

**Table 9.3.5.2.2-1 Fading test for single antenna (TDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|
| Bandwidth | MHz | 10 MHz | |
| Transmission mode | | 9 | |
| Uplink downlink configuration | | 2 | |
| Special subframe configuration | | 4 | |
| Cyclic Prefix | | Normal | Normal |
| Cell ID | | 0 | 1 |
| SINR (Note 8) | dB | -2 | N/A |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | -98 |
| Propagation channel | | EPA5 | Static (Note 7) |
| Correlation and antenna configuration | | Low (2 x 2) | (1 x 2) |
| Beamforming Model | | As specified in Section B.4.3 (Note 11, 12) | N/A |
| DIP (Note 4) | dB | N/A | -0.41 |
| Cell-specific reference signals | | Antenna ports 0,1 | Antenna port 0 |
| CSI reference signals | | Antenna ports 15,16 | N/A |
| CSI-RS periodicity and subframe offset | | 5/3 | N/A |
| CSI-RS reference signal configuration | | 2 | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | Subframes / bitmap | N/A | 3 / 0010000000000000 |
| CodeBookSubsetRestriction bitmap | | 001111 | N/A |
| Reference measurement channel | | Note 2 | N/A |
| Reporting mode | | PUCCH 1-1 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 5 | N/A |
| CQI delay | ms | 10 | N/A |
| Physical channel for CQI/PMI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type for CQI/PMI | | 2 | N/A |
| Physical channel for RI reporting | | PUCCH Format 2 | N/A |
| PUCCH Report Type for RI | | 3 | N/A |
| *cqi-pmi-ConfigurationIndex* | | 3 | N/A |
| *ri-ConfigIndex* | | 805 (Note 9) | N/A |
| Max number of HARQ transmissions | | 1 | N/A |
| ACK/NACK feedback mode | | Multiplexing | N/A |
| 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)<br>Note 2: Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.<br>Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in | | | |

| | |
|---|---|
| | uplink subframe SF#2 and #7. |
| Note 4: | The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1. |
| Note 5: | Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. Intefering cell is fully loaded. |
| Note 6: | Both cells are time-synchronous. |
| Note 7: | Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present. |
| Note 8: | SINR corresponds to $\hat{E}_s/N_{oc}'$ of Cell 1 as defined in clause 8.1.1. |
| Note 9: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 10: | Downlink physical channel setup in Cell 2 applies OCNG pattern OP.1 TDD as defined in Annex A.5.2.1. |
| Note 11: | The precoder in clause B.4.3 follows UE recommended PMI. |
| Note 12: | If the UE reports in an available uplink reporting instance at 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 9.3.5.2.2-2 Minimum requirement (TDD)**

| | |
|---|---|
| $\gamma$ | 1.8 |
| UE Category | ≥2 |

## 9.3.6 Minimum requirement (With multiple CSI processes)

The purpose of the test is to verify the reporting accuracy of the CQI and the UE processing capability for multiple CSI processes. Each CSI process is associated with a CSI-RS resource and a CSI-IM resource as shown in Table 9.3.6-1. For UE supports one CSI process, CSI process 2 is configured and the corresponding requirements shall be fulfilled. For UE supports three CSI processes, CSI processes 0, 1 and 2 are configured and the corresponding requirements shall be fulfilled. For UE supports four CSI processes, CSI processes 0, 1, 2 and 3 are configured and the corresponding requirements shall be fulfilled.

**Table 9.3.6-1 Configuration of CSI processes**

| | CSI process 0 | CSI process 1 | CSI process 2 | CSI process 3 |
|---|---|---|---|---|
| CSI-RS resource | CSI-RS signal 0 | CSI-RS signal 1 | CSI-RS signal 0 | CSI-RS signal 1 |
| CSI-IM resource | CSI-IM resource 0 | CSI-IM resource 0 | CSI-IM resource 1 | CSI-IM resource 2 |

### 9.3.6.1 FDD

For the parameters specified in Table 9.3.6.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.6.1-2 and by the following

a) a sub-band differential CQI offset level of 0 shall be reported at least $\alpha$% of the time but less than $\beta$% for each sub-band for CSI process 1, 2, or 3;

b) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least $\delta$% of the time for CSI process 0;

c) the difference of the median CQIs of the reported wideband CQI for configurated CSI processes shall be greater or equal to the values as in Table 9.3.6.1-3;

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

e) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

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

**Table 9.3.6.1-1 Fading test for FDD**

| Parameter | | Unit | Test 1 | | | | Test 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP1 | | TP2 | | TP1 | | TP2 | |
| Bandwidth | | MHz | 10 MHz | | | | 10 MHz | | | |
| Transmission mode | | | 10 | | 10 | | 10 | | 10 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | | 0 | | | |
| | $\rho_B$ | dB | 0 | | | | 0 | | | |
| | $P_c$ | dB | -3 | | 0 | | -3 | | 0 | |
| | σ | dB | -3 | | | | -3 | | | |
| SNR (Note 7) | | dB | 10 | 11 | 7 | 8 | 14 | 15 | 9 | 10 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -87 | -91 | -90 | -84 | -85 | -89 | -88 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | | | -98 | | | |
| Propagation channel | | | EPA 5 Low | | Clause B.2.4.1 with $\tau_d = 0.45\,\mu$s, $a$ = 1, $f_D = 5$ Hz | | EPA 5 Low | | Clause B.2.4.1 with $\tau_d = 0.45\,\mu$s, $a$ = 1, $f_D = 5$ Hz | |
| Antenna configuration | | | 4x2 | | 2x2 | | 4x2 | | 2x2 | |
| Beamforming Model | | | As specified in Section B.4.3 | | | | As specified in Section B.4.3 | | | |
| Timing offset between TPs | | us | 0 | | | | 0 | | | |
| Frequency offset between TPs | | Hz | 0 | | | | 0 | | | |
| Cell-specific reference signals | | | Antenna ports 0,1 | | | | Antenna ports 0,1 | | | |
| CSI-RS signal 0 | | | Antenna ports 15,…,18 | | N/A | | Antenna ports 15,…,18 | | N/A | |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | N/A | | 5/1 | | N/A | |
| CSI-RS 0 configuration | | | 0 | | N/A | | 0 | | N/A | |
| CSI-RS signal 1 | | | N/A | | Antenna ports 15,16 | | N/A | | Antenna ports 15,16 | |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | | 5/1 | | N/A | | 5/1 | |
| CSI-RS 1 configuration | | | N/A | | 5 | | N/A | | 5 | |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | N/A | | 1 / 1110000000000000 | | N/A | | 1 / 1110000000000000 | |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 1 / 0010011000000000 | | N/A | | 1 / 0010011000000000 | | N/A | |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | 5/1 | | 5/1 | | 5/1 | |
| CSI-IM 0 configuration | | | 2 | | 2 | | 2 | | 2 | |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | N/A | | 5/1 | | N/A | |
| CSI-IM 1 configuration | | | 6 | | N/A | | 6 | | N/A | |
| CSI-IM 2 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | | 5/1 | | N/A | | 5/1 | |
| CSI-IM 2 configuration | | | N/A | | 1 | | N/A | | 1 | |
| CSI process 0 | CSI-RS | | CSI-RS 0 | | | | CSI-RS 0 | | | |
| | CSI-IM | | CSI-IM 0 | | | | CSI-IM 0 | | | |
| | Reporting mode | | PUCCH 1-1 | | | | PUCCH 1-1 | | | |
| | CodeBookSubsetRestriction bitmap | | 0x0000 0000 0000 0001 | | | | 0x0000 0000 0000 0001 | | | |
| | Reporting periodicity | ms | $N_{pd}$ = 5 | | | | $N_{pd}$ = 5 | | | |
| | CQI delay | ms | 11 | | | | 11 | | | |
| | Physical channel for CQI/ PMI reporting | | PUSCH (Note 6) | | | | PUSCH (Note 6) | | | |
| | PUCCH Report Type for CQI/PMI | | 2 | | | | 2 | | | |
| | PUCCH channel | | PUCCH Format 2 | | | | PUCCH Format 2 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | for RI reporting | | | | | |
| | PUCCH report type for RI | | 3 | | 3 | |
| | *cqi-pmi-ConfigurationIndex* | | 4 | | 4 | |
| | *ri-ConfigIndex* | | 2 | | 2 | |
| CSI process 1 | CSI-RS | | CSI-RS 1 | | CSI-RS 1 | |
| | CSI-IM | | CSI-IM 0 | | CSI-IM 0 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 000001 | | 000001 | |
| | Reporting interval (Note 10) | ms | 5 | | 5 | |
| | CQI delay | ms | 11 | | 11 | |
| | Sub-band size | RB | 6 (full size) | | 6 (full size) | |
| CSI process 2 (For UE configured single process) | CSI-RS | | CSI-RS 0 | | CSI-RS 0 | |
| | CSI-IM | | CSI-IM 1 | | CSI-IM 1 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 0x0000 0000 0000 0001 | | 0x0000 0000 0000 0001 | |
| | Reporting interval (Note 8) | ms | 5 | | 5 | |
| | CQI delay | ms | 8 | | 8 | |
| | Sub-band size | RB | 6 (full size) (Note 9) | | 6 (full size) (Note 9) | |
| CSI process 2 (For UE configured multiple processes) | CSI-RS | | CSI-RS 0 | | CSI-RS 0 | |
| | CSI-IM | | CSI-IM 1 | | CSI-IM 1 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 0x0000 0000 0000 0001 | | 0x0000 0000 0000 0001 | |
| | Reporting interval (Note 10) | ms | 5 | | 5 | |
| | CQI delay | ms | 11 | | 11 | |
| | Sub-band size | RB | 6 (full size) (Note 9) | | 6 (full size) (Note 9) | |
| CSI process 3 | CSI-RS | | CSI-RS 1 | | CSI-RS 1 | |
| | CSI-IM | | CSI-IM 2 | | CSI-IM 2 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 000001 | | 000001 | |
| | Reporting interval (Note 10 | ms | 5 | | 5 | |
| | CQI delay | ms | 11 | | 11 | |
| | Sub-band size | RB | 6 (full size) | | 6 (full size) | |
| CSI process for PDSCH scheduling | | | CSI process 2 | | CSI process 2 | |
| Cell ID | | | 0 | 6 | 0 | 6 |
| Quasi-co-located CSI-RS | | | CSI-RS 0 | CSI-RS 1 | CSI-RS 0 | CSI-RS 1 |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 |
| PMI for subframe 2, 3, 4, 7, 8 and 9 | | | 0x0000 0000 0000 0001 | 100000 | 0x0000 0000 0000 0001 | 100000 |
| PMI for subframe 1 and 6 | | | 0x0000 0000 0001 0000 | 100000 | 0x0000 0000 0001 0000 | 100000 |
| Max number of HARQ transmissions | | | 1 | N/A | 1 | N/A |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 2: 3 symbols allocated to PDCCH.
Note 3: Reference measurement channel RC.12 FDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 2, 3, 4, 7, 8 and 9 from TP1.
Note 4: TM10 OCNG OP.8 FDD as specified in A.5.1.8 is transmitted on subframe 1 and 6 from TP1.
Note 5: TM10 OCNG OP.8 FDD as specified in A.5.1.8 is transmitted on subframe 1, 2, 3, 4, 6, 7, 8 and 9 from TP2
Note 6: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#2 and #7.
Note 7: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 8: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.
Note 9: For these sub-bands which are not selected for PDSCH transmission, TM10 OCNG should be transmitted.

| | |
|---|---|
| Note 10: | PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#2 and #7 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#1 and #6. |

**Table 9.3.6.1-2 Minimum requirement (FDD)**

| | CSI process 0 | CSI process 1 | CSI process 2 | CSI process 3 |
|---|---|---|---|---|
| $\alpha$ [%] | N/A | 2 | 2 | 2 |
| $\beta$ [%] | N/A | 40 | 40 | 40 |
| $\delta$ [%] | 10 | N/A | N/A | N/A |
| $\gamma$ | N/A | N/A | 1.02 | N/A |
| UE Category | ≥1 | | | |

**Table 9.3.6.1-3 Minimum median CQI difference between configured CSI processes (FDD)**

| | CSI process 1 | CSI process 2 | CSI process 3 |
|---|---|---|---|
| **CSI process 0** | N/A | 1 | 3 |
| UE Category | ≥1 | | |

### 9.3.6.2 TDD

For the parameters specified in Table 9.3.6.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.6.2-2 and by the following

a) a sub-band differential CQI offset level of 0 shall be reported at least $\alpha$% of the time but less than $\beta$% for each sub-band for CSI process 1, 2, or 3;

b) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least $\delta$% of the time for CSI process 0;

c) the difference of the median CQIs of the reported wideband CQI for configurated CSI processes shall be greater or equal to the values as in Table 9.3.6.2-3;

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

e) when transmitting on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level the corresponding TBS, the average BLER for the indicated transport formats shall be greater or equal to 0.02.

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

**Table 9.3.6.2-1 Fading test for TDD**

| Parameter | | Unit | Test 1 | | | | Test 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP1 | | TP2 | | TP1 | | TP2 | |
| Bandwidth | | MHz | 10 MHz | | | | 10 MHz | | | |
| Transmission mode | | | 10 | | 10 | | 10 | | 10 | |
| Uplink downlink configuration | | | 2 | | 2 | | 2 | | 2 | |
| Special subframe configuration | | | 4 | | 4 | | 4 | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | | 0 | | | |
| | $\rho_B$ | dB | 0 | | | | 0 | | | |
| | $P_C$ | dB | -3 | | 0 | | -3 | | 0 | |
| | σ | dB | -3 | | | | -3 | | | |
| SNR (Note 7) | | dB | 10 | 11 | 7 | 8 | 14 | 15 | 9 | 10 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -87 | -91 | -90 | -84 | -85 | -89 | -88 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | | | -98 | | | |
| Propagation channel | | | EPA 5 Low | | Clause B.2.4.1 with $\tau_d = 0.45\,\mu s$, $a = 1$, $f_D = 5$ Hz | | EPA 5 Low | | Clause B.2.4.1 with $\tau_d = 0.45\,\mu s$, $a = 1$, $f_D = 5$ Hz | |
| Antenna configuration | | | 4x2 | | 2x2 | | 4x2 | | 2x2 | |
| Beamforming Model | | | As specified in Section B.4.3 | | | | As specified in Section B.4.3 | | | |
| Timing offset between TPs | | us | 0 | | | | 0 | | | |
| Frequency offset between TPs | | Hz | 0 | | | | 0 | | | |
| Cell-specific reference signals | | | Antenna ports 0,1 | | | | Antenna ports 0,1 | | | |
| CSI-RS signal 0 | | | Antenna ports 15,…, 18 | | N/A | | Antenna ports 15,…, 18 | | N/A | |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | | N/A | | 5/3 | | N/A | |
| CSI-RS 0 configuration | | | 0 | | N/A | | 0 | | N/A | |
| CSI-RS signal 1 | | | N/A | | Antenna ports 15, 16 | | N/A | | Antenna ports 15, 16 | |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | | 5/3 | | N/A | | 5/3 | |
| CSI-RS 1 configuration | | | N/A | | 5 | | N/A | | 5 | |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | N/A | | 3 / 1110000000000000 | | N/A | | 3 / 1110000000000000 | |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0010011000000000 | | N/A | | 3 / 0010011000000000 | | N/A | |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | | 5/3 | | 5/3 | | 5/3 | |
| CSI-IM 0 configuration | | | 2 | | 2 | | 2 | | 2 | |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | | N/A | | 5/3 | | N/A | |
| CSI-IM 1 configuration | | | 6 | | N/A | | 6 | | N/A | |
| CSI-IM 2 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | | 5/3 | | N/A | | 5/3 | |
| CSI-IM 2 configuration | | | N/A | | 1 | | N/A | | 1 | |
| CSI process 0 | CSI-RS | | CSI-RS 0 | | | | CSI-RS 0 | | | |
| | CSI-IM | | CSI-IM 0 | | | | CSI-IM 0 | | | |
| | Reporting mode | | PUCCH 1-1 | | | | PUCCH 1-1 | | | |
| | CodeBookSubsetRestriction bitmap | | 0x0000 0000 0000 0001 | | | | 0x0000 0000 0000 0001 | | | |
| | Reporting periodicity | ms | $N_{pd}$ = 5 | | | | $N_{pd}$ = 5 | | | |
| | CQI delay | ms | 12 | | | | 12 | | | |
| | Physical channel for CQI/ PMI reporting | | PUSCH (Note 6) | | | | PUSCH (Note 6) | | | |
| | PUCCH Report | | 2 | | | | 2 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Type for CQI/PMI | | | | | |
| | PUCCH channel for RI reporting | | PUCCH Format 2 | | PUCCH Format 2 | |
| | PUCCH report type for RI | | 3 | | 3 | |
| | *cqi-pmi-ConfigurationIndex* | | 3 | | 3 | |
| | *ri-ConfigIndex* | | 805 (Note 10) | | 805 (Note 10) | |
| CSI process 1 | CSI-RS | | CSI-RS 1 | | CSI-RS 1 | |
| | CSI-IM | | CSI-IM 0 | | CSI-IM 0 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 000001 | | 000001 | |
| | Reporting interval (Note 9) | ms | 5 | | 5 | |
| | CQI delay | ms | 12 | | 12 | |
| | Sub-band size | RB | 6 (full size) | | 6 (full size) | |
| CSI process 2 | CSI-RS | | CSI-RS 0 | | CSI-RS 0 | |
| | CSI-IM | | CSI-IM 1 | | CSI-IM 1 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 0x0000 0000 0000 0001 | | 0x0000 0000 0000 0001 | |
| | Reporting interval (Note 9) | ms | 5 | | 5 | |
| | CQI delay | ms | 12 | | 12 | |
| | Sub-band size | RB | 6 (full size) (Note 8) | | 6 (full size) (Note 8) | |
| CSI process 3 | CSI-RS | | CSI-RS 1 | | CSI-RS 1 | |
| | CSI-IM | | CSI-IM 2 | | CSI-IM 2 | |
| | Reporting mode | | PUSCH 3-1 | | PUSCH 3-1 | |
| | CodeBookSubsetRestriction bitmap | | 000001 | | 000001 | |
| | Reporting interval (Note 9) | ms | 5 | | 5 | |
| | CQI delay | ms | 12 | | 12 | |
| | Sub-band size | RB | 6 (full size) | | 6 (full size) | |
| CSI process for PDSCH scheduling | | | CSI process 2 | | CSI process 2 | |
| Cell ID | | | 0 | 6 | 0 | 6 |
| Quasi-co-located CSI-RS | | | CSI-RS 0 | CSI-RS 1 | CSI-RS 0 | CSI-RS 1 |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 |
| PMI for subframe 4and 9 | | | 0x0000 0000 0000 0001 | 100000 | 0x0000 0000 0000 0001 | 100000 |
| PMI for subframe 3 and 8 | | | 0x0000 0000 0001 0000 | 100000 | 0x0000 0000 0001 0000 | 100000 |
| Max number of HARQ transmissions | | | 1 | N/A | 1 | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | Multiplexing | N/A |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 2: 3 symbols allocated to PDCCH.
Note 3: Reference measurement channel RC.12 TDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 4 and 9 from TP1.
Note 4: TM10 OCNG OP.8 TDD is transmitted as specified in A.5.2.8 on subframe 3 and 8 from TP1.
Note 5: TM10 OCNG OP.8 TDD is transmitted as specified in A.5.2.8 on subframe 3, 4, 8 and 9 from TP2.
Note 6: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2.
Note 7: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 8: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#7 and #2.
Note 9: For these sub-bands which are not selected for PDSCH transmission, TM10 OCNG should be transmitted.
Note 10: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available.

**Table 9.3.6.2-2 Minimum requirement (TDD)**

| | CSI process 0 | CSI process 1 | CSI process 2 | CSI process 3 |
|---|---|---|---|---|
| $\alpha$ [%] | N/A | 2 | 2 | 2 |
| $\beta$ [%] | N/A | 40 | 40 | 40 |
| $\delta$ [%] | 10 | N/A | N/A | N/A |
| $\gamma$ | N/A | N/A | 1.02 | N/A |
| UE Category | ≥1 | | | |

**Table 9.3.6.2-3 Minimum median CQI difference between configured CSI processes (TDD)**

| | CSI process 1 | CSI process 2 | CSI process 3 |
|---|---|---|---|
| **CSI process 0** | N/A | 1 | 3 |
| UE Category | ≥1 | | |

# 9.4 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 6 with 1 TX and transmission mode 9 with 4 TX 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.

The requirements for transmission mode 9 with 8 TX are specified in terms of the ratio

$$\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$$

In the definition of $\gamma$, for PUSCH 3-1 single PMI and PUSCH 1-2 multiple PMI requirements, $t_{follow1,\,follow2}$ is 70% of the maximum throughput obtained at $SNR_{follow1,\,follow2}$ using the precoders configured according to the UE reports, and $t_{rnd1,\,rnd2}$ is the throughput measured at $SNR_{follow1,\,follow2}$ with random precoding .

## 9.4.1 Single PMI

### 9.4.1.1 Minimum requirement PUSCH 3-1 (Cell-Specific Reference Symbols)

#### 9.4.1.1.1 FDD

For the parameters specified in Table 9.4.1.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.1.1-2.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EVA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | Low 2 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | 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).<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). | | | |

**Table 9.4.1.1.1-2 Minimum requirement (FDD)**

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

#### 9.4.1.1.2 TDD

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | Low 2 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | 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.<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). | | | |

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

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

### 9.4.1.2 Minimum requirement PUCCH 2-1 (Cell-Specific Reference Symbols)

#### 9.4.1.2.1 FDD

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | σ | dB | 3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| PMI delay | | ms | 8 or 9 |
| Reporting mode | | | PUCCH 2-1 (Note 6) |
| Reporting periodicity | | ms | $N_{pd}$ = 2 |
| Physical channel for CQI reporting | | | PUSCH (Note 3) |
| PUCCH Report Type for wideband CQI/PMI | | | 2 |
| PUCCH Report Type for subband CQI | | | 1 |
| Measurement channel | | | R.14-1 FDD |
| OCNG Pattern | | | OP.1/2 FDD |
| Precoding granularity | | PRB | 6 (full size) |
| Number of bandwidth parts (*J*) | | | 3 |
| K | | | 1 |
| *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).

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#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.

Note 4: Reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and instead data is to be transmitted on the most recently used subband for bandwidth part with j=1.

Note 5: In the case where wideband PMI is reported, data is to be transmitted on the most recently used subband.

Note 6: The bit field for PMI confirmation in DCI format 1B shall be mapped to "0" and TPMI information shall indicate the codebook index used in Table 6.3.4.2.3-2 of TS36.211 [4] according to the latest PMI report on PUCCH.

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

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

#### 9.4.1.2.2 TDD

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | 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 fedback mode | | | Multiplexing |
| Note 1: For random precoder selection, the precoder shall be updated in each available downlink transmission instance.<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#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3.<br>Note 4: 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 9.4.1.2.2-2 Minimum requirement (TDD)**

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

## 9.4.1.3 Minimum requirement PUSCH 3-1 (CSI Reference Symbol)

### 9.4.1.3.1 FDD

For the parameters specified in Table 9.4.1.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.1-2.

**Table 9.4.1.3.1-1 PMI test for single-layer (FDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Propagation channel | | | EPA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | Low ULA 4 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| Beamforming model | | | Annex B.4.3 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 1 |
| CSI-RS reference signal configuration | | | 6 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | Pc | dB | -3 |
| | σ | dB | -3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| Reporting mode | | | PUSCH 3-1 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 8 |
| Measurement channel | | | R.44 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).<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: PDSCH _RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver. | | | |

**Table 9.4.1.3.1-2 Minimum requirement (FDD)**

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

#### 9.4.1.3.2 TDD

For the parameters specified in Table 9.4.1.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.3.2-2.

**Table 9.4.1.3.2-1 PMI test for single-layer (TDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Precoding granularity | | PRB | 50 |
| Antenna configuration | | | 8 x 2 |
| Correlation modeling | | | High, Cross polarized |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,22 |
| Beamforming model | | | Annex B.4.3 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 4 |
| CSI-RS reference signal configuration | | | 0 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 001F FFE0 0000 0000 FFFF |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | Pc | dB | -6 |
| | σ | dB | -3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| Reporting mode | | | PUSCH 3-1 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 10 |
| Measurement channel | | | R.45-1 TDD for UE Category 1, R.45 TDD for UE Category ≥2 |
| OCNG Pattern | | | OP.7 TDD for UE Category 1, and OP.1 TDD for UE Category ≥2 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity).<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: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8. | | | |

| | |
|---|---|
| Note 4: | Randomization of the principle beam direction shall be used as specified in B.2.3A.4 |

**Table 9.4.1.3.2-2 Minimum requirement (TDD)**

| Parameter | Test 1 |
|---|---|
| $\gamma$ | 3 |
| UE Category | ≥1 |

# 9.4.1a Void

## 9.4.1a.1 Void

### 9.4.1a.1.1 Void

# 9.4.1a.1.2 Void

# 9.4.2 Multiple PMI

## 9.4.2.1 Minimum requirement PUSCH 1-2 (Cell-Specific Reference Symbols)

### 9.4.2.1.1 FDD

For the parameters specified in Table 9.4.2.1.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.1.1-2.

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Propagation channel | | | EPA5 |
| Precoding granularity (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 |
| OCNG Pattern | | | OP.1/2 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>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: 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 |

#### 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<br>R.11 TDD for UE Category ≥2 |
| OCNG Pattern | | | OP.1/2 TDD |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| Note 1: For random precoder selection, the precoders shall be updated in each available downlink transmission instance.<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: 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 |

## 9.4.2.2 Minimum requirement PUSCH 2-2 (Cell-Specific Reference Symbols)

### 9.4.2.2.1 FDD

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

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

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

**Table 9.4.2.2.1-2 Minimum requirement (FDD)**

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

### 9.4.2.2.2 TDD

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 6 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Correlation and antenna configuration | | | Low 4 x 2 |
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 |
| | 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 TDD |
| Subband size (*k*) | | RBs | 3 (full size) |
| Number of preferred subbands (*M*) | | | 5 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| Note 1: For random precoder selection, the precoders shall be updated in each available downlink transmission instance.<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). | | | |

**Table 9.4.2.2.2-2 Minimum requirement (TDD)**

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

### 9.4.2.3 Minimum requirement PUSCH 1-2 (CSI Reference Symbol)

#### 9.4.2.3.1 FDD

For the parameters specified in Table 9.4.2.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.1-2.

**Table 9.4.2.3.1-1 PMI test for single-layer (FDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Propagation channel | | | EVA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Correlation and antenna configuration | | | Low ULA 4 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| Beamforming model | | | Annex B.4.3 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 1 |
| CSI-RS reference signal configuration | | | 8 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | Pc | dB | -3 |
| | σ | dB | -3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| Reporting mode | | | PUSCH 1-2 |
| Reporting interval | | ms | 5 |
| PMI delay | | ms | 8 |
| Measurement channel | | | R.45-1 FDD for UE Category 1, R.45 FDD for UE Category ≥2 |
| OCNG Pattern | | | OP.7 FDD for UE Category 1 OP.1 FDD for UE Category ≥2 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| Note 1: For random precoder selection, the precoders shall be updated in each TTI (1 ms granularity).<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: Void.<br>Note 4: PDSCH _RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver. | | | |

**Table 9.4.2.3.1-2 Minimum requirement (FDD)**

| Parameter | Test 1 |
|---|---|
| $\gamma$ | 1.3 |
| UE Category | ≥1 |

#### 9.4.2.3.2 TDD

For the parameters specified in Table 9.4.2.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.2-2.

**Table 9.4.2.3.2-1 PMI test for single-layer (TDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Antenna configuration | | | 8 x 2 |
| Correlation modeling | | | High, Cross polarized |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,22 |
| Beamforming model | | | Annex B.4.3 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 4 |
| CSI-RS reference signal configuration | | | 4 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 001F FFE0 0000 0000 FFFF |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | Pc | db | -6 |
| | σ | dB | -3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| Reporting mode | | | PUSCH 1-2 |
| Reporting interval | | ms | 5 (Note 4) |
| PMI delay | | ms | 10 |
| Measurement channel | | | R.45-1 TDD for UE Category 1, R.45 TDD for UE Category ≥2 |
| OCNG Pattern | | | OP.7 TDD for UE Category 1 OP.1 TDD for UE Category ≥2 |
| 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 TTI (1 ms granularity).<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: Void.<br>Note 4: PDCCH DCI format 0 with a trigger for aperiodic | | | |

| | |
|---|---|
| | CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#3 and #8. |
| Note 5: | Randomization of the principle beam direction shall be used as specified in B.2.3A.4. |

**Table 9.4.2.3.2-2 Minimum requirement (TDD)**

| Parameter | Test 1 |
|---|---|
| $\gamma$ | 3.5 |
| UE Category | ≥1 |

### 9.4.3 Void

#### 9.4.3.1 Void

##### 9.4.3.1.1 Void

##### 9.4.3.1.2 Void

## 9.5 Reporting of Rank Indicator (RI)

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI (CQI) reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission. Transmission mode 4 is used with the specified CodebookSubSetRestriction in section 9.5.1, transmission mode 9 is used with the specified CodebookSubSetRestriction in section 9.5.2 and transmission mode 3 is used with the specified CodebookSubSetRestriction in section 9.5.3, and transmission mode 10 is used with the specified CodebookSubSetRestriction in section 9.5.5.

For fixed rank 1 transmission in sections 9.5.1, 9.5.2 and 9.5.5, the RI and PMI reporting is restricted to two single-layer precoders, For fixed rank 2 transmission in sections 9.5.1, 9.5.2 and 9.5.5, the RI and PMI reporting is restricted to one two-layer precoder, For follow RI transmission in sections 9.5.1, 9.5.2, the RI and PMI reporting is restricted to select the union of these precoders. Channels with low and high correlation are used to ensure that RI reporting reflects the channel condition.

For fixed rank 1 transmission in section 9.5.3, the RI reporting is restricted to single-layer, for fixed rank 2 transmission in section 9.5.3, the RI reporting is restricted to two-layers. For follow RI transmission in section 9.5.3, the RI reporting is either one or two layers.

### 9.5.1 Minimum requirement (Cell-Specific Reference Symbols)

#### 9.5.1.1 FDD

The minimum performance requirement in Table 9.5.1.1-2 is defined as

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<br>010000 for fixed RI = 2<br>010011 for UE reported RI | | |
| Antenna correlation | | | Low | Low | High |
| RI configuration | | | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUCCH 1-1 (Note 4) | | |
| Physical channel for CQI/PMI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type for CQI/PMI | | | 2 | | |
| Physical channel for RI reporting | | | PUSCH (Note 3) | | |
| PUCCH Report Type for RI | | | 3 | | |
| Reporting periodicity | | ms | $N_{pd}$= 5 | | |
| PMI and CQI delay | | ms | 8 | | |
| *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 | 0.9 |
| $\gamma_2$ | 1 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

### 9.5.1.2 TDD

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

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

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 ≥ $\gamma_2$;

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=1 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUSCH 3-1 (Note 3) | | |
| Reporting interval | | ms | 5 | | |
| PMI and CQI delay | | ms | 10 or 11 | | |
| ACK/NACK feedback mode | | | Bundling | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).<br>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.<br>Note 3: Reported wideband CQI and PMI are used and sub-band CQI is discarded. | | | | | |

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

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| $\gamma_1$ | N/A | 1.05 | 0.9 |
| $\gamma_2$ | 1 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

## 9.5.2 Minimum requirement (CSI Reference Symbols)

### 9.5.2.1 FDD

The minimum performance requirement in Table 9.5.2.1-2 is defined as

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 ≥ $\gamma_1$;

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 ≥ $\gamma_2$;

For the parameters specified in Table 9.5.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.2.1-2.

**Table 9.5.2.1-1 RI Test (FDD)**

| Parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| PDSCH transmission mode | | | 9 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Propagation condition and antenna configuration | | | 2 x 2 EPA5 | | |
| Cell-specific reference signals | | | Antenna ports 0 | | |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signals | | | Antenna ports 15, 16 | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | | |
| CSI reference signal configuration | | | 6 | | |
| CodeBookSubsetRestriction bitmap | | | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI | | |
| Antenna correlation | | | Low | Low | High |
| RI configuration | | | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUCCH 1-1 | | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | | |
| PUCCH Report Type for CQI/PMI | | | 2 | | |
| Physical channel for RI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type for RI | | | 3 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | |
| PMI and CQI delay | | ms | 8 | | |
| *cqi-pmi-ConfigurationIndex* | | | 2 | | |
| *ri-ConfigurationInd* | | | 1 (Note 4) | | |

- Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on PMI and CQI estimation at a downlink subframe not later than SF#(n-4), this reported PMI and wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
- Note 2: Reference measurement channel RC.9 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
- Note 3: To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.
- Note 4: To avoid the ambiguity of TE behaviour when applying CQI and PMI during rank switching, RI reports are to be applied at the TE with one subframe delay in addition to Note 1 to align with CQI and PMI reports.

**Table 9.5.2.1-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| $\gamma_1$ | N/A | 1.05 | 0.9 |
| $\gamma_2$ | 1 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

### 9.5.2.2 TDD

The minimum performance requirement in Table 9.5.2.2-2 is defined as

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

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

For the parameters specified in Table 9.5.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.2.2-2.

**Table 9.5.2.2-1 RI Test (TDD)**

| Parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| PDSCH transmission mode | | | 9 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Uplink downlink configuration | | | 1 | | |
| Special subframe configuration | | | 4 | | |
| Propagation condition and antenna configuration | | | 2 x 2 EPA5 | | |
| Cell-specific reference signals | | | Antenna ports 0 | | |
| CSI reference signals | | | Antenna ports 15, 16 | | |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signal configuration | | | 4 | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/4 | | |
| CodeBookSubsetRestriction bitmap | | | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI | | |
| Antenna correlation | | | Low | Low | High |
| RI configuration | | | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUCCH 1-1 | | |
| Physical channel for CQI/ PMI reporting | | | PUSCH (Note 3) | | |
| PUCCH report type for CQI/ PMI | | | 2 | | |
| Physical channel for RI reporting | | | PUCCH Format 2 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | |
| PMI and CQI delay | | ms | 10 | | |
| ACK/NACK feedback mode | | | Bundling | | |
| *cqi-pmi-ConfigurationIndex* | | | 4 | | |
| *ri-ConfigurationInd* | | | 1 | | |

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

Note 2: Reference measurement channel RC.9 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

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

**Table 9.5.2.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| $\gamma_1$ | N/A | 1.05 | 0.9 |
| $\gamma_2$ | 1 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

## 9.5.3 Minimum requirement (CSI measurements in case two CSI subframe sets are configured)

### 9.5.3.1 FDD

The minimum performance requirement in Table 9.5.3.1-2 is defined as

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

For the parameters specified in Table 9.5.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.3.1-2.

**Table 9.5.3.1-1 RI Test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 3 | Note 10 | 3 | Note 10 |
| Downlink power allocation | $\rho_A$ | dB | -3 | | -3 | |
| | $\rho_B$ | dB | -3 | | -3 | |
| | σ | dB | 0 | | 0 | |
| Propagation condition and antenna configuration | | | 2 x 2 EPA5 | | 2 x 2 EPA5 | |
| CodeBookSubsetRestriction bitmap | | | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A |
| Antenna correlation | | | Low | | Low | |
| RI configuration | | | Fixed RI=1 and follow RI | N/A | Fixed RI=1 and follow RI | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | 0 | -12 | 20 | 6 |
| $N_{oc}^{(j)}$ | $N_{oc1}^{(j)}$ | dBmW/15kHz | -98 (Note 3) | N/A | -102 (Note 3) | N/A |
| | $N_{oc2}^{(j)}$ | | -98 (Note 4) | N/A | -98 (Note 4) | N/A |
| | $N_{oc3}^{(j)}$ | | -98 (Note 5) | N/A | -94.8 (Note 5) | N/A |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -110 | -78 | -92 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | 1 | 0 | 1 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | | 2.5 (synchronous cells) | |
| ABS Pattern (Note 6) | | | N/A | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 |
| RLM/RRM Measurement Subframe Pattern (Note 7) | | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A |
| CSI Subframe Sets (Note 8) | $C_{CSI,0}$ | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A |
| | $C_{CSI,1}$ | | 01111111<br>01111111<br>01111111<br>01111111<br>01111111 | | 01111111<br>01111111<br>01111111<br>01111111<br>01111111 | |
| Number of control OFDM Symbols | | | 3 | 3 | 3 | 3 |
| Maximum number of HARQ transmissions | | | 1 | | 1 | |
| Reporting mode | | | PUCCH 1-0 | | PUCCH 1-0 | |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | PUCCH Format 2 | |
| PUCCH Report Type for CQI | | | 4 | | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| Physical channel for RI reporting | | PUCCH Format 2 | | PUCCH Format 2 | |
| PUCCH Report Type for RI | | 3 | | 3 | |
| Reporting periodicity | ms | $N_{pd}$= 10 | | $N_{pd}$= 10 | |
| *cqi-pmi-ConfigurationIndex* | | 11 | | 11 | |
| *ri-ConfigurationInd* | | 5 | | 5 | |
| *cqi-pmi-ConfigurationIndex2* | | 10 | | 10 | |
| *ri-ConfigurationInd2* | | 2 | | 2 | |
| Cyclic prefix | | Normal | Normal | Normal | Normal |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 2: Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
Note 3: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 5: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 6: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 7: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 8: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 9: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell 1 and Cell 2 is the same.
Note 10: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5.

**Table 9.5.3.1-2 Minimum requirement (FDD)**

| | **Test 1** | **Test 2** |
|---|---|---|
| $\gamma_1$ | 0.9 | 1.05 |
| UE Category | ≥2 | ≥2 |

## 9.5.3.2 TDD

The minimum performance requirement in Table 9.5.3.2-2 is defined as

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

For the parameters specified in Table 9.5.3.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.3.2-2.

**Table 9.5.3.2-1 RI Test (TDD)**

| Parameter | | Unit | Test1 | | Test2 | |
|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 3 | Note 11 | 3 | Note 11 |
| Uplink downlink configuration | | | 1 | | 1 | |
| Special subframe configuration | | | 4 | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | -3 | |
| | $\rho_B$ | dB | -3 | | -3 | |
| | σ | dB | 0 | | 0 | |
| Propagation condition and antenna configuration | | | 2 x 2 EPA5 | | 2 x 2 EPA5 | |
| CodeBookSubsetRestriction bitmap | | | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | N/A |
| Antenna correlation | | | Low | | Low | |
| RI configuration | | | Fixed RI=1 and follow RI | N/A | Fixed RI=1 and follow RI | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | 0 | -12 | 20 | 6 |
| $N_{oc}^{(j)}$ | $N_{oc1}^{(j)}$ | dB[mW/15kHz] | -98 (Note 4) | N/A | -102 (Note 4) | N/A |
| | $N_{oc2}^{(j)}$ | | -98 (Note 5) | N/A | -98 (Note 5) | N/A |
| | $N_{oc3}^{(j)}$ | | -98 (Note 6) | N/A | -94.8 (Note 6) | N/A |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -110 | -78 | -92 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | 1 | 0 | 1 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | | 2.5 (synchronous cells) | |
| ABS Pattern (Note 7) | | | N/A | 0000000001<br>0000000001 | N/A | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 8) | | | 0000000001<br>0000000001 | N/A | 0000000001<br>0000000001 | N/A |
| CSI Subframe Sets (Note 9) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A | 0000000001<br>0000000001 | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | | 1100111000<br>1100111000 | |
| Number of control OFDM Symbols | | | 3 | 3 | 3 | 3 |
| Maximum number of HARQ transmissions | | | 1 | | 1 | |
| Reporting mode | | | PUCCH 1-0 | | PUCCH 1-0 | |
| Physical channel for $C_{CSI,0}$ CQI and RI reporting | | | PUCCH Format 2 | | PUCCH Format 2 | |
| PUCCH Report Type for CQI | | | 4 | | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| Physical channel for $C_{CSI,1}$ CQI and RI reporting | | PUSCH (Note 3) | | PUSCH (Note 3) | |
| PUCCH Report Type for RI | | 3 | | 3 | |
| Reporting periodicity | ms | $N_{pd}$= 10 | | $N_{pd}$= 10 | |
| ACK/NACK feedback mode | | Multiplexing | | Multiplexing | |
| *cqi-pmi-ConfigurationIndex* | | 8 | | 8 | |
| *ri-ConfigurationInd* | | 5 | | 5 | |
| *cqi-pmi-ConfigurationIndex2* | | 9 | | 9 | |
| *ri-ConfigurationInd2* | | 0 | | 0 | |
| Cyclic prefix | | Normal | Normal | Normal | Normal |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 2: Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.
Note 3: To avoid collisions between RI/CQI reports and HARQ-ACK it is necessary to report them on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#9 to allow periodic RI/CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#3.
Note 4: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS
Note 5: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 6: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 7: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 8: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].
Note 9: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 10: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell 1 and Cell 2 is the same.
Note 11: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5.

**Table 9.5.3.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma_1$ | 0.9 | 1.05 |
| UE Category | ≥2 | ≥2 |

## 9.5.4 Minimum requirement (CSI measurements in case two CSI subframe sets are configured and CRS assistance information are configured)

### 9.5.4.1 FDD

For the parameters specified in Table 9.5.4.1-1, the minimum performance requirement in Table 9.5.4.1-2 is defined as

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 ≥ $\gamma_1$;

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 ≥ $\gamma_2$;

In Table 9.5.4.1-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggresso cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 9.5.4.1-1: RI Test (FDD)**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | 10 | 10 |
| PDSCH transmission mode | | | 3 | As defined in Note 1 | As defined in Note 1 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 | -3 | -3 |
| | σ | dB | 0 | N/A | N/A |
| Propagation condition and antenna configuration | | | 2×2 EPA5 (Note 2) | 2×2 EPA5 (Note 2) | 2×2 EPA5 (Note 2) |
| CodeBookSubsetRestriction bitmap | | | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | As defined in Note 1 | As defined in Note 1 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dB[mW/15kHz] | -98 (Note 3) | N/A | N/A |
| | $N_{oc2}$ | dB[mW/15kHz] | -98 (Note 4) | N/A | N/A |
| | $N_{oc3}$ | dB[mW/15kHz] | -93 (Note 5) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 9.5.4.1-2 for each test | 12 | 10 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | Reference Value in Table 9.5.4.1-2 for each test | -86 | -88 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 6) | | | N/A | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 |
| RLM/RRM Measurement Subframe Pattern (Note 7) | | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | N/A |
| CSI Subframe Sets (Note 8) | $C_{CSI,0}$ | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A | N/A |
| | $C_{CSI,1}$ | | 01111111<br>01111111<br>01111111<br>01111111<br>01111111 | N/A | N/A |
| Number of control OFDM symbols | | | 3 | Note 9 | Note 9 |
| Maximum number of HARQ transmissions | | | 1 | N/A | N/A |
| Reporting mode | | | PUCCH 1-0 | N/A | N/A |
| Physical channel for CQI reporting | | | PUCCH format 2 | N/A | N/A |
| PUCCH Report Type for CQI | | | 4 | N/A | N/A |
| Physical channel for RI reporting | | | PUCCH Format 2 | N/A | N/A |
| PUCCH Report Type for RI | | | 3 | N/A | N/A |
| Reporting periodicity | | ms | $N_{pd}$= 10 | N/A | N/A |

| | | | | |
|---|---|---|---|---|
| *cqi-pmi-ConfigurationIndex* | | 11 | N/A | N/A |
| *ri-ConfigurationInd* | | 5 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex2* | | 10 | N/A | N/A |
| *ri-ConfigurationInd2* | | 2 | N/A | N/A |
| Cyclic prefix | | Normal | Normal | Normal |

Note 1: Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern OP.5 FDD as defined in Annex A.5.1.5.
Note 2: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 3: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS.
Note 4: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.
Note 5: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS
Note 6: ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 7: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]
Note 8: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].
Note 9: The number of control OFDM symbols is not available for ABS and is 3 for the subframe indicated by "0" of ABS pattern.
Note 10: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4).
Note 11: Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
Note 12: The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same.
Note 13: SIB-1 will not be transmitted in Cell2 and Cell 3 in this test.

**Table 9.5.4.1-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| $\hat{E}_s / N_{oc2}$ for Cell 1 (dB) | 4 | 20 | 20 |
| $\hat{I}_{or}^{(j)}$ for Cell 1 (dB[mW/15kHz]) | -94 | -78 | -78 |
| Antenna correlation | High for Cell 1, low for Cell 2 and Cell 3 | Low for Cell 1, Cell 2 and Cell 3 | High for Cell 1, low for Cell 2 and Cell 3 |
| $\gamma_1$ | N/A | 1.05 | 0.9 |
| $\gamma_2$ | 1.05 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

## 9.5.4.2 TDD

For the parameters specified in Table 9.5.4.2-1, the minimum performance requirement in Table 9.5.4.2-2 is defined as

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 ≥ $\gamma_1$;

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 ≥ $\gamma_2$;

In Table 9.5.4.2-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggresso cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 9.5.4.2-1: RI Test (TDD)**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | 10 | 10 |
| PDSCH transmission mode | | | 3 | As defined in Note 1 | As defined in Note 1 |
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 | -3 | -3 |
| | σ | dB | 0 | N/A | N/A |
| Propagation condition and antenna configuration | | | 2×2 EPA5 (Note 2) | 2×2 EPA5 (Note 2) | 2×2 EPA5 (Note 2) |
| CodeBookSubsetRestriction bitmap | | | 01 for fixed RI = 1<br>10 for fixed RI = 2<br>11 for UE reported RI | As defined in Note 1 | As defined in Note 1 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dB[mW/15kHz] | -98 (Note 3) | N/A | N/A |
| | $N_{oc2}$ | dB[mW/15kHz] | -98 (Note 4) | N/A | N/A |
| | $N_{oc3}$ | dB[mW/15kHz] | -93 (Note 5) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 9.5.4.2-2 for each test | 12 | 10 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | Reference Value in Table 9.5.4.2-2 for each test | -86 | -88 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | μs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 126 | 1 |
| ABS pattern (Note 6) | | | N/A | 0000000001<br>0000000001 | 0000000001<br>0000000001 |
| RLM/RRM Measurement Subframe Pattern (Note 7) | | | 0000000001<br>0000000001 | N/A | N/A |
| CSI Subframe Sets (Note 8) | $C_{CSI,0}$ | | 0000000001<br>0000000001 | N/A | N/A |
| | $C_{CSI,1}$ | | 1100111000<br>1100111000 | N/A | N/A |
| Number of control OFDM symbols | | | 3 | Note 9 | Note 9 |
| Maximum number of HARQ transmissions | | | 1 | N/A | N/A |
| Reporting mode | | | PUCCH 1-0 | N/A | N/A |
| Physical channel for $C_{CSI,0}$ CQI and RI reporting | | | PUCCH format 2 | N/A | N/A |
| Physical channel for $C_{CSI,1}$ CQI and RI reporting | | | PUSCH (Note 14) | N/A | N/A |
| PUCCH Report Type for CQI | | | 4 | N/A | N/A |
| PUCCH Report Type for RI | | | 3 | N/A | N/A |
| Reporting periodicity | | ms | $N_{pd}$= 10 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| *cqi-pmi-ConfigurationIndex* | | | 8 | N/A | N/A |
| *ri-ConfigurationInd* | | | 5 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex2* | | | 9 | N/A | N/A |
| *ri-ConfigurationInd2* | | | 0 | N/A | N/A |
| Cyclic prefix | | | Normal | Normal | Normal |

| | |
|---|---|
| Note 1: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern OP.5 TDD as defined in Annex A.5.2.5. |
| Note 2: | The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. |
| Note 3: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 4: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 5: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS |
| Note 6: | ABS pattern as defined in [9]. PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel. |
| Note 7: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 8: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. |
| Note 9: | The number of control OFDM symbols is not available for ABS and is 3 for the subframe indicated by “0” of ABS pattern. |
| Note 10: | If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4). |
| Note 11: | Reference measurement channel in Cell 1 RC.2 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |
| Note 12: | The number of the CRS ports in Cell1, Cell2 and Cell 3 is the same. |
| Note 13: | SIB-1 will not be transmitted in Cell2 and Cell 3 in this test. |
| Note 14: | To avoid collisions between RI/CQI reports and HARQ-ACK it is necessary to report them on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic RI/CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |

**Table 9.5.4.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 | Test 3 |
|---|---|---|---|
| $\widehat{E}_s/N_{oc2}$ for Cell 1 (dB) | 4 | 20 | 20 |
| $\hat{I}_{or}^{(j)}$ for Cell 1 (dB[mW/15kHz]) | -94 | -78 | -78 |
| Antenna correlation | High for Cell 1, low for Cell 2 and Cell 3 | Low for Cell 1, Cell 2 and Cell 3 | High for Cell 1, low for Cell 2 and Cell 3 |
| $\gamma_1$ | N/A | 1.05 | 0.9 |
| $\gamma_2$ | 1.05 | N/A | N/A |
| UE Category | ≥2 | ≥2 | ≥2 |

## 9.5.5 Minimum requirement (with CSI process)

Each CSI process is associated with a CSI-RS resource and a CSI-IM resource as shown in Table 9.5.5-1.

For UE supports one CSI process, CSI process 0 is configured for Test 1 and Test 2, but CSI process 1 is not configured for Test 2. The corresponding γ requirements for Test 1 and Test 2 shall be fulfilled. The requirement on reported RI for CSI process 1 in Test 2 is not applicable.

For UE supports multiple CSI processes, CSI process 0 is configured for Test 1 and CSI processes 0 and 1 are configured for Test 2. The corresponding γ requirements for Test 1 and Test 2 shall be fulfilled, and also the requirement on reported RI for CSI process 1 in Test 2.

**Table 9.5.5-1 Configuration of CSI processes**

| | CSI process 0 | CSI process 1 |
|---|---|---|
| CSI-RS resource | CSI-RS signal 0 | CSI-RS signal 1 |
| CSI-IM resource | CSI-IM resource 0 | CSI-IM resource 1 |

#### 9.5.5.1 FDD

The minimum performance requirement in Table 9.5.5.1-2 is defined as

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

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

c) For Test 2, the RI reported for CSI process 1 shall be the same as the most recent RI reported for CSI process 0 if UE is configured with multiple CSI processes.

For the parameters specified in Table 9.5.5.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.5.1-2.

**Table 9.5.5.1-1 RI Test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | TP1 | TP2 | TP1 | TP2 |
| Bandwidth | | MHz | 10 MHz | | 10 MHz | |
| Transmission mode | | | 10 | 10 | 10 | 10 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | 0 | |
| | $\rho_B$ | dB | 0 | | 0 | |
| | $P_C$ | dB | 0 | 0 | 0 | 0 |
| | σ | dB | 0 | | 0 | |
| SNR | | dB | 0 | 0 | 20 | 20 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -78 | -78 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA 5 Low | EPA 5 Low | EPA 5 Low | EPA 5 High |
| Antenna configuration | | | 2x2 | 2x2 | 2x2 | 2x2 |
| Beamforming Model | | | As specified in Section B.4.3 | | As specified in Section B.4.3 | |
| Timing offset between TPs | | us | 0 | | 0 | |
| Frequency offset between TPs | | Hz | 0 | | 0 | |
| Cell-specific reference signals | | | Antenna ports 0 | | Antenna ports 0 | |
| CSI-RS signal 0 | | | Antenna ports 15,16 | N/A | Antenna ports 15,16 | N/A |
| CSI-RS 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | N/A | 5/1 | N/A |
| CSI-RS 0 configuration | | | 0 | N/A | 0 | N/A |
| CSI-RS signal 1 | | | N/A | Antenna ports 15,16 | N/A | Antenna ports 15,16 |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | 5/1 | N/A | 5/1 |
| CSI-RS 1 configuration | | | N/A | 3 | N/A | 3 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | N/A | 1 / 10000010000 00000 | N/A | 1 / 10000010000 00000 |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 1 / 00110000000 00000 | N/A | 1 / 00110000000 00000 | N/A |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | N/A | 5/1 | N/A |
| CSI-IM 0 configuration | | | 2 | N/A | 2 | N/A |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | 5/1 | N/A | 5/1 |
| CSI-IM 1 configuration | | | N/A | 6 | N/A | 6 |
| RI configuration | | | Fixed RI=2 and follow RI | N/A | Fixed RI=1 and follow RI | N/A |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 6) | N/A | PUSCH (Note 6) | PUSCH (Note 6) |
| PUCCH Report Type for CQI/PMI | | | 2 | N/A | 2 | 2 |
| Physical channel for RI reporting | | | PUCCH Format 2 | N/A | PUCCH Format 2 | PUCCH Format 2 |
| PUCCH Report Type for RI | | | 3 | N/A | 3 | 3 |
| CSI process 0 (Note 7) | CSI-RS | | CSI-RS 0 | N/A | CSI-RS 0 | N/A |
| | CSI-IM | | CSI-IM 0 | N/A | CSI-IM 0 | N/A |
| | Reporting mode | | PUCCH 1-1 | N/A | PUCCH 1-1 | N/A |
| | Reporting periodicity | ms | $N_{pd}$ = 5 | N/A | $N_{pd}$ = 5 | N/A |
| | CQI delay | ms | 8 | N/A | 10 | N/A |
| | *cqi-pmi-ConfigurationIndex* | | 6 | N/A | 6 | N/A |
| | *ri-ConfigIndex* | | 1 | N/A | 1 | N/A |
| CSI process 1 (Note 7, Note 9) | CSI-RS | | N/A | N/A | N/A | CSI-RS 1 |
| | CSI-IM | | N/A | N/A | N/A | CSI-IM 1 |
| | Reporting mode | | N/A | N/A | N/A | PUCCH 1-1 |
| | Reporting periodicity | ms | N/A | N/A | N/A | $N_{pd}$ = 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | CQI delay | ms | N/A | N/A | N/A | 10 |
| | *cqi-pmi-ConfigurationIndex* | | N/A | N/A | N/A | 4 |
| | *ri-ConfigIndex* | | N/A | N/A | N/A | 1 |
| CSI process for PDSCH scheduling | | | CSI process 0 | | CSI process 0 | |
| Cell ID | | | 0 | 6 | 0 | 6 |
| Quasi-co-located CSI-RS | | | CSI-RS 0 | CSI-RS 1 | CSI-RS 0 | CSI-RS 1 |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 |
| PMI for subframe 2, 3, 4, 7, 8 and 9 | | | 010000 for fixed RI = 2<br>010011 for UE reported RI | 100000 | 000011 for fixed RI = 1<br>010011 for UE reported RI | N/A |
| PMI for subframe 1 and 6 | | | 100000 | 100000 | 100000 | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | 1 | N/A |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: 3 symbols allocated to PDCCH
Note 3: Reference measurement channel RC.13 FDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 2, 3, 4, 7, 8 and 9 from TP1.
Note 4: TM10 OCNG as specified in A.5.1.8 is transmitted on subframe 1 and 6 from TP1.
Note 5: TM10 OCNG as specified in A.5.1.8 is transmitted on subframe 1, 2, 3, 4, 6, 7, 8 and 9 from TP2 for Test 1; TP2 is blanked for Test 2.
Note 6: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.
Note 7: If UE supports multiple CSI processes, CSI process 0 is configured as ‘RI-reference CSI process’ for CSI process 1.
Note 8: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.
Note 9: If UE supports one CSI process, CSI process 1 is not configured in Test 2.

**Table 9.5.5.1-2 Minimum requirement (FDD)**

| | **Test 1** | **Test 2** |
|---|---|---|
| $\gamma_1$ | N/A | 1.0 |
| $\gamma_2$ | 1.0 | N/A |
| UE Category | ≥2 | ≥2 |

## 9.5.5.2 TDD

The minimum performance requirement in Table 9.5.5.2-2 is defined as

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

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

c) For Test 2, the RI reported for CSI process 1 shall be the same as the most recent RI reported for CSI process 0 if UE is configured with multiple CSI processes.

For the parameters specified in Table 9.5.5.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.5.2-2.

**Table 9.5.5.2-1 RI Test (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | TP1 | TP2 | TP1 | TP2 |
| Bandwidth | | MHz | 10 MHz | | 10 MHz | |
| Transmission mode | | | 10 | 10 | 10 | 10 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | 0 | |
| | $\rho_B$ | dB | 0 | | 0 | |
| | $P_c$ | dB | 0 | 0 | 0 | 0 |
| | σ | dB | 0 | | 0 | |
| Uplink downlink configuration | | | 2 | 2 | 2 | 2 |
| Special subframe configuration | | | 4 | 4 | 4 | 4 |
| SNR | | dB | 0 | 0 | 20 | 20 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -78 | -78 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA 5 Low | EPA 5 Low | EPA 5 Low | EPA 5 High |
| Antenna configuration | | | 2x2 | 2x2 | 2x2 | 2x2 |
| Beamforming Model | | | As specified in Section B.4.3 | | As specified in Section B.4.3 | |
| Timing offset between TPs | | us | 0 | | 0 | |
| Frequency offset between TPs | | Hz | 0 | | 0 | |
| Cell-specific reference signals | | | Antenna ports 0 | | Antenna ports 0 | |
| CSI-RS signal 0 | | | Antenna ports 15,16 | N/A | Antenna ports 15,16 | N/A |
| CSI-RS 0 periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | | 5/3 | N/A | 5/3 | N/A |
| CSI-RS 0 configuration | | | 0 | N/A | 0 | N/A |
| CSI-RS signal 1 | | | N/A | Antenna ports 15,16 | N/A | Antenna ports 15,16 |
| CSI-RS 1 periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | | N/A | 5/3 | N/A | 5/3 |
| CSI-RS 1 configuration | | | N/A | 3 | N/A | 3 |
| Zero-power CSI-RS 0 configuration $I_{\text{CSI-RS}}$ / *ZeroPowerCSI-RS* bitmap | | | N/A | 3 / 1000001000000000 | N/A | 3 / 1000001000000000 |
| Zero-power CSI-RS 1 configuration $I_{\text{CSI-RS}}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0011000000000000 | N/A | 3 / 0011000000000000 | N/A |
| CSI-IM 0 periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | | 5/3 | N/A | 5/3 | N/A |
| CSI-IM 0 configuration | | | 2 | N/A | 2 | N/A |
| CSI-IM 1 periodicity and subframe offset $T_{\text{CSI-RS}}$ / $\Delta_{\text{CSI-RS}}$ | | | N/A | 5/3 | N/A | 5/3 |
| CSI-IM 1 configuration | | | N/A | 6 | N/A | 6 |
| RI configuration | | | Fixed RI=2 and follow RI | N/A | Fixed RI=1 and follow RI | N/A |
| CSI process 0 (Note 6, 7) | CSI-RS | | CSI-RS 0 | N/A | CSI-RS 0 | N/A |
| | CSI-IM | | CSI-IM 0 | N/A | CSI-IM 0 | N/A |
| | Reporting mode | | PUSCH 3-1 | N/A | PUSCH 3-1 | N/A |
| | Reporting Interval | ms | *5* | N/A | *5* | N/A |
| | CQI delay | ms | 11 | N/A | 11 | N/A |
| CSI process 1 (Note 6, 7, 8) | CSI-RS | | N/A | N/A | N/A | CSI-RS 1 |
| | CSI-IM | | N/A | N/A | N/A | CSI-IM 1 |
| | Reporting mode | | N/A | N/A | N/A | PUSCH 3-1 |
| | Reporting Interval | ms | N/A | N/A | N/A | *5* |
| | CQI delay | ms | N/A | N/A | N/A | 11 |
| CSI process for PDSCH scheduling | | | CSI process 0 | | CSI process 0 | |
| Cell ID | | | 0 | 6 | 0 | 6 |
| Quasi-co-located CSI-RS | | | CSI-RS 0 | CSI-RS 1 | CSI-RS 0 | CSI-RS 1 |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 | Same Cell ID as Cell 1 | Same Cell ID as Cell 2 |
| PMI for subframe 4 and 9 | | | 010000 for fixed RI = 2 010011 for UE | 100000 | 000011 for fixed RI = 1 010011 for UE | N/A |

| | | | | | |
|---|---|---|---|---|---|
| | | reported RI | | reported RI | |
| PMI for subframe 3 and 8 | | 100000 | 100000 | 100000 | N/A |
| Max number of HARQ transmissions | | 1 | N/A | 1 | N/A |
| ACK/NACK feedback mode | | Multiplexing | N/A | Multiplexing | N/A |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 2: 3 symbols allocated to PDCCH<br>Note 3: Reference measurement channel RC.13 TDD according to Table A.4-1. PDSCH transmission is scheduled on subframe 4 and 9 from TP1.<br>Note 4: TM10 OCNG as specified in A.5.2.8 is transmitted on subframe 3 and 8 from TP1.<br>Note 5: TM10 OCNG as specified in A.5.2.8 is transmitted on subframe 3, 4, 8 and 9 from TP2 for Test 1; TP2 is blanked for Test 2.<br>Note 6: Reported wideband CQI and PMI are used and sub-band CQI is discarded.<br>Note 7: If UE supports multiple CSI processes, CSI process 0 is configured as 'RI-reference CSI process' for CSI process 1.<br>Note 8: If UE supports one CSI process, CSI process 1 is not configured in Test 2.<br>Note 9: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3and #8 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#7 and #2. | | | | | |

**Table 9.5.5.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma_1$ | N/A | 1.0 |
| $\gamma_2$ | 1.0 | N/A |
| UE Category | ≥2 | ≥2 |

# 9.6 Additional requirements for carrier aggregation

This clause includes requirements for the reporting of channel state information (CSI) with the UE configured for carrier aggregation. The purpose is to verify that the channel state for each cell is correctly reported with multiple cells configured for periodic reporting.

## 9.6.1 Periodic reporting on multiple cells (Cell-Specific Reference Symbols)

### 9.6.1.1 FDD

The following requirements apply to UE Category ≥3. For the parameters specified in Table 9.6.1.1-1 and Table 9.6.1.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband CQI}_{\text{Pcell}} - \text{wideband CQI}_{\text{Scell}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-1: Parameters for PUCCH 1-0 static test on multiple cells (FDD)**

| Parameter | | Unit | Pcell | Scell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | |
| SNR | | dB | 10 | 4 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -94 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | |
| PUCCH Report Type | | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 | |
| *cqi-pmi-ConfigurationIndex* | | | 11 | 16 [shift of 5 ms relative to Pcell] |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. | | | | |

**Table 9.6.1.1-2: PUCCH 1-0 static test (FDD)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 10MHz for both cells |
| 2 | 20MHz for both cells |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. | |

### 9.6.1.2 TDD

The following requirements apply to UE Category ≥3. For the parameters specified in Table 9.6.1.2-1 and Table 9.6.1.2-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband CQI}_{Pcell} - \text{wideband CQI}_{Scell} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-1: PUCCH 1-0 static test on multiple cells (TDD)**

| Parameter | | Unit | Pcell | Scell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Uplink downlink configuration | | | 2 | |
| Special subframe configuration | | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | |
| SNR | | dB | 10 | 4 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -94 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | |
| PUCCH Report Type | | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 | |
| *cqi-pmi-ConfigurationIndex* | | | 8 | 13 [shift of 5 ms relative to Pcell] |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. | | | | |

**Table 9.6.1.2-2: PUCCH 1-0 static test (TDD)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 20MHz for both cells |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. | |

# 10 Performance requirement (MBMS)

## 10.1 FDD (Fixed Reference Channel)

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

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

| Parameter | Unit | Value |
|---|---|---|
| Number of HARQ processes | Processes | None |
| Subcarrier spacing | kHz | 15 kHz |
| Allocated subframes per Radio Frame (Note 1) | | 6 subframes |
| Number of OFDM symbols for PDCCH | | 2 |
| Cyclic Prefix | | Extended |
| Note1: For FDD mode, up to 6 subframes (#1/2/3/6/7/8) are available for MBMS, in line with TS 36.331. | | |

### 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 | | MBMS UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | BLER (%) | SNR(dB) | |
| 1 | 10 MHz | R.37 FDD | OP.4 FDD | MBSFN channel model (Table B.2.6-1) | 1x2 low | 1 | 4.1 | ≥1 |
| 2 | 10 MHz | R.38 FDD | OP.4 FDD | | | | 11.0 | ≥1 |
| 3 | 10 MHz | R.39 FDD | OP.4 FDD | | | | 20.1 | ≥2 |
| | 5.0MHz | R.39-1 FDD | OP.4 FDD | | | | 20.5 | 1 |

## 10.2 TDD (Fixed Reference Channel)

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

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

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

### 10.2.1 Minimum requirement

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

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

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

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

**Table 10.2.1-2: Minimum performance**

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

# Annex A (normative): Measurement channels

# A.1 General

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

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

# A.2 UL reference measurement channels

## A.2.1 General

The measurement channels in the following subclauses are defined to derive the requirements in clause 6 (Transmitter Characteristics) and clause 7 (Receiver Characteristics). The measurement channels represent example configurations of physical channels for different data rates.

### A.2.1.1 Applicability and common parameters

The UL reference measurement channels comprise transmission of PUSCH and Demodulation Reference signals only. The following conditions apply:

- 1 HARQ transmission
- Cyclic Prefix normal
- PUSCH hopping off
- Link adaptation off
- Demodulation Reference signal as per TS 36.211 [4] subclause 5.5.2.1.2.

Where ACK/NACK is transmitted, it is assumed to be multiplexed on PUSCH as per TS 36.212 [5] subclause 5.2.2.6.

- ACK/NACK 1 bit
- ACK/NACK mapping adjacent to Demodulation Reference symbol
- ACK/NACK resources punctured into data
- Max number of resources for ACK/NACK: 4 SC-FDMA symbols per subframe
- No CQI transmitted, no RI transmitted

### A.2.1.2 Determination of payload size

The algorithm for determining the payload size $A$ is as follows; given a desired coding rate $R$ and radio block allocation $N_{RB}$

1. Calculate the number of channel bits $N_{ch}$ that can be transmitted during the first transmission of a given sub-frame.

2. Find $A$ such that the resulting coding rate is as close to $R$ as possible, that is,

$$\min\left|R-(A+24*(N_{CB}+1))/N_{ch}\right|,\ where\ N_{CB}=\begin{cases}0, if\ C=1\\ C, if\ C>1\end{cases}$$ subject to

a) A is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of $N_{\mathrm{RB}}$ resource blocks.

b) *C* is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].

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 and the chosen code rate should not exceed 0.93.

## A.2.1.3 Overview of UL reference measurement channels

In Table A.2.1.3-1 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**

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

#### 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)<br>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)<br>Note 2: As per Table 4.2-2 in TS 36.211 [4] | | | | | | | |

## A.2.3.1.3 64-QAM

[FFS]

## A.2.3.2 Partial RB allocation

For each channel bandwidth, various partial RB allocations are specified. The number of allocated RBs is chosen according to values specified in the Tx and Rx requirements. The single allocated RB case is included.

The allocated RBs are contiguous and start from one end of the channel bandwidth. A single allocated RB is at one end of the channel bandwidth.

### A.2.3.2.1 QPSK

**Table A.2.3.2.1-1 Reference Channels for QPSK with partial RB allocation**

| Parameter | Ch BW | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | MHz | | | | | | Bits | Bits | | Bits | | |
| | 1.4 - 20 | 1 | 1 | 12 | QPSK | 1/3 | 72 | 24 | 1 | 288 | 144 | ≥ 1 |
| | 1.4 - 20 | 2 | 1 | 12 | QPSK | 1/3 | 176 | 24 | 1 | 576 | 288 | ≥ 1 |
| | 1.4 - 20 | 3 | 1 | 12 | QPSK | 1/3 | 256 | 24 | 1 | 864 | 432 | ≥ 1 |
| | 1.4 - 20 | 4 | 1 | 12 | QPSK | 1/3 | 392 | 24 | 1 | 1152 | 576 | ≥ 1 |
| | 1.4 - 20 | 5 | 1 | 12 | QPSK | 1/3 | 424 | 24 | 1 | 1440 | 720 | ≥ 1 |
| | 3-20 | 6 | 1 | 12 | QPSK | 1/3 | 600 | 24 | 1 | 1728 | 864 | ≥ 1 |
| | 3-20 | 8 | 1 | 12 | QPSK | 1/3 | 808 | 24 | 1 | 2304 | 1152 | ≥ 1 |
| | 3-20 | 9 | 1 | 12 | QPSK | 1/3 | 776 | 24 | 1 | 2592 | 1296 | ≥ 1 |
| | 3-20 | 10 | 1 | 12 | QPSK | 1/3 | 872 | 24 | 1 | 2880 | 1440 | ≥ 1 |
| | 3-20 | 12 | 1 | 12 | QPSK | 1/3 | 1224 | 24 | 1 | 3456 | 1728 | ≥ 1 |
| | 5-20 | 15 | 1 | 12 | QPSK | 1/3 | 1320 | 24 | 1 | 4320 | 2160 | ≥ 1 |
| | 5-20 | 16 | 1 | 12 | QPSK | 1/3 | 1384 | 24 | 1 | 4608 | 2304 | ≥ 1 |
| | 5-20 | 18 | 1 | 12 | QPSK | 1/3 | 1864 | 24 | 1 | 5184 | 2592 | ≥ 1 |
| | 5-20 | 20 | 1 | 12 | QPSK | 1/3 | 1736 | 24 | 1 | 5760 | 2880 | ≥ 1 |
| | 5-20 | 24 | 1 | 12 | QPSK | 1/3 | 2472 | 24 | 1 | 6912 | 3456 | ≥ 1 |
| | 10-20 | 25 | 1 | 12 | QPSK | 1/3 | 2216 | 24 | 1 | 7200 | 3600 | ≥ 1 |
| | 10-20 | 27 | 1 | 12 | QPSK | 1/3 | 2792 | 24 | 1 | 7776 | 3888 | ≥ 1 |
| | 10-20 | 30 | 1 | 12 | QPSK | 1/3 | 2664 | 24 | 1 | 8640 | 4320 | ≥ 1 |
| | 10-20 | 32 | 1 | 12 | QPSK | 1/3 | 2792 | 24 | 1 | 9216 | 4608 | ≥ 1 |
| | 10-20 | 36 | 1 | 12 | QPSK | 1/3 | 3752 | 24 | 1 | 10368 | 5184 | ≥ 1 |
| | 10-20 | 40 | 1 | 12 | QPSK | 1/3 | 4136 | 24 | 1 | 11520 | 5760 | ≥ 1 |
| | 10-20 | 45 | 1 | 12 | QPSK | 1/3 | 4008 | 24 | 1 | 12960 | 6480 | ≥ 1 |
| | 10-20 | 48 | 1 | 12 | QPSK | 1/3 | 4264 | 24 | 1 | 13824 | 6912 | ≥ 1 |
| | 15 - 20 | 50 | 1 | 12 | QPSK | 1/3 | 5160 | 24 | 1 | 14400 | 7200 | ≥ 1 |
| | 15 - 20 | 54 | 1 | 12 | QPSK | 1/3 | 4776 | 24 | 1 | 15552 | 7776 | ≥ 1 |
| | 15 - 20 | 60 | 1 | 12 | QPSK | 1/4 | 4264 | 24 | 1 | 17280 | 8640 | ≥ 1 |
| | 15 - 20 | 64 | 1 | 12 | QPSK | 1/4 | 4584 | 24 | 1 | 18432 | 9216 | ≥ 1 |
| | 15 - 20 | 72 | 1 | 12 | QPSK | 1/4 | 5160 | 24 | 1 | 20736 | 10368 | ≥ 1 |
| | 20 | 75 | 1 | 12 | QPSK | 1/5 | 4392 | 24 | 1 | 21600 | 10800 | ≥ 1 |
| | 20 | 80 | 1 | 12 | QPSK | 1/5 | 4776 | 24 | 1 | 23040 | 11520 | ≥ 1 |
| | 20 | 81 | 1 | 12 | QPSK | 1/5 | 4776 | 24 | 1 | 23328 | 11664 | ≥ 1 |
| | 20 | 90 | 1 | 12 | QPSK | 1/6 | 4008 | 24 | 1 | 25920 | 12960 | ≥ 1 |
| | 20 | 96 | 1 | 12 | QPSK | 1/6 | 4264 | 24 | 1 | 27648 | 13824 | ≥ 1 |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>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 $N_{\mathrm{RB}}$

1. Calculate the number of channel bits $N_{\mathrm{ch}}$ that can be transmitted during the first transmission of a given sub-frame.

2. Find *A* such that the resulting coding rate is as close to *R* as possible, that is,

$$\min\left|R-(A+24*(N_{CB}+1))/N_{ch}\right|, \; where \; N_{CB}=\begin{cases}0, if \;\; C=1\\ C, if \;\; C>1\end{cases}$$ subject to

a) A is a valid TB size according to section 7.1.7 of TS 36.213 [6] assuming an allocation of $N_{\mathrm{RB}}$ resource blocks.

b) *C* is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].

3. If there is more than one *A* that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

4. For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL+DwPTS (12 OFDM symbol): 2UL

## A.3.1.1 Overview of DL reference measurement channels

In Table A.3.1.1-1 are listed the DL reference measurement channels specified in annexes A.3.2 to A.3.10 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.3.10 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** | | | | | | | | | |
| 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** | | | | | | | | | |
| 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.42 FDD | 20 | QPSK | 1/3 | 100 | | ≥ 1 | |
| FDD | Table A.3.3.1-1 | R.2 FDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.1-2 | R.3-1 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.1-2 | R.3 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.5 FDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.1-3 | R.6 FDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.7 FDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.8 FDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.9 FDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| FDD | Table A.3.3.1-3a | R.6-1 FDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.7-1 FDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.8-1 FDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-1 FDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-2 FDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| FDD | Table A.3.3.1-6 | R.41 FDD | 10 | QPSK | 1/10 | 50 | | ≥ 1 | |
| **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: Carrier aggregation with power imbalance** | | | | | | | | | |
| FDD | Table A.3.3.1-7 | R.49 FDD | 20 | 64QAM | 0.84-0.87 | 100 | | ≥ 5 | |
| **FDD, PDSCH Performance: Carrier aggregation with timing offset** | | | | | | | | | |
| FDD | Table A.3.3.2.1-3 | R.60 FDD | 10 | 64QAM | | 50 | | ≥ 3 | |
| **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.11-1 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.11-2 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-1 | R.11-3 FDD | 10 | 16QAM | 1/2 | 40 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-1 | R.11-4 FDD | 10 | QPSK | 1/2 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-1 | R.30 FDD | 20 | 16QAM | 1/2 | 100 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.30-1 FDD | 15 | 16QAM | 1/2 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.35 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.35-1 FDD | 20 | 64QAM | 0.39 | 100 | | 4 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FDD | Table A.3.3.2.1-1 | R.35-2 FDD | 15 | 64QAM | 0.39 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-1 | R.35-3 FDD | 10 | 64QAM | 0.39 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-2 | R.35-4 FDD | 10 | 64QAM | 0.47 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-2 | R.46 FDD | 10 | QPSK | | 50 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-2 | R.47 FDD | 10 | 16QAM | | 50 | | ≥ 1 | |
| **FDD, 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.14-3 FDD | 20 | 16QAM | 1/2 | 100 | | ≥ 2 | |
| FDD | Table A.3.3.2.2-1 | R.36 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| **FDD, PDSCH Performance (UE specific RS) Two antenna ports (CSI-RS)** | | | | | | | | | |
| FDD | Table A.3.3.3.1-1 | R.51 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| **FDD, PDSCH Performance (UE specific RS) Two antenna ports (CSI-RS, non Quasi Co-located)** | | | | | | | | | |
| FDD | Table A.3.3.3.1-2 | R.52 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.3.1-2 | R.53 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.3.1-2 | R.54 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| **FDD, PDSCH Performance (UE specific RS) Four antenna ports (CSI-RS)** | | | | | | | | | |
| FDD | Table A.3.3.3.2-1 | R.43 FDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.3.2-1 | R.50 FDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.3.2-2 | R.44 FDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.3.2-2 | R.45 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.3.2-2 | R.45-1 FDD | 10 | 16QAM | 1/2 | 39 | | ≥ 1 | |
| FDD | Table A.3.3.3.2-1 | R.48 FDD | 10 | QPSK | | 50 | | ≥ 1 | |
| **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.42 TDD | 20 | QPSK | 1/3 | 100 | | ≥ 1 | |
| TDD | Table A.3.4.1-1 | R.2 TDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.1-2 | R.3-1 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.1-2 | R.3 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.5 TDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.1-3 | R.6 TDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.7 TDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.8 TDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.9 TDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| TDD | Table A.3.4.1-3a | R.6-1 TDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.7-1 TDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.8-1 TDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-1 TDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-2 TDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| TDD | Table A.3.4.1-6 | R.41 TDD | 10 | QPSK | 1/10 | 50 | | ≥ 1 | |
| **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: Carrier aggregation with power imbalance** | | | | | | | | | |
| TDD | Table A.3.4.1-7 | R.49 TDD | 20 | 64QAM | 0.81-087 | 100 | | ≥ 5 | |
| **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.11-4 TDD | 10 | QPSK | 1/2 | 50 | | ≥ 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.30-1 TDD | 20 | 16QAM | 1/2 | 100 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-1 | R.30-2 TDD | 20 | 16QAM | 1/2 | 100 | | 3 | |
| TDD | Table A.3.4.2.1-1 | R.35 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-1 | R.35-1 TDD | 20 | 64QAM | 0.39 | 100 | | 4 | |
| TDD | Table A.3.4.2.1-2 | R.35-2 TDD | 10 | 64QAM | 0.47 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-2 | R.46 TDD | 10 | QPSK | | 50 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-2 | R.47 TDD | 10 | 16QAM | | 50 | | ≥ 1 | |
| **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.43 TDD | 20 | 16QAM | 1/2 | 100 | | ≥2 | |
| 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 | |
| **TDD, PDSCH Performance (UE specific RS) Two antenna ports (CSI-RS)** | | | | | | | | | |
| TDD | Table A.3.4.3.3-1 | R.51 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| **TDD, PDSCH Performance (UE specific RS) Two antenna ports (CSI-RS, non Quasi Co-located)** | | | | | | | | | |
| TDD | Table A.3.4.3.3-2 | R.52 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.3-2 | R.53 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.3-2 | R.54 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| **TDD, PDSCH Performance (UE specific RS) Four antenna ports (CSI-RS)** | | | | | | | | | |
| TDD | Table A.3.4.3.4-1 | R.44 TDD | 10 | 64QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.4-1 | R.48 TDD | 10 | QPSK | | 50 | | ≥ 1 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **TDD, PDSCH Performance (UE specific RS) Eight antenna ports (CSI-RS)** | | | | | | | | | |
| TDD | Table A.3.4.3.5-1 | R.50 TDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.3.5-2 | R.45 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.5-2 | R.45-1 TDD | 10 | 16QAM | 1/2 | 39 | | ≥ 1 | |
| **FDD, PDCCH / PCFICH Performance** | | | | | | | | | |
| FDD | Table A.3.5.1-1 | R.15 FDD | 10 | PDCCH | | | | | |
| FDD | Table A.3.5.1-1 | R.15-1 FDD | 10 | PDCCH | | | | | |
| FDD | Table A.3.5.1-1 | R.15-2 FDD | 10 | PDCCH | | | | | |
| FDD | Table A.3.5.1-1 | R.16 FDD | 10 | PDCCH | | | | | |
| FDD | Table A.3.5.1-1 | R.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.15-1 TDD | 10 | PDCCH | | | | | |
| TDD | Table A.3.5.2-1 | R.15-2 TDD | 10 | PDCCH | | | | | |
| TDD | Table A.3.5.2-1 | R.16 TDD | 10 | PDCCH | | | | | |
| TDD | Table A.3.5.2-1 | R.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 (CRS)** | | | | | | | | | |
| 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- | | | ≥ 4 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.88 | | | | |
| FDD | Table A.3.9.1-1 | R.31-5 FDD | 15 | 64QAM | 0.85-0.91 | | | ≥ 3 | |
| **TDD, Sustained data rate (CRS)** | | | | | | | | | |
| 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.31-3A TDD | 15 | 64QAM | 0.87-0.90 | | | ≥ 2 | |
| TDD | Table A.3.9.2-1 | R.31-4 TDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |
| **FDD, Sustained data rate test with EPDCCH scheduling (CRS)** | | | | | | | | | |
| FDD | Table A.3.9.3-1 | R.31E-1 FDD | 10 | 64QAM | 0.40-0.41 | | | ≥ 1 | |
| FDD | Table A.3.9.3-1 | R.31E-2 FDD | 10 | 64QAM | 0.59-0.66 | | | ≥ 2 | |
| FDD | Table A.3.9.3-1 | R.31E-3 FDD | 20 | 64QAM | 0.59-0.63 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31E-3C FDD | 15 | 64QAM | 0.87-0.92 | | | ≥ 3 | |
| FDD | Table A.3.9.3-1 | R.31E-3A FDD | 10 | 64QAM | 0.85-0.92 | | | ≥ 2 | |
| FDD | Table A.3.9.3-1 | R.31E-4 FDD | 20 | 64QAM | 0.87-0.91 | | | ≥ 3 | |
| FDD | Table A.3.9.1-1 | R.31E-4B FDD | 15 | 64QAM | 0.87-0.90 | | | ≥ 4 | |
| **TDD, Sustained data rate test with EPDCCH scheduling (CRS)** | | | | | | | | | |
| TDD | Table A.3.9.4-1 | R.31E-1 TDD | 10 | 64QAM | 0.40-0.41 | | | ≥ 1 | |
| TDD | Table A.3.9.4-1 | R.31E-2 TDD | 10 | 64QAM | 0.59-0.65 | | | ≥ 2 | |
| TDD | Table A.3.9.4-1 | R.31E-3 TDD | 20 | 64QAM | 0.59-0.63 | | | ≥ 2 | |
| TDD | Table A.3.9.4-1 | R.31E-3A TDD | 15 | 64QAM | 0.87-0.92 | | | ≥ 2 | |
| TDD | Table A.3.9.4-1 | R.31E-4 TDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |
| **FDD, ePDCCH performance** | | | | | | | | | |
| FDD | Table A.3.10.1-1 | R.55 FDD | 10 | EPDCCH | | | | | |
| FDD | Table A.3.10.1-1 | R.56 FDD | 10 | EPDCCH | | | | | |
| FDD | Table A.3.10.1-1 | R.57 FDD | 10 | EPDCCH | | | | | |
| FDD | Table A.3.10.1-1 | R.58 FDD | 10 | EPDCCH | | | | | |
| FDD | Table A.3.10.1-1 | R.59 FDD | 10 | EPDCCH | | | | | |
| **TDD, ePDCCH performance** | | | | | | | | | |
| TDD | Table A.3.10.2-1 | R.55 TDD | 10 | EPDCCH | | | | | |
| TDD | Table A.3.10.2-1 | R.56 TDD | 10 | EPDCCH | | | | | |
| TDD | Table A.3.10.2-1 | R.57 TDD | 10 | EPDCCH | | | | | |
| TDD | Table A.3.10.2-1 | R.58 TDD | 10 | EPDCCH | | | | | |
| TDD | Table A.3.10.2-1 | R.59 TDD | 10 | EPDCCH | | | | | |

# 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 subclause 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 subclause 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 | | 9 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 1320 | 2216 | 4392 | 6712 | 8760 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 152 | 872 | 1800 | 4392 | 6712 | 8760 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 1 | 1 | 1 | 2 | 2 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 1 | 1 | 1 | 1 | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1368 | 3780 | 6300 | 13800 | 20700 | 27600 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 528 | 2940 | 5460 | 12960 | 19860 | 26760 |
| Max. Throughput averaged over 1 frame | kbps | 341.6 | 1143.2 | 1952.8 | 3952.8 | 6040.8 | 7884 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz<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.3.2-2: 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) | | 3 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmission | | 1 | 1 | 1 | 1 | 1 | 1 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target coding rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Information Bit Payload per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | 408 | 1320 | 2216 | 4392 | 6712 | 8760 |
| For Sub-Frame 1, 6 | | N/A | 968 | 1544 | 3240 | 4968 | 6712 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 208 | 1064 | 1800 | 4392 | 6712 | 8760 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frame 4, 9 | | 1 | 1 | 1 | 1 | 2 | 2 |
| For Sub-Frame 1, 6 | | N/A | 1 | 1 | 1 | 1 | 2 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 1 | 1 | 1 | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | 1368 | 3780 | 6300 | 13800 | 20700 | 27600 |
| For Sub-Frame 1, 6 | | N/A | 3276 | 5556 | 11256 | 16956 | 22656 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 672 | 3084 | 5604 | 13104 | 20004 | 26904 |
| Max. Throughput averaged over 1 frame | kbps | 102.4 | 564 | 932 | 1965.6 | 3007.2 | 3970.4 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 25 | 50 | 75 | 100 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated subframes per Radio Frame | | 8 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2984 | 8504 | 14112 | 30576 | 46888 | 61664 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6456 | 12576 | 28336 | 45352 | 61664 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | 3 | 5 | 8 | 11 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 5 | 8 | 11 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4104 | 11340 | 18900 | 41400 | 62100 | 82800 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 8820 | 16380 | 38880 | 59580 | 80280 |
| Max. Throughput averaged over 1 frame | kbps | 2387.2 | 7448.8 | 12547 | 27294 | 42046 | 55498 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz.<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.3.2-3a: 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 | | 8 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2984 | 8504 | 10296 | 10296 | 10296 | 10296 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6456 | 8248 | 10296 | 10296 | 10296 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 2 | 2 | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4104 | 11340 | 13608 | 14076 | 14076 | 14076 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 8820 | 11088 | 14076 | 14076 | 14076 |
| Max. Throughput averaged over 1 frame | kbps | 2387.2 | 7448.8 | 9079.6 | 9266.4 | 9266.4 | 9266.4 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz.<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.3.2-3b: Fixed Reference Channel for Maximum input level for UE Category 2 (FDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 25 | 50 | 75 | 83 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated subframes per Radio Frame | | 8 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2984 | 8504 | 14112 | 30576 | 46888 | 51024 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6456 | 12576 | 28336 | 45352 | 51024 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | 3 | 5 | 8 | 9 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 5 | 8 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4104 | 11340 | 18900 | 41400 | 62100 | 68724 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 8820 | 16380 | 38880 | 59580 | 66204 |
| Max. Throughput averaged over 1 frame | kbps | 2387.2 | 7448.8 | 12547 | 27294 | 42046 | 45922 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz.<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.3.2-4: Fixed Reference Channel for Maximum input level for UE Categories ≥ 3 (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 | | 2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 2984 | 8504 | 14112 | 30576 | 46888 | 61664 |
| For Sub-Frames 1,6 | Bits | N/A | 6968 | 11448 | 23688 | 35160 | 46888 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6968 | 12576 | 30576 | 45352 | 61664 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 3 | 5 | 8 | 11 |
| For Sub-Frames 1,6 | | N/A | 2 | 2 | 4 | 6 | 8 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 5 | 8 | 11 |
| Binary Channel Bits per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4104 | 11340 | 18900 | 41400 | 62100 | 82800 |
| For Sub-Frames 1,6 | | N/A | 9828 | 16668 | 33768 | 50868 | 67968 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9252 | 16812 | 39312 | 60012 | 80712 |
| Max. Throughput averaged over 1 frame | kbps | 596.8 | 3791.2 | 6369.6 | 13910 | 20945 | 27877 |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 18 | 17 | 17 | 17 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Uplink-Downlink Configuration (Note 5) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame | | 2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 2984 | 8504 | 10296 | 10296 | 10296 | 10296 |
| For Sub-Frames 1,6 | Bits | N/A | 6968 | 8248 | 7480 | 7480 | 7480 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6968 | 8248 | 10296 | 10296 | 10296 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frames 1,6 | | N/A | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 2 | 2 | 2 | 2 |
| Binary Channel Bits per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4104 | 11340 | 13608 | 14076 | 14076 | 14076 |
| For Sub-Frames 1,6 | | N/A | 9828 | 11880 | 11628 | 11628 | 11628 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9252 | 11520 | 14076 | 14076 | 14076 |
| Max. Throughput averaged over 1 frame | kbps | 596.8 | 3791.2 | 4533.6 | 4584.8 | 4584.8 | 4584.8 |

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

**Table A.3.2-4b: Fixed Reference Channel for Maximum input level for UE Category 2 (TDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 25 | 50 | 75 | 83 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Uplink-Downlink Configuration (Note 5) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame | | 2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 2984 | 8504 | 14112 | 30576 | 46888 | 51024 |
| For Sub-Frames 1,6 | Bits | N/A | 6968 | 11448 | 23688 | 35160 | 39232 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 6968 | 12576 | 30576 | 45352 | 51024 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 3 | 5 | 8 | 9 |
| For Sub-Frames 1,6 | | N/A | 2 | 3 | 5 | 7 | 7 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 5 | 8 | 9 |
| Binary Channel Bits per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4104 | 11340 | 18900 | 41400 | 62100 | 68724 |
| For Sub-Frames 1,6 | | N/A | 9828 | 16668 | 33768 | 50868 | 56340 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9252 | 16380 | 39312 | 60012 | 66636 |
| Max. Throughput averaged over 1 frame | kbps | 596.8 | 3791.2 | 6369.6 | 13910 | 20945 | 23154 |

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

# 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.42 FDD | | R.2 FDD | | |
| Channel bandwidth | MHz | 1.4 | 20 | | 10 | | |
| Allocated resource blocks (Note 4) | | 6 | 100 | | 50 | | |
| Allocated subframes per Radio Frame | | 9 | 9 | | 9 | | |
| Modulation | | QPSK | QPSK | | QPSK | | |
| Target Coding Rate | | 1/3 | 1/3 | | 1/3 | | |
| Information Bit Payload (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 8760 | | 4392 | | |
| For Sub-Frame 5 | Bits | N/A | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | 152 | 8760 | | 4392 | | |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | | 1 | | |
| For Sub-Frame 5 | | N/A | N/A | | N/A | | |
| For Sub-Frame 0 | | 1 | 2 | | 1 | | |
| Binary Channel Bits (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1368 | 27600 | | 13800 | | |
| For Sub-Frame 5 | Bits | N/A | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | 528 | 26760 | | 12960 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 0.342 | 7.884 | | 3.953 | | |
| UE Category | | ≥ 1 | ≥ 1 | | ≥ 1 | | |

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

**Table A.3.3.1-2: 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 | | | | 9 | 9 | | |
| Modulation | | | | 16QAM | 16QAM | | |
| Target Coding Rate | | | | 1/2 | 1/2 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 6456 | 14112 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 5736 | 12960 | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | | | 2 | 3 | | |
| For Sub-Frame 5 | | | | N/A | N/A | | |
| For Sub-Frame 0 | | | | 1 | 3 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 12600 | 27600 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 10920 | 25920 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | 5.738 | 12.586 | | |
| UE Category | | | | ≥ 1 | ≥ 2 | | |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | R.5 FDD | R.6 FDD | R.7 FDD | R.8 FDD | R.9 FDD |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | 15 | 25 | 50 | 75 | 100 |
| Allocated subframes per Radio Frame | | | 9 | 9 | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 8504 | 14112 | 30576 | 46888 | 61664 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 6456 | 12576 | 28336 | 45352 | 61664 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | | 2 | 3 | 5 | 8 | 11 |
| For Sub-Frame 5 | | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | | 2 | 3 | 5 | 8 | 11 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 11340 | 18900 | 41400 | 62100 | 82800 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 8820 | 16380 | 38880 | 59580 | 80280 |
| Max. Throughput averaged over 1 frame | Mbps | | 7.449 | 12.547 | 27.294 | 42.046 | 55.498 |
| UE Category | | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 |

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.3.3.1-3a: 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 | | | 9 | 9 | 9 | 9 | 9 |
| Modulation | | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 10296 | 10296 | 10296 | 10296 | 51024 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 8248 | 10296 | 10296 | 10296 | 51024 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | | 2 | 2 | 2 | 2 | 9 |
| For Sub-Frame 5 | | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | | 2 | 2 | 2 | 2 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 13608 | 14076 | 14076 | 14076 | 68724 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 11088 | 14076 | 14076 | 14076 | 66204 |
| Max. Throughput averaged over 1 frame | Mbps | | 9.062 | 9.266 | 9.266 | 9.266 | 45.922 |
| UE Category | | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 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 | | | 9 | | 9 | | |
| Modulation | | | 16QAM | | 16QAM | | |
| Target Coding Rate | | | 1/2 | | 1/2 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 224 | | 256 | | |
| For Sub-Frame 5 | Bits | | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | | 224 | | 256 | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | | 1 | | 1 | | |
| For Sub-Frame 5 | | | N/A | | N/A | | |
| For Sub-Frame 0 | | | 1 | | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | 504 | | 552 | | |
| For Sub-Frame 5 | Bits | | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | | 504 | | 552 | | |
| Max. Throughput averaged over 1 frame | Mbps | | 0.202 | | 0.230 | | |
| UE Category | | | ≥ 1 | | ≥ 1 | | |

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 3) | | 111111 |
| Allocated subframes per Radio Frame | | 3 |
| 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 4) | | |
| 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: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.<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.3.3.1-6: Fixed Reference Channel QPSK R=1/10**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | | | R.41 FDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | | 50 | | |
| Allocated subframes per Radio Frame | | | | | 9 | | |
| Modulation | | | | | QPSK | | |
| Target Coding Rate | | | | | 1/10 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | | 1384 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 1384 | | |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | | | | 1 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | | 13800 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 12960 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | | 1.246 | | |
| UE Category | | | | | ≥ 1 | | |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.3.1-7: PCell Fixed Reference Channel for CA demodulation with power imbalance**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.49 FDD |
| Channel bandwidth | MHz | 20 |
| Allocated resource blocks | | 100 |
| Allocated subframes per Radio Frame | | 9 |
| Modulation | | 64QAM |
| Coding Rate | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.84 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | | 0.87 |
| Information Bit Payload | | |
| For Sub-Frames 0,1,2,3,4,6,7,8,9 | Bits | 63776 |
| For Sub-Frame 5 | Bits | N/A |
| Number of Code Blocks per Sub-Frame (Note 3) | | |
| For Sub-Frames 0,1,2,3,4,6,7,8,9 | Code Blocks | 11 |
| For Sub-Frame 5 | Code Blocks | N/A |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 75600 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 73080 |
| Max. Throughput averaged over 1 frame | Mbps | 57.398 |
| UE Category | | ≥5 |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | |

## A.3.3.2 Multi-antenna transmission (Common Reference Symbols)

### A.3.3.2.1 Two antenna ports

**Table A.3.3.2.1-1: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.10 FDD | R.11 FDD | R.11-1 FDD | R.11-2 FDD | R.11-3 FDD Note 5 | R.11-4 FDD | R.30 FDD | R.30-1 FDD | R.35-1 FDD | R.35 FDD | R.35-2 FDD | R.35-3 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 5 | 10 | 10 | 20 | 15 | 20 | 10 | 15 | 10 |
| Allocated resource blocks (Note 4) | | 50 | 50 | 50 | 25 | 40 | 50 | 100 | 75 | 100 | 50 | 75 | 50 |
| Allocated subframes per Radio Frame | | 9 | 9 | 8 | 9 | 9 | 9 | 9 | 8 | 8 | 9 | 8 | 8 |
| Modulation | | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | QPSK | 16QAM | 16QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 0.39 | 1/2 | 0.39 | 0.39 |
| Information Bit Payload (Note 4) | | | | | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4392 | 12960 | 12960 | 5736 | 10296 | 6968 | 25456 | 19080 | 30576 | 19848 | 22920 | 15264 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 4392 | 12960 | N/A | 4968 | 10296 | 6968 | 25456 | N/A | N/A | 18336 | N/A | N/A |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 3 | 3 | 1 | 2 | 2 | 5 | 4 | 5 | 4 | 4 | 3 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 1 | 3 | N/A | 1 | 2 | 2 | 5 | N/A | N/A | 3 | N/A | N/A |
| Binary Channel Bits (Note 4) | | | | | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 13200 | 26400 | 26400 | 12000 | 21120 | 13200 | 52800 | 39600 | 79200 | 39600 | 59400 | 39600 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 12384 | 24768 | N/A | 10368 | 19488 | 12384 | 51168 | N/A | N/A | 37152 | N/A | N/A |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 3.953 | 11.664 | 10.368 | 5.086 | 9.266 | 6.271 | 22.910 | 15.264 | 24.461 | 17.712 | 18.336 | 12.211 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 | 4 | ≥ 2 | ≥ 2 | ≥ 2 |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 4: Given per component carrier per codeword.
Note 5: For R.11-3 resource blocks of RB6–RB45 are allocated.

**Table A.3.3.2.1-2: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.46 FDD | R.47 FDD | R.35-4 FDD | | | | | |
| Channel bandwidth | MHz | 10 | 10 | 10 | | | | | |
| Allocated resource blocks (Note 4) | | 50 | 50 | 50 | | | | | |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | | | | | |
| Modulation | | QPSK | 16QAM | 64QAM | | | | | |
| Target Coding Rate | | | | 0.47 | | | | | |
| Information Bit Payload (Note 4) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 5160 | 8760 | 18336 | | | | | |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | | | | | |
| For Sub-Frame 0 | Bits | 5160 | 8760 | 16416 | | | | | |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 2 | 3 | | | | | |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | | | | | |
| For Sub-Frame 0 | Bits | 1 | 2 | 3 | | | | | |
| Binary Channel Bits (Note 4) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 13200 | 26400 | 39600 | | | | | |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | | | | | |
| For Sub-Frame 0 | Bits | 12384 | 24768 | 37152 | | | | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 4.644 | 7.884 | 16.310 | | | | | |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | | | | | |

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

**Table A.3.3.2.1-3: PCell and SCell Fixed Reference Channel for NC CA demodulation with timing offset and power imbalance**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.60 FDD |
| Channel bandwidth | MHz | 10 |
| Number of CRS ports | | 2 |
| Allocated resource blocks | | 50 |
| Allocated subframes per Radio Frame | | 8 |
| Modulation | | 64QAM |
| Coding Rate | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.54 |
| For Sub-Frame 5 | | n/a |
| For Sub-Frame 0 | | n/a |
| Information Bit Payload | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 21384 |
| For Sub-Frame 5 | Bits | n/a |
| For Sub-Frame 0 | Bits | n/a |
| Number of Code Blocks per Sub-Frame (Note 3) | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Code Blocks | 4 |
| For Sub-Frame 5 | Code Blocks | n/a |
| For Sub-Frame 0 | Code Blocks | n/a |
| Binary Channel Bits Per Sub-Frame (Note 4) | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 39600 |
| For Sub-Frame 5 | Bits | n/a |
| For Sub-Frame 0 | Bits | n/a |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 17.11 |
| UE Category | | ≥ 3 |
| 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: Given per component carrier per codeword. | | |

#### 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.14-3 FDD | R.36 FDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 20 | 10 |
| Allocated resource blocks (Note 4) | | 6 | 50 | 50 | 6 | 3 | 100 | 50 |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | 8 | 8 | 9 | 9 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload (Note 4) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | [25456] | 18336 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | n/a | N/A |
| For Sub-Frame 0 | Bits | 152 | 3624 | 11448 | N/A | N/A | [22920] | 18336 |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 1 | 3 | 1 | 1 | 5 | 3 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | n/a | N/A |
| For Sub-Frame 0 | | 1 | 1 | 2 | N/A | N/A | 4 | 3 |
| Binary Channel Bits (Note 4) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 51200 | 38400 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | n/a | N/A |
| For Sub-Frame 0 | Bits | 480 | 12032 | 24064 | N/A | N/A | 49664 | 36096 |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 0.342 | 3.876 | 11.513 | 1.235 | 0.595 | [22.656] | 16.502 |
| UE Category | | ≥ 1 | ≥ 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.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>Note 4: Given per component carrier per codeword. | | | | | | | | |

### A.3.3.3 Reference Measurement Channel for UE-Specific Reference Symbols

#### A.3.3.3.1 Two antenna port (CSI-RS)

The reference measurement channels in Table A.3.3.3.1-1 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports.

**Table A.3.3.3.1-1: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.51 FDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 50 (Note 3) |
| Allocated subframes per Radio Frame | | 9 |
| Modulation | | 16QAM |
| Target Coding Rate | | 1/2 |
| Information Bit Payload | | |
| For Sub-Frames 1,4,6,9 | Bits | 11448 |
| For Sub-Frames 2,3,7,8 | Bits | 11448 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 9528 |
| Number of Code Blocks (Note 4) | | |
| For Sub-Frames 1,4,6,9 | Code blocks | 2 |
| For Sub-Frames 2,3,7,8 | Code blocks | 2 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 2 |
| Binary Channel Bits | | |
| For Sub-Frames 1,4,6,9 | Bits | 24000 |
| For Sub-Frames 2,7 | | 23600 |
| For Sub-Frames 3,8 | | 23200 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 19680 |
| Max. Throughput averaged over 1 frame | Mbps | 10.1112 |
| UE Category | | ≥ 2 |
| 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: 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.<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). | | |

The reference measurement channels in Table A.3.3.3.1-2 apply for verifying demudlation performance for UE-specific reference symbols with two cell specific antenna ports and two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS in same subframe.

**Table A.3.3.3.1-2: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.52 FDD | R.53 FDD | R.54 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 |
| Allocated resource blocks | | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 16QAM |
| Target Coding Rate | | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | |
| For Sub-Frames 1,3,4,6,8,9 | Bits | 18336 | 18336 | 11448 |
| For Sub-Frames 2,7 | Bits | 16416 | 16416 | 11448 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 14688 | 14688 | 9528 |
| Number of Code Blocks (Note 4) | | | | |
| For Sub-Frames 1,3,4,6,8,9 | Code blocks | 3 | 3 | 2 |
| For Sub-Frames 2, 7 | Code blocks | 3 | 3 | 2 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 3 | 3 | 2 |
| Binary Channel Bits | | | | |
| For Sub-Frames 1,3,4,6,8,9 | Bits | 36000 | 36000 | 24000 |
| For Sub-Frames 2,7 | | 34200 | 33600 | 22800 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 29520 | 29520 | 19680 |
| Max. Throughput averaged over 1 frame | Mbps | 15.7536 | 15.7536 | 10.1112 |
| 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: 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.<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). | | | | |

## A.3.3.3.2 Four antenna ports (CSI-RS)

The reference measurement channels in Table A.3.3.3.2-1 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-1: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.43 FDD | R.50 FDD | R.48 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 |
| Allocated resource blocks | | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 |
| Modulation | | QPSK | 64QAM | QPSK |
| Target Coding Rate | | 1/3 | 1/2 | |
| Information Bit Payload | | | | |
| For Sub-Frames 1,4,6,9 | Bits | 3624 | 18336 | 6200 |
| For Sub-Frames 2,3,7,8 | Bits | 3624 | 16416 | 6200 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 2984 | 14688 | 4968 |
| Number of Code Blocks (Note 4) | | | | |
| For Sub-Frames 1,4,6,9 | Code blocks | 1 | 3 | 2 |
| For Sub-Frames 2,3,7,8 | Code blocks | 1 | 3 | 2 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 1 | 3 | 1 |
| Binary Channel Bits | | | | |
| For Sub-Frames 1,4,6,9 | Bits | 12000 | 36000 | 12000 |
| For Sub-Frames 2,7 | | 11600 | 34800 | 11600 |
| For Sub-Frames 3,8 | | 11600 | 34800 | 12000 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 9840 | 29520 | 9840 |
| Max. Throughput averaged over 1 frame | Mbps | 3.1976 | 15.3696 | 5.4568 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 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: 50 resource blocks are allocated in sub-frames 1, 2, 3, 4, 6, 7, 8, 9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0.<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). | | | | |

The reference measurement channels in Table A.3.3.3.2-2 apply for verifying FDD PMI accuracy measurement with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-2: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.44 FDD | R.45 FDD | R.45-1 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 |
| Allocated resource blocks | | 50[3] | 50[3] | 39 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 |
| Modulation | | QPSK | 16QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 |
| Information Bit Payload | | | | |
| For Sub-Frames (Non CSI-RS subframe) | Bits | 3624 | 11448 | 8760 |
| For Sub-Frames (CSI-RS subframe) | Bits | 3624 | 11448 | 8760 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 2984 | 9528 | 8760 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | |
| For Sub-Frames (Non CSI-RS subframe) | | 1 | 2 | 2 |
| For Sub-Frames (CSI-RS subframe) | | 1 | 2 | 2 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A |
| For Sub-Frame 5 | | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | | | | |
| For Sub-Frames (Non CSI-RS subframe) | Bits | 12000 | 24000 | 18720 |
| For Sub-Frames (CSI-RS subframe) | Bits | 11600 | 23200 | 18096 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 9840 | 19680 | 18720 |
| Max. Throughput averaged over 1 frame | Mbps | 3.1976 | 10.1112 | 7.884 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: For R.44 and R.45, 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. For R.45-1, 39 resource blocks are allocated in all subframes (RB0–RB20 and RB30–RB47).<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) | | | | |

# 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.42 TDD | | R.2 TDD |
| Channel bandwidth | MHz | 1.4 | 20 | | 10 |
| Allocated resource blocks (Note 6) | | 6 | 100 | | 50 |
| Uplink-Downlink Configuration (Note 4) | | 1 | 1 | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3 | 3+2 | | 3+2 |
| Modulation | | QPSK | QPSK | | QPSK |
| Target Coding Rate | | 1/3 | 1/3 | | 1/3 |
| Information Bit Payload (Note 6) | | | | | |
| For Sub-Frames 4,9 | Bits | 408 | 8760 | | 4392 |
| For Sub-Frames 1,6 | Bits | N/A | 7736 | | 3240 |
| For Sub-Frame 5 | Bits | N/A | N/A | | N/A |
| For Sub-Frame 0 | Bits | 208 | 8760 | | 4392 |
| Number of Code Blocks (Notes 5 and 6) | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | | 1 |
| For Sub-Frames 1,6 | | N/A | 2 | | 1 |
| For Sub-Frame 5 | | N/A | N/A | | N/A |
| For Sub-Frame 0 | | 1 | 2 | | 1 |
| Binary Channel Bits (Note 6) | | | | | |
| For Sub-Frames 4,9 | Bits | 1368 | 27600 | | 13800 |
| For Sub-Frames 1,6 | Bits | N/A | 22656 | | 11256 |
| For Sub-Frame 5 | Bits | N/A | N/A | | N/A |
| For Sub-Frame 0 | Bits | 672 | 26904 | | 13104 |
| Max. Throughput averaged over 1 frame (Note 6) | Mbps | 0.102 | 4.175 | | 1.966 |
| UE Category | | ≥ 1 | ≥ 1 | | ≥ 1 |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| 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) | | | | 3+2 | 3+2 | | |
| Modulation | | | | 16QAM | 16QAM | | |
| Target Coding Rate | | | | 1/2 | 1/2 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | 6456 | 14112 | | |
| For Sub-Frames 1,6 | Bits | | | 5160 | 11448 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 5736 | 12960 | | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | | | 2 | 3 | | |
| For Sub-Frames 1,6 | | | | 1 | 2 | | |
| For Sub-Frame 5 | | | | N/A | N/A | | |
| For Sub-Frame 0 | | | | 1 | 3 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | 12600 | 27600 | | |
| For Sub-Frames 1,6 | Bits | | | 11112 | 22512 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 11208 | 26208 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | 2.897 | 6.408 | | |
| UE Category | | | | ≥ 1 | ≥ 2 | | |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| 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) | | | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 8504 | 14112 | 30576 | 46888 | 61664 |
| For Sub-Frames 1,6 | Bits | | 6968 | 11448 | 23688 | 35160 | 46888 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 6968 | 12576 | 30576 | 45352 | 61664 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | | 2 | 3 | 5 | 8 | 11 |
| For Sub-Frames 1,6 | | | 2 | 2 | 4 | 6 | 8 |
| For Sub-Frame 5 | | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | | 2 | 3 | 5 | 8 | 11 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 11340 | 18900 | 41400 | 62100 | 82800 |
| For Sub-Frames 1,6 | Bits | | 9828 | 16668 | 33768 | 50868 | 67968 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 9252 | 16812 | 39312 | 60012 | 80712 |
| Max. Throughput averaged over 1 frame | Mbps | | 3.791 | 6.370 | 13.910 | 20.945 | 27.877 |
| UE Category | | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.<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 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.3.4.1-3a: 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) | | | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 10296 | 10296 | 10296 | 10296 | 51024 |
| For Sub-Frames 1,6 | Bits | | 8248 | 7480 | 7480 | 7480 | 39232 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 8248 | 10296 | 10296 | 10296 | 51024 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | | | 2 | 2 | 2 | 2 | 9 |
| For Sub-Frames 1,6 | | | 2 | 2 | 2 | 2 | 7 |
| For Sub-Frame 5 | | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | | 2 | 2 | 2 | 2 | 9 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 13608 | 14076 | 14076 | 14076 | 68724 |
| For Sub-Frames 1,6 | Bits | | 11880 | 11628 | 11628 | 11628 | 56340 |
| For Sub-Frame 5 | Bits | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | | 11520 | 14076 | 14076 | 14076 | 66636 |
| Max. Throughput averaged over 1 frame | Mbps | | 4.534 | 4.585 | 4.585 | 4.585 | 23.154 |
| UE Category | | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 |

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

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| 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) | | | 3+2 | | 3+2 | | |
| Modulation | | | 16QAM | | 16QAM | | |
| Target Coding Rate | | | 1/2 | | 1/2 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 224 | | 256 | | |
| For Sub-Frames 1,6 | Bits | | 208 | | 208 | | |
| For Sub-Frame 5 | Bits | | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | | 224 | | 256 | | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | | 1 | | 1 | | |
| For Sub-Frames 1,6 | | | 1 | | 1 | | |
| For Sub-Frame 5 | | | N/A | | N/A | | |
| For Sub-Frame 0 | | | 1 | | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | 504 | | 552 | | |
| For Sub-Frames 1,6 | Bits | | 456 | | 456 | | |
| For Sub-Frame 5 | Bits | | N/A | | N/A | | |
| For Sub-Frame 0 | Bits | | 504 | | 552 | | |
| Max. Throughput averaged over 1 frame | Mbps | | 0.109 | | 0.118 | | |
| UE Category | | | ≥ 1 | | ≥ 1 | | |

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

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

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.29 TDD (MBSFN) |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 1 |
| MBSFN Configuration (Note 3) | | 010010 |
| Uplink-Downlink Configuration (Note 4) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 1+2 |
| Modulation | | 16QAM |
| Target Coding Rate | | 1/2 |
| Information Bit Payload | | |
| For Sub-Frames 4,9 | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6 | Bits | 208 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 256 |
| Number of Code Blocks per Sub-Frame (Note 5) | | |
| 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: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation.<br>Note 4: as per Table 4.2-2 in TS 36.211 [4].<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | |

**Table A.3.4.1-6: Fixed Reference Channel QPSK R=1/10**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | | | R.41 TDD | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | | 50 | | |
| Uplink-Downlink Configuration (Note 4) | | | | | 1 | | |
| Allocated subframes per Radio Frame (D+S) | | | | | 3+2 | | |
| Modulation | | | | | QPSK | | |
| Target Coding Rate | | | | | 1/10 | | |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | | 1384 | | |
| For Sub-Frames 1,6 | Bits | | | | 1032 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 1384 | | |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | | | | | 1 | | |
| For Sub-Frames 1,6 | | | | | 1 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | | | | 13800 | | |
| For Sub-Frames 1,6 | Bits | | | | 11256 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 13104 | | |
| Max. Throughput averaged over 1 frame | Mbps | | | | 0.622 | | |
| UE Category | | | | | ≥ 1 | | |

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.3.4.1-7: PCell Fixed Reference Channel for CA demodulation with power imbalance**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.49 TDD |
| Channel bandwidth | MHz | 20 |
| Allocated resource blocks | | 100 |
| Uplink-Downlink Configuration (Note 1) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 |
| Modulation | | 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | | |
| For Sub-Frames 0,4,5,9 | OFDM symbols | 3 |
| For Sub-Frames 1,6 | OFDM symbols | 2 |
| Target Coding Rate | | |
| For Sub-Frames 4,9 | | 0.84 |
| For Sub-Frames 1,6 | | 0.81 |
| For Sub-Frames 5 | | N/A |
| For Sub-Frames 0 | | 0.87 |
| Information Bit Payload | | |
| For Sub-Frames 0, 4, 9 | Bits | 63776 |
| For Sub-Frame 1,6 | Bits | 55056 |
| For Sub-Frame 5 | Bits | N/A |
| Number of Code Blocks per Sub-Frame (Note 2) | | |
| For Sub-Frames 0, 4, 9 | Code Blocks | 11 |
| For Sub-Frame 1,6 | Code Blocks | 9 |
| For Sub-Frame 5 | Code Blocks | N/A |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 4,9 | Bits | 75600 |
| For Sub-Frame 1,6 | Bits | 67968 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 73512 |
| Max. Throughput averaged over 1 frame | Mbps | 30.144 |
| UE Category | | ≥5 |
| Note 1: Reference signal, synchronization signals and PBC allocated as per TS 36.211 [4].<br>Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | |

## 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 Note 6 | R.11-4 TDD | R.30 TDD | R.30-1 TDD | R.30-2 TDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 5 | 10 | 10 | 20 | 20 | 20 |
| Allocated resource blocks (Note 5) | | 50 | 50 | 50 | 25 | 40 | 50 | 100 | 100 | 100 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 | 2+2 | 3+2 | 3+2 | 2 | 3+2 | 2+2 | 2 |
| Modulation | | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | QPSK | 16QAM | 16QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload (Note 5) | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4392 | 12960 | 12960 | 5736 | 10296 | 6968 | 25456 | 25456 | 25456 |
| For Sub-Frames 1,6 | | 3240 | 9528 | 9528 | 5160 | 9144 | N/A | 22920 | 21384 | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 4392 | 12960 | N/A | 4968 | 10296 | N/A | 25456 | N/A | N/A |
| Number of Code Blocks (Notes 4 and 5) | | | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 3 | 3 | 1 | 2 | 2 | 5 | 5 | 5 |
| For Sub-Frames 1,6 | | 1 | 2 | 2 | 1 | 2 | N/A | 4 | 4 | N/A |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 3 | N/A | 1 | 2 | N/A | 5 | N/A | N/A |
| Binary Channel Bits (Note 5) | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 13200 | 26400 | 26400 | 12000 | 21120 | 13200 | 52800 | 52800 | 52800 |
| For Sub-Frames 1,6 | | 10656 | 21312 | 21312 | 10512 | 16992 | 10656 | 42912 | 42912 | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 12528 | 25056 | N/A | 10656 | 19776 | 12528 | 51456 | N/A | N/A |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 1.966 | 5.794 | 4.498 | 2.676 | 4.918 | 1.39 | 12.221 | 9.368 | 5.091 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 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 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 (other
Note 5: Given per component carrier per codeword.
Note 6: For R.11-3 resource blocks of RB6–RB45 are allocated.

**Table A.3.4.2.1-2: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.46 TDD | R.47 TDD | R.35-2 TDD | | | |
| Channel bandwidth | MHz | 10 | 10 | 10 | | | |
| Allocated resource blocks (Note 5) | | 50 | 50 | 50 | | | |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | | | |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 | 2+2 | | | |
| Modulation | | QPSK | 16QAM | 64QAM | | | |
| Target Coding Rate | | | | 0.47 | | | |
| Information Bit Payload (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | Bits | 5160 | 8760 | 18336 | | | |
| For Sub-Frames 1,6 | | 3880 | 7480 | 14688 | | | |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | | | |
| For Sub-Frame 0 | Bits | 5160 | 8760 | N/A | | | |
| Number of Code Blocks (Notes 4 and 5) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 3 | | | |
| For Sub-Frames 1,6 | | 1 | 2 | 3 | | | |
| For Sub-Frame 5 | | N/A | N/A | N/A | | | |
| For Sub-Frame 0 | | 1 | 2 | N/A | | | |
| Binary Channel Bits (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | Bits | 13200 | 26400 | 39600 | | | |
| For Sub-Frames 1,6 | | 10656 | 21312 | 31968 | | | |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | | | |
| For Sub-Frame 0 | Bits | 12528 | 25056 | N/A | | | |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 2.324 | 4.124 | 6.604 | | | |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | | | |

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

#### 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.43 TDD | R.36 TDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 20 | 10 |
| Allocated resource blocks (Note 6) | | 6 | 50 | 50 | 6 | 3 | 100 | 50 |
| Uplink-Downlink Configuration (Note 4) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3 | 3+2 | 2+2 | 2 | 2 | 2+2 | 2+2 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 64QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload (Note 6) | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | 25456 | 18336 |
| For Sub-Frames 1,6 | Bits | N/A | 3240 | 9528 | N/A | N/A | 21384 | 15840 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 208 | 4392 | N/A | N/A | N/A | N/A | N/A |
| Number of Code Blocks (Notes 5 and 6) | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 1 | 3 | 1 | 1 | 5 | 3 |
| For Sub-Frames 1,6 | | N/A | 1 | 2 | N/A | N/A | 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 | 1 | N/A | N/A | N/A | N/A | N/A |
| Binary Channel Bits (Note 6) | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 51200 | 38400 |
| For Sub-Frames 1,6 | | N/A | 10256 | 20512 | N/A | N/A | 41312 | 30768 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 624 | 12176 | N/A | N/A | N/A | N/A | N/A |
| Max. Throughput averaged over 1 frame (Note 6) | Mbps | 0.102 | 1.966 | 4.498 | 0.309 | 0.149 | 9.368 | 6.835 |
| UE Category | | ≥ 1 | ≥ 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. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.<br>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.<br>Note 3: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 4: As per Table 4.2-2 in TS 36.211 [4].<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>Note 6: Given per component carrier per codeword. | | | | | | | | |

### 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) | | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | QPSK | 16QAM | 16QAM | 64QAM | 64QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 3/4 | 3/4 | 1/2 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4392 | 12960 | 5736 | 28336 | 10296 | 224 |
| For Sub-Frames 1,6 | Bits | 3240 | 9528 | 4584 | 22920 | 8248 | 176 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 2984 | 9528 | 3880 | 22152 | 10296 | 224 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 3 | 1 | 5 | 2 | 1 |
| For Sub-Frames 1,6 | | 1 | 2 | 1 | 4 | 2 | 1 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | 1 | 4 | 2 | 1 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 12600 | 25200 | 11400 | 37800 | 13608 | 504 |
| For Sub-Frames 1,6 | Bits | 10356 | 20712 | 10212 | 31068 | 11340 | 420 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 10332 | 20664 | 7752 | 30996 | 13608 | 504 |
| Max. Throughput averaged over 1 frame | Mbps | 1.825 | 5.450 | 2.452 | 12.466 | 4.738 | 0.102 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 |

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

## 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) | | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+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 5) | | | | | | | |
| 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 resouce 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.3.4.3.3 Two antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.3-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports.

**Table A.3.4.3.3-1: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.51 TDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 50 (Note 5) |
| Uplink-Downlink Configuration (Note 3) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 |
| Modulation | | 16QAM |
| Target Coding Rate | | 1/2 |
| Information Bit Payload | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 11448 |
| For Sub-Frame 4,9 | Bits | 11448 |
| For Sub-Frames 1,6 | Bits | 7736 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 9528 |
| Number of Code Blocks (Note 4) | | |
| For Sub-Frames 4, 9 (non CSI-RS subframe) | Code blocks | 2 |
| For Sub-Frames 4,9 | Code blocks | 2 |
| For Sub-Frames 1,6 | Code blocks | 2 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | Code blocks | 2 |
| Binary Channel Bits | | |
| For Sub-Frames 4, 9 (non CSI-RS subframe) | Bits | 24000 |
| For Sub-Frames 4,9 | | 22800 |
| For Sub-Frames 1,6 | | 15744 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 19680 |
| Max. Throughput averaged over 1 frame | Mbps | 4.7896 |
| UE Category | | ≥ 2 |
| 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: 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. | | |

The reference measurement channels in Table A.3.4.3.3-2 apply for verifying demudlation performance for UE-specific reference symbols with two cell specific antenna ports and two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS in same subframe.

**Table A.3.4.3.3-2: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports with ZP CSI-RS and NZP CSI-RS**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.52 TDD | R.53 TDD | R.54 TDD |
| Channel bandwidth | MHz | 10 | 10 | 10 |
| Allocated resource blocks | | 50 (Note 5) | 50 (Note 5) | 50 (Note 5) |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 16QAM |
| Target Coding Rate | | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | |
| For Sub-Frame 4,9 | Bits | 16416 | 16416 | 11448 |
| For Sub-Frames 1,6 | Bits | 11832 | 11832 | 7736 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 14688 | 14688 | 9528 |
| Number of Code Blocks (Note 4) | | | | |
| For Sub-Frames 4,9 | Code blocks | 3 | 3 | 2 |
| For Sub-Frames 1,6 | Code blocks | 2 | 2 | 2 |
| For Sub-Frame 5 | | n/a | n/a | n/a |
| For Sub-Frame 0 | Code blocks | 3 | 3 | 2 |
| Binary Channel Bits | | | | |
| For Sub-Frames 4,9 | | 34200 | 33600 | 22800 |
| For Sub-Frames 1,6 | | 23616 | 23616 | 15744 |
| For Sub-Frame 5 | Bits | n/a | n/a | n/a |
| For Sub-Frame 0 | Bits | 29520 | 29520 | 19680 |
| Max. Throughput averaged over 1 frame | Mbps | 7.1184 | 7.1184 | 4.7896 |
| UE Category | | ≥ 2 | ≥ 2 | ≥ 2 |
| 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: 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. | | | | |

## A.3.4.3.4 Four antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.4-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-1: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.44 TDD | R.48 TDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks | | 50 (Note 4) | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 |
| Modulation | | 64QAM | QPSK |
| Target Coding Rate | | ½ | |
| Information Bit Payload | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 18336 | N/A |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 16416 | 6200 |
| For Sub-Frames 1,6 | | 11832 | 4264 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | 14688 | 4968 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | | 3 | 2 |
| For Sub-Frames 4,9 (CSI-RS subframe) | | 3 | 2 |
| For Sub-Frames 1,6 | | 2 | 1 |
| For Sub-Frame 5 | | N/A | N/A |
| For Sub-Frame 0 | | 3 | 1 |
| Binary Channel Bits Per Sub-Frame | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 36000 | 12000 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 33600 | 11600 |
| For Sub-Frames 1,6 | | 23616 | 7872 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | 29520 | 9840 |
| Max. Throughput averaged over 1 frame | Mbps | 7.1184 | 2.5896 |
| UE Category | | ≥ 2 | ≥ 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: 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.<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | |

## A.3.4.3.5 Eight antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.5-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and eight CSI-RS antenna ports.

**Table A.3.4.3.5-1: Fixed Reference Channel for CDM-multiplexed DM RS with eight CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.50 TDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 |
| Modulation | | QPSK |
| Target Coding Rate | | 1/3 |
| Information Bit Payload | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 3624 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 3624 |
| For Sub-Frames 1,6 | | 2664 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 2984 |
| Number of Code Blocks per Sub-Frame (Note 5) | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | | 1 |
| For Sub-Frames 4,9 (CSI-RS subframe) | | 1 |
| For Sub-Frames 1,6 | | 1 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | | 1 |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 12000 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 10400 |
| For Sub-Frames 1,6 | | 7872 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 9840 |
| Max. Throughput averaged over 1 frame | Mbps | 1.556 |
| 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: 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.<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | |

The reference measurement channels in Table A.3.4.3.5-2 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and eight CSI-RS antenna ports.

**Table A.3.4.3.5-2: Fixed Reference Channel for eight antenna ports (CSI-RS)**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.45 TDD | R.45-1 TDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks | | 50[4] | 39 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 |
| Allocated subframes per Radio Frame | | 5 | 5 |
| Modulation | | 16QAM | 16QAM |
| Target Coding Rate | | 1/2 | 1/2 |
| Information Bit Payload | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | Bits | 11448 | 8760 |
| For Sub-Frames 1,6 | Bits | 7736 | 7480 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | 9528 | 8760 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | | 2 | 2 |
| For Sub-Frames 1,6 | | 2 | 2 |
| For Sub-Frame 5 | | N/A | N/A |
| For Sub-Frame 0 | | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | Bits | 22400 | 17472 |
| For Sub-Frames 1,6 | Bits | 15744 | 14976 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | 19680 | 18720 |
| Max. Throughput averaged over 1 frame | Mbps | 4.7896 | 4.1240 |
| UE Category | | ≥ 2 | ≥ 1 |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: For R.45, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.45-1, 39 resource blocks are allocated in sub-frames 0,4,9 and the DwPTS portion of sub-frames 1,6 (RB0–RB20 and RB30–RB47).
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Localized allocation started from RB #0 is applied.

# 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.15-1 FDD | R.15-2 FDD | R.16 FDD | R.17 FDD |
| Number of transmitter antennas | | 1 | 2 | 2 | 2 | 4 |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | 5 |
| Number of OFDM symbols for PDCCH | symbols | 2 | 3 | 2 | 2 | 2 |
| Aggregation level | CCE | 8 | 8 | 8 | 4 | 2 |
| DCI Format | | Format 1 | Format 1 | Format 1 | Format 2 | Format 2 |
| Cell ID | | 0 | 0 | 0 | 0 | 0 |
| Payload (without CRC) | Bits | 31 | 31 | 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.15-1 TDD | R.15-2 TDD | R.16 TDD | R.17 TDD |
| Number of transmitter antennas | | 1 | 2 | 2 | 2 | 4 |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | 5 |
| Number of OFDM symbols for PDCCH | symbols | 2 | 3 | 2 | 2 | 2 |
| Aggregation level | CCE | 8 | 8 | 8 | 4 | 2 |
| DCI Format | | Format 1 | Format 1 | Format 1 | Format 2 | Format 2 |
| Cell ID | | 0 | 0 | 0 | 0 | 0 |
| Payload (without CRC) | Bits | 34 | 34 | 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.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.1-2: 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.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; and reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

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

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

## 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.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.2-2: 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.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

**Table A.3.8.2-3: 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.<br>Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

## 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 | R.31-5 FDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 10 | 15 | 20 | 15 | 15 |
| Allocated resource blocks (Note 8) | | Note 5 | Note 6 | Note 7 | Note 6 | Note 10 | Note 7 | Note 11 | Note 9 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | | | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.40 | 0.59 | 0.59 | 0.85 | 0.87 | 0.88 | 0.85 | 0.85 |
| For Sub-Frame 5 | | 0.40 | 0.64 | 0.62 | 0.89 | 0.88 | 0.87 | 0.87 | 0.91 |
| For Sub-Frame 0 | | 0.40 | 0.63 | 0.61 | 0.90 | 0.91 | 0.90 | 0.88 | 0.88 |
| Information Bit Payload (Note 8) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 | 55056 |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 35160 | 51024 | 71112 | 52752 | 52752 |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 | 55056 |
| Number of Code Blocks (Notes 3 and 8) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 | 9 |
| For Sub-Frame 5 | Bits | 2 | 5 | 9 | 6 | 9 | 12 | 9 | 9 |
| For Sub-Frame 0 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 | 9 |
| Binary Channel Bits (Note 8) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 26100 | 43200 | 86400 | 43200 | 58752 | 86400 | 64800 | 64800 |
| For Sub-Frame 5 | Bits | 26100 | 39744 | 82080 | 39744 | 57888 | 82080 | 60480 | 60480 |
| For Sub-Frame 0 | Bits | 26100 | 40752 | 83952 | 40752 | 56304 | 83952 | 62352 | 62352 |
| Number of layers | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 8) | Mbps | 10.296 | 25.456 | 51.024 | 36.542 | 51.024 | 74.950 | 54.826 | 54.826 |
| UE Categories | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 | ≥ 3 | ≥ 4 | ≥ 3 |

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 4: Resource blocks $n_{PRB}$ = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 5: Resource blocks $n_{PRB}$ = 6..14,30..49 are allocated for the user data in all sub-frames.
Note 6: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Given per component carrier per codeword.
Note 9: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 10: Resource blocks $n_{PRB}$ = 4..71 are allocated for the user data in sub-frames 0,1,2,3,4,5,6,7,8,9.
Note 11: Resource blocks $n_{PRB}$ = 4..74 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.

## 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.31-3A 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 | 4 |
| 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-Frames 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-Frames 3,7,8 | | 2 | 5 | 9 | N/A | N/A |
| For Sub-Frame 1 | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | | 2 | 5 | 9 | 9 | 12 |
| For Sub-Frame 6 | Bits | 2 | 5 | 9 | n/a | N/A |
| For Sub-Frame 0 | | 2 | 5 | 9 | 9 | 13 |
| Binary Channel Bits Per Sub-Frame | | | | | | |
| For Sub-Frames 4,9 | Bits | 26100 | 43200 | 86400 | 58752 | 86400 |
| For Sub-Frames 3,7,8 | Bits | 26100 | 43200 | 86400 | 0 | 0 |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 |
| 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 (Note 10) | 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
Note10: Given per component carrier per codeword.

## A.3.9.3 FDD (EPDCCH scheduling)

**Table A.3.9.3-1: Fixed Reference Channel for sustained data-rate test with EPDCCH scheduling (FDD)**

| Parameter | Unit | Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.31E-1 FDD | R.31E-2 FDD | R.31E-3 FDD | R.31E-3A FDD | R.31E-3C FDD | R.31E-4 FDD | R.31E-4B FDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 10 | 15 | 20 | 15 |
| Allocated resource blocks (Note 8) | | Note 5 | Note 6 | Note 7 | Note 6 | Note 9 | Note 7 | Note 10 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate (subframes with PDCCH USS monitoring) | | | | | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.3972 | 0.5926 | 0.5933 | 0.8533 | 0.8725 | 0.8763 | 0.8533 |
| For Sub-Frame 5 | | 0.3972 | 0.6441 | 0.6246 | 0.8889 | 0.8855 | 0.8702 | 0.8762 |
| For Sub-Frame 0 | | 0.3972 | 0.6282 | 0.6106 | 0.9046 | 0.9105 | 0.9018 | 0.8868 |
| Coding Rate (subframes with EPDCCH USS monitoring) | | | | | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.4114 | 0.6047 | 0.5993 | 0.8707 | 0.8855 | 0.8851 | 0.8649 |
| For Sub-Frame 5 | | 0.4114 | 0.6584 | 0.6312 | 0.9086 | 0.8990 | 0.8794 | 0.8889 |
| For Sub-Frame 0 | | 0.4114 | 0.6418 | 0.6170 | 0.9242 | 0.9246 | 0.9112 | 0.8993 |
| Information Bit Payload (Note 8) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 35160 | 51024 | 71112 | 52752 |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 36696 | 51024 | 75376 | 55056 |
| Number of Code Blocks (Notes 3 and 8) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 |
| For Sub-Frame 5 | Bits | 2 | 5 | 9 | 6 | 9 | 12 | 9 |
| For Sub-Frame 0 | Bits | 2 | 5 | 9 | 6 | 9 | 13 | 9 |
| Binary Channel Bits (Note 8) (subframes with PDCCH USS monitoring) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 26100 | 43200 | 86400 | 43200 | 58752 | 86400 | 64800 |
| For Sub-Frame 5 | Bits | 26100 | 39744 | 82080 | 39744 | 57888 | 82080 | 60480 |
| For Sub-Frame 0 | Bits | 26100 | 40752 | 83952 | 40752 | 56304 | 83952 | 62352 |
| Binary Channel Bits (Note 8) (subframes with EPDCCH USS monitoring) | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 25200 | 42336 | 85536 | 42336 | 57888 | 85536 | 63936 |
| For Sub-Frame 5 | Bits | 25200 | 38880 | 81216 | 38880 | 57024 | 81216 | 59616 |
| For Sub-Frame 0 | Bits | 25200 | 39888 | 83088 | 39888 | 55440 | 83088 | 61488 |
| Number of layers | | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 8) | Mbps | 10.296 | 25.456 | 51.024 | 36.542 | 51.024 | 74.950 | 54.826 |
| UE Categories | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 | ≥ 3 | ≥ 4 |

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211.
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 4: Resource blocks $n_{PRB}$ = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 5: Resource blocks $n_{PRB}$ = 6..14,30..49 are allocated for the user data in all sub-frames.
Note 6: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Given per component carrier per codeword.
Note 9: Resource blocks $n_{PRB}$ = 4..71 are allocated for the user data in sub-frames 0,1,2,3,4,5,6,7,8,9.
Note 10: 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.3.9.4 TDD (EPDCCH scheduling)

**Table A.3.9.4-1: Fixed Reference Channel for sustained data-rate with EPDCCH scheduling (TDD)**

| Parameter | Unit | Value | | | | |
|---|---|---|---|---|---|---|
| Reference channel | | R.31E-1 TDD | R.31E-2 TDD | R.31E-3 TDD | R.31E-3A TDD | R.31E-4 TDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | Note 8 |
| Uplink-Downlink Configuration (Note 3) | | 5 | 5 | 5 | 1 | 1 |
| Number of HARQ Processes per component carrier | Processes | 15 | 15 | 15 | 7 | 7 |
| Allocated subframes per Radio Frame (D+S) | | 8+1 | 8+1 | 8+1 | 4 | 4 |
| Coding Rate (subframes with PDCCH USS monitoring) | | | | | | |
| For Sub-Frames 4,9 | | 0.3972 | 0.5926 | 0.5933 | 0.8725 | 0.8763 |
| For Sub-Frames 3,7,8 | | 0.3972 | 0.5926 | 0.5933 | N/A | N/A |
| For Sub-Frames 1 | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frames 5 | | 0.3972 | 0.6372 | 0.6213 | 0.8790 | 0.8656 |
| For Sub-Frames 6 | | 0.3972 | 0.5986 | 0.5963 | N/A | N/A |
| For Sub-Frames 0 | | 0.3972 | 0.6216 | 0.6075 | 0.9036 | 0.8972 |
| Coding Rate (subframes with EPDCCH USS monitoring) | | | | | | |
| For Sub-Frames 4,9 | | 0.4114 | 0.6047 | 0.5993 | 0.8856 | 0.8851 |
| For Sub-Frames 3,7,8 | | 0.4114 | 0.6047 | 0.5993 | N/A | N/A |
| For Sub-Frames 1 | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frames 5 | | 0.4114 | 0.6512 | 0.6279 | 0.8922 | 0.8748 |
| For Sub-Frames 6 | | 0.4114 | 0.6109 | 0.6024 | N/A | N/A |
| For Sub-Frames 0 | | 0.4114 | 0.6349 | 0.6138 | 0.9175 | 0.9065 |
| Information Bit Payload | | | | | | |
| For Sub-Frames 4,9 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 |
| For Sub-Frames 3,7,8 | Bits | 10296 | 25456 | 51024 | N/A | N/A |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | N/A | N/A |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 51024 | 71112 |
| For Sub-Frame 6 | Bits | 10296 | 25456 | 51024 | N/A | N/A |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | |
| For Sub-Frames 4,9 | | 2 | 5 | 9 | 9 | 13 |
| For Sub-Frames 3,7,8 | | 2 | 5 | 9 | N/A | N/A |
| For Sub-Frame 1 | | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | | 2 | 5 | 9 | 9 | 12 |
| For Sub-Frame 6 | Bits | 2 | 5 | 9 | N/A | N/A |
| For Sub-Frame 0 | | 2 | 5 | 9 | 9 | 13 |
| Binary Channel Bits per Sub-Frame (subframes with PDCCH USS monitoring) | | | | | | |
| For Sub-Frames 4,9 | Bits | 26100 | 43200 | 86400 | 58752 | 86400 |
| For Sub-Frames 3,7,8 | Bits | 26100 | 43200 | 86400 | N/A | N/A |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | N/A | N/A |
| For Sub-Frame 5 | Bits | 26100 | 40176 | 82512 | 58320 | 82512 |
| For Sub-Frame 6 | Bits | 26100 | 42768 | 85968 | N/A | N/A |
| For Sub-Frame 0 | Bits | 26100 | 41184 | 84384 | 56736 | 84384 |
| Binary Channel Bits per Sub-Frame (subframes with EPDCCH USS monitoring) | | | | | | |
| For Sub-Frames 4,9 | Bits | 25200 | 42336 | 85536 | 57888 | 85536 |
| For Sub-Frames 3,7,8 | Bits | 25200 | 42336 | 85536 | N/A | N/A |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | N/A | N/A |
| For Sub-Frame 5 | Bits | 25200 | 39312 | 81648 | 57456 | 81648 |
| For Sub-Frame 6 | Bits | 25200 | 41904 | 85104 | N/A | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| For Sub-Frame 0 | Bits | 25200 | 40320 | 83520 | 55872 | 83520 |
| Number of layers | | 1 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 10) | Mbps | 8.237 | 20.365 | 40.819 | 20.409 | 29.724 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 |

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
Note10: Given per component carrier per codeword.

### A.3.10 Reference Measurement Channels for EPDCCH performance requirements

#### A.3.10.1 FDD

**Table A.3.10.1-1: Reference Channel FDD**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.55 FDD | R.56 FDD | R.57 FDD | R.58 FDD | R.59 FDD | |
| Number of transmitter antennas | | 2 | 2 | 2 | 2 | 2 | |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | 10 | |
| Number of OFDM symbols for PDCCH | symbols | 2 | 2 | 1 | 1 | 1 | |
| Aggregation level | ECCE | 4 | 16 | 2 | 8 | 2 | |
| DCI Format | | 2A | 2A | 2C | 2C | 2D | |

#### A.3.10.2 TDD

**Table A.3.10.2-1: Reference Channel TDD**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.55 TDD | R.56 TDD | R.57 TDD | R.58 TDD | R.59 TDD | |
| Number of transmitter antennas | | 2 | 2 | 2 | 2 | 2 | |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | 10 | |
| Number of OFDM symbols for PDCCH | symbols | 2 | 2 | 1 | 1 | 1 | |
| Aggregation level | CCE | 4 | 16 | 2 | 8 | 2 | |
| DCI Format | | 2A | 2A | 2C | 2C | 2D | |

## 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 or 7 (Note 8) | 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 or 7 (Note 8) | 1 | |
| RC.6 FDD | FDD | 10 | 15 | - | | MCS.16 | 8 | 1 | Note 6 |
| RC.6 TDD | TDD | 10 | 15 | Note 3 | | MCS.16 | 7 | 1 | Note 6 |
| **1 CRS Port + CSI-RS** | | | | | | | | | |
| RC.8 FDD | FDD | 10 | 6 | - | Non CSI-RS<br>2 CSI-RS | MCS.11<br>MCS.12 | 8 | 1 | |
| RC.8 TDD | TDD | 10 | 6 | Note 3 | Non CSI-RS<br>2 CSI-RS | MCS.11<br>MCS.12 | 10 | 1 | |
| RC.9 FDD | FDD | 10 | 50 | - | Non CSI-RS<br>2 CSI-RS | MCS.3<br>MCS.4 | 8 | 1 | |
| RC.9 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS<br>2 CSI-RS | MCS.3<br>MCS.4 | 7 | 1 | |
| **2 CRS Port + CSI-RS** | | | | | | | | | |
| RC.7 FDD | FDD | 10 | 50 | - | Non CSI-RS<br>4 CSI-RS | MCS.5<br>MCS.7 | 8 | 1 | |
| RC.7 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS<br>8 CSI-RS | MCS.5<br>MCS.8 | 10 | 1 | |
| RC.11 FDD | FDD | 10 | 50 | - | Non CSI-RS<br>2 CSI-RS | MCS.5<br>MCS.6 | 8 | 1 | |
| RC.11 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS<br>2 CSI-RS | MCS.5<br>MCS.6 | 10 | 1 | |
| **1 CRS Port + CSI-RS + CSI-IM** | | | | | | | | | |
| RC.13 FDD | FDD | 10 | 50 | - | Non CSI-RS/IM<br>CSI-RS/IM | MCS.3<br>N/A | 8 | 1 | |
| RC.13 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS/IM<br>CSI-RS/IM | MCS.3<br>N/A | 10 | 1 | |
| **2 CRS Port + CSI-RS + CSI-IM** | | | | | | | | | |
| RC.10 FDD | FDD | 10 | 50 | - | Non CSI-RS<br>4 CSI-RS, | MCS.5<br>MCS.8 | 8 | 1 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 CSI process | | | | |
| RC.10 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS | MCS.5 | 10 | 1 | |
| | | | | | 8 CSI-RS, 1 CSI process | MCS.9 | | | |
| RC.12 FDD | FDD | 10 | 6 | - | Non CSI-RS/IM | MCS.13 | 8 | 1 | |
| | | | | | CSI-RS/IM | N/A | | | |
| RC.12 TDD | TDD | 10 | 6 | Note 3 | Non CSI-RS/IM | MCS.13 | 10 | 1 | |
| | | | | | CSI-RS/IM | N/A | | | |

Note 1: 3 symbols allocated to PDCCH.
Note 2: For FDD only subframes 1, 2, 3, 4, 6, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead.
Note 3: TDD UL-DL configuration as specified in the individual tests.
Note 4: For TDD when UL-DL configuration 1 is used only subframes 4 and 9 are allocated to avoide PBCH and synchronizaiton signal overhead.
Note 5: For TDD when UL-DL configuration 2 is used only subframes 3, 4, 8, and 9 are allocated to avoid PBCH and synchronization signal overhead.
Note 6: Centered within the Transmission Bandwidth Configuration (Figure 5.6-1).
Note 7: Only subframes 2, 3, 4, 7, 8 and 9 are allocated to avoid PBCH and synchronization signal overhead.
Note 8: The number of HARQ processes is 10 for TDD UL/DL configuration 2 and 7 for TDD UL/DL configuration 1.

**Table A.4-1a: Void**

**Table A.4-1b: Void**

**Table A.4-1c: Void**

**Table A.4-1d: Void**

**Table A.4-1e: Void**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Table A.4-5: Void**

**Table A.4-5a: Void**

**Table A.4-5b: Void**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# A.5 OFDMA Channel Noise Generator (OCNG)

## A.5.1 OCNG Patterns for FDD

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

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

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

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

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

For the performance requirements of UE with the CA capability, the OCNG patterns apply for each CC.

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

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

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

| **Relative power level $\gamma_{PRB}$ [dB]** | | | **PDSCH Data** |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB | |
| 0 | 0 | 0 | Note 1 |

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

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

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

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

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

| **Relative power level $\gamma_{PRB}$ [dB]** | | | **PDSCH Data** |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | |
| 0 | 0 | 0 | Note 1 |
| 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.<br>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH 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.<br>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.<br><br>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 OCNG FDD pattern 5: One sided dynamic 16QAM modulated OCNG FDD pattern

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

**Table A.5.1.5-1: OP.5 FDD: One sided dynamic 16QAM modulated OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| Subframe | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| Allocation | | | |
| First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB | First unallocated PRB<br>–<br>Last unallocated PRB | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM 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 3 (Large Delay CDD). 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.5.1.6 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)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | |
| 0 | 0 | 0 | Note 1 |
| 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.5.1.7 OCNG FDD pattern 7: dynamic OCNG FDD pattern when user data is in multiple non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data, EPDCCH or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in multiple parts by the *M* allocated blocks for data transmission). The *m*-th allocated block starts with RPB $N_{Start,m}$ and ends with PRB $N_{End,m}-1$, where *m* = 1, …, *M*. The system bandwidth starts with RPB 0 and ends with $N_{RB}-1$.

**Table A.5.1.7-1: OP.7 FDD: OCNG FDD Pattern when user data is in multiple non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| Subframe | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| Allocation | | | |
| 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) – (PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$) – (PRB $N_{RB}-1$) | 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) – (PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$) – (PRB $N_{RB}-1$) | 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) – (PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$) – (PRB $N_{RB}-1$) | |
| 0 | 0 | 0 | Note 1 |
| 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.5.1.8 OCNG FDD pattern 8: Dynamic OCNG FDD pattern for TM10 transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain where there are *M* unallocated PRB blocks labled from 1-st block to *M*-th block (*M*>1) and the *m*-th block starts with PRB $N_{Start,m}$ and end with PRB $N_{End,m}$, orwhen the unallocated area is continuous in frequency domain where *M* =1 (one sided). The system bandwidth starts with RPB 0 and ends with $N_{RB}-1$. $N_{End,M}$ should be equal to or less than $N_{RB}-1$..

**Table A.5.1.8-1: OP.8 FDD: Dynamic OCNG FDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | |
| 0 | 0 | 0 | Note 1,2,3 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.<br>Note 2: The OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode10. The the transmit power is equal between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.<br>Note 3: The detailed test set-up for TM10 transmission i.e PMI configuration is specified to each test case. | | | |

# 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.

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

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

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

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

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

| Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data |
|---|---|---|---|---|
| Subframe (only if available for DL) | | | | |
| 0 | 5 | 3, 4, 6, 7, 8, 9 (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.

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

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

## A.5.2.3 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.<br>Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.<br>Note 3: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.<br>N/A Not Applicable | | | | | | |

### A.5.2.5 OCNG TDD pattern 5: One sided dynamic 16QAM modulated OCNG TDD pattern

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

**Table A.5.2.5-1: OP.5 TDD: One sided dynamic 16QAM modulated OCNG TDD Pattern**

| **Relative power level $\gamma_{PRB}$ [dB]** | | | | **PDSCH Data** |
|---|---|---|---|---|
| **Subframe (only if available for DL)** | | | | |
| 0 | 5 | 3, 4, 7, 8, 9 and 6 (as normal subframe) 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 16QAM 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 3 (Large Delay CDD). 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.5.2.6 OCNG TDD pattern 6: dynamic OCNG TDD pattern when user data is in 2 non-contiguous blocks

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

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

| **Relative power level $\gamma_{PRB}$ [dB]** | | | | **PDSCH Data** |
|---|---|---|---|---|
| **Subframe (only if available for DL)** | | | | |
| 0 | 5 | 3, 4, 6, 7, 8, 9<br>(6 as normal subframe)<br>Note 2 | 1,6<br>(6 as special subframe)<br>Note 2 | |
| **Allocation** | | | | |
| 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1)<br>and<br>(Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | |
| 0 | 0 | 0 | 0 | Note 1 |

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

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

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

## A.5.2.7 OCNG TDD pattern 7: dynamic OCNG TDD pattern when user data is in multiple non-contiguous blocks

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data, EPDCCH or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in multiple parts by the *M* allocated blocks for data transmission). The *m*-th allocated block starts with RPB $N_{Start,m}$ and ends with PRB $N_{End,m}-1$, where *m* = 1, …, *M*. The system bandwidth starts with RPB 0 and ends with $N_{RB}-1$.

**Table A.5.2.7-1: OP.7 TDD: OCNG TDD Pattern when user data is in multiple non-contiguous blocks**

| Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data |
|---|---|---|---|---|
| **Subframe (only if available for DL)** | | | | |
| 0 | 5 | 3, 4, 6, 7, 8, 9<br>(6 as normal subframe)<br>Note 2 | 1,6<br>(6 as special subframe)<br>Note 2 | |
| **Allocation** | | | | |
| 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) –<br>(PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$ ) – (PRB $N_{RB}-1$) | 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) –<br>(PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$ ) – (PRB $N_{RB}-1$) | 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) –<br>(PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$ ) – (PRB $N_{RB}-1$) | 0 – (PRB $N_{Start,1}-1$)<br>…<br>(PRB $N_{End,(m-1)}$) –<br>(PRB $N_{Start,m}-1$)<br>…<br>(PRB $N_{End,M}$ ) – (PRB $N_{RB}-1$) | |
| 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.

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

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

## A.5.2.8 OCNG TDD pattern 8: Dynamic OCNG TDD pattern for TM10 transmission

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain where there are *M* unallocated PRB blocks labled from 1-st block to *M*-th block (*M*>1) and the *m*-th block starts with PRB $N_{Start,m}$ and end with PRB $N_{End,m}$, or when the unallocated area is continuous in frequency domain where *M* =1 (one sided). The system bandwidth starts with RPB 0 and ends with $N_{RB}-1$. $N_{End,M}$ should be equal to or less than $N_{RB}-1$.

**Table A.5.2. 8-1: OP.8 TDD: Dynamic OCNG TDD Pattern**

| Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$) … *m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$) … *M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | |
| 0 | 0 | 0 | Note 1,2,3 |

Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.

Note 2: The OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode10. The the transmit power is equal between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.

Note 3: The detailed test set-up for TM10 transmission i.e PMI configuration is specified to each test case.

# Annex B (normative): Propagation conditions

# B.1 Static propagation condition

For 1 port transmission the channel matrix is defined in the frequency domain by

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

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

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

For 4 port transmission the channel matrix is defined in the frequency domain by

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

For 8 port transmission the channel matrix is defined in the frequency domain by

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

# B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum, that is characterized by a classical spectrum shape and a maximum Doppler frequency

- A set of correlation matrices defining the correlation between the UE and eNodeB antennas in case of multi-antenna systems.

- Additional multi-path models used for CQI (Channel Quality Indication) tests

## B.2.1 Delay profiles

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

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

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

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

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | 0.0 |
| 30 | -1.0 |
| 70 | -2.0 |
| 90 | -3.0 |
| 110 | -8.0 |
| 190 | -17.2 |
| 410 | -20.8 |

**Table B.2.1-3 Extended Vehicular A model (EVA)**

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | 0.0 |
| 30 | -1.5 |
| 150 | -1.4 |
| 310 | -3.6 |
| 370 | -0.6 |
| 710 | -9.1 |
| 1090 | -7.0 |
| 1730 | -12.0 |
| 2510 | -16.9 |

**Table B.2.1-4 Extended Typical Urban model (ETU)**

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | -1.0 |
| 50 | -1.0 |
| 120 | -1.0 |
| 200 | 0.0 |
| 230 | 0.0 |
| 500 | 0.0 |
| 1600 | -3.0 |
| 2300 | -5.0 |
| 5000 | -7.0 |

## B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as EVA[number], EPA[number] or ETU[number] where 'number' indicates the maximum Doppler frequency (Hz).

**Table B.2.2-1 Void**

## B.2.3 MIMO Channel Correlation Matrices

The MIMO channel correlation matrices defined in B.2.3 apply for the antenna configuration using uniform linear arrays at both eNodeB and UE.

### B.2.3.1 Definition of MIMO Correlation Matrices

Table B.2.3.1-1 defines the correlation matrix for the eNodeB

**Table B.2.3.1-1 eNodeB correlation matrix**

| | One antenna | Two antennas | Four antennas |
|---|---|---|---|
| eNode B Correlation | $R_{eNB} = 1$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \mathbf{1} \end{pmatrix}$ | $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9^*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9^*} & \alpha^{1/9^*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9^*} & \alpha^{1/9^*} & 1 \end{pmatrix}$ |

Table B.2.3.1-2 defines the correlation matrix for the UE:

**Table B.2.3.1-2 UE correlation matrix**

| | One antenna | Two antennas | Four antennas |
|---|---|---|---|
| UE Correlation | $R_{UE} = 1$ | $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & \mathbf{1} \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9^*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9^*} & \beta^{1/9^*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9^*} & \beta^{1/9^*} & 1 \end{pmatrix}$ |

Table B.2.3.1-3 defines the channel spatial correlation matrix $R_{spat}$ . The parameters, α and β in Table B.2.3.1-3 defines the spatial correlation between the antennas at the eNodeB and UE.

**Table B.2.3.1-3: $R_{spat}$ correlation matrices**

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

For cases with more antennas at either eNodeB or UE or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of $R_{eNB}$ and $R_{UE}$ according to $R_{spat} = R_{eNB} \otimes R_{UE}$ .

## B.2.3.2 MIMO Correlation Matrices at High, Medium and Low Level

The $\alpha$ 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} = \begin{bmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.8999 & 0.8894 & 0.8587 & 0.8099 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8894 & 0.8999 & 0.8894 & 0.8587 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.8587 & 0.8894 & 0.8999 & 0.8894 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.8099 & 0.8587 & 0.8894 & 0.8999 \\ 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9541 & 0.9430 & 0.9105 & 0.8587 \\ 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9430 & 0.9541 & 0.9430 & 0.9105 \\ 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 & 0.9430 \\ 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8587 & 0.9105 & 0.9430 & 0.9541 \\ 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 \\ 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 \\ 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.9767 \\ 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 \\ 0.8999 & 0.8894 & 0.8587 & 0.8099 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.8894 & 0.8999 & 0.8894 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.8587 & 0.8894 & 0.8999 & 0.8894 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.8099 & 0.8587 & 0.8894 & 0.8999 & 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{bmatrix}$ |

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

| | |
|---|---|
| **1x2 case** | N/A |
| **2x2 case** | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ |
| **4x2 case** | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{pmatrix}$ |
| **4x4 case** | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 0.5855 & 0.5787 & 0.5588 & 0.5270 \\ 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.5787 & 0.5855 & 0.5787 & 0.5588 \\ 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.5588 & 0.5787 & 0.5855 & 0.5787 \\ 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.5270 & 0.5588 & 0.5787 & 0.5855 \\ 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 \\ 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 \\ 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 \\ 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$ |

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

| | |
|---|---|
| **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.2.3A MIMO Channel Correlation Matrices using cross polarized antennas

The MIMO channel correlation matrices defined in B.2.3A apply for the antenna configuration using cross polarized antennas at both eNodeB and UE. The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at eNB and cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at UE.

For the cross-polarized antennas, the N antennas are labelled such that antennas for one polarization are listed from 1 to N/2 and antennas for the other polarization are listed from N/2+1 to N, where N is the number of transmit or receive antennas.

# B.2.3A.1 Definition of MIMO Correlation Matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P\left(R_{eNB} \otimes \Gamma \otimes R_{UE}\right)P^T$$

where

- $R_{UE}$ is the spatial correlation matrix at the UE with same polarization,
- $R_{eNB}$ is the spatial correlation matrix at the eNB with same polarization,
- $\Gamma$ is a polarization correlation matrix, and
- $(\bullet)^T$ denotes transpose.

The matrix $\Gamma$ is defined as

$$\Gamma = \begin{bmatrix} 1 & 0 & -\gamma & 0 \\ 0 & 1 & 0 & \gamma \\ -\gamma & 0 & 1 & 0 \\ 0 & \gamma & 0 & 1 \end{bmatrix}$$

A permutation matrix $P$ elements are defined as

$$P(a,b) = \begin{cases} 1 & for \quad a = (j-1)Nr + i \quad and \quad b = 2(j-1)Nr + i, \qquad i = 1,\cdots,Nr,\ j = 1,\cdots Nt/2 \\ 1 & for \quad a = (j-1)Nr + i \quad and \quad b = 2(j - Nt/2)Nr - Nr + i, \quad i = 1,\cdots,Nr,\ j = Nt/2+1,\cdots,Nt \\ 0 & otherwise \end{cases} \cdot$$

where $N_t$ and $N_r$ is the number of transmitter and receiver respectively. This is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in B.2.3A.

# B.2.3A.2 Spatial Correlation Matrices using cross polarized antennas at eNB and UE sides

## B.2.3A.2.1 Spatial Correlation Matrices at eNB side

For 2-antenna transmitter using one pair of cross-polarized antenna elements, $R_{eNB} = 1$.

For 4-antenna transmitter using two pairs of cross-polarized antenna elements, $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \boldsymbol{1} \end{pmatrix}$.

For 8-antenna transmitter using four pairs of cross-polarized antenna elements, $R_{eNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$.

### B.2.3A.2.2 Spatial Correlation Matrices at UE side

For 2-antenna receiver using one pair of cross-polarized antenna elements, $R_{UE} = 1$.

For 4-antenna receiver using two pairs of cross-polarized antenna elements, $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & \mathbf{1} \end{pmatrix}$.

## B.2.3A.3 MIMO Correlation Matrices using cross polarized antennas

The values for parameters *α*, *β* and *γ* for high spatial correlation are given in Table B.2.3A.3-1.

**Table B.2.3A.3-1**

| High spatial correlation | | |
|---|---|---|
| □ | □ | □ |
| 0.9 | 0.9 | 0.3 |
| Note 1: Value of *α* applies when more than one pair of cross-polarized antenna elements at eNB side.<br>Note 2: Value of *β* applies when more than one pair of cross-polarized antenna elements at UE side. | | |

The correlation matrices for high spatial correlation are defined in Table B.2.3A.3-2 as below.

The values in Table B.2.3A.3-2 have been adjusted to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

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

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 8x2 high spatial correlation case, a=0.00010.

**Table B.2.3A.3-2: MIMO correlation matrices for high spatial correlation**

| | |
|---|---|
| **8x2 case** | $R_{high} = \begin{bmatrix} 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.2700 \\ 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 \\ 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 \\ 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 \\ 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 \\ 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & -0.2700 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 \\ 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.2700 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 \\ -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & -0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 \\ 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 \\ -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 \\ 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 \\ -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 \\ 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 \\ -0.2700 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 \end{bmatrix}$ |

## B.2.3A.4 Beam steering approach

Given the channel spatial correlation matrix in B.2.3A.1, the corresponding random channel matrix ***H*** can be calculated. The signal model for the k-th subframe is denoted as

$$y = HD_{\theta_k}Wx + n$$

Where

- H is the Nr xNt channel matrix per subcarrier.

- $D_{\theta_k}$ is the steering matrix, which is $D_{\theta_k} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_k} & 0 & 0 \\ 0 & 0 & e^{j2\theta_k} & 0 \\ 0 & 0 & 0 & e^{j3\theta_k} \end{bmatrix}$,

- $\theta_k$ controls the phase variation, and the phase for k-th subframe is denoted by $\theta_k = \theta_0 + \Delta\theta \cdot k$, where $\theta_0$ is the random start value with the uniform distribution, i.e., $\theta_0 \in [0, 2\pi]$, $\Delta\theta$ is the step of phase variation, which is defined in Table B.2.3A.4-1, and $k$ is the linear increment of 1 for every subframe throughout the simulation,

- $W$ is the precoding matrix for 8 transmission antennas,

- $y$ is the received signal, $x$ is the transmitted signal, and $n$ is AWGN.

**Table B.2.3A.4-1: The step of phase variation**

| Variation Step | Value (rad/subframe) |
|---|---|
| $\Delta\theta$ | $1.2566 \times 10^{-3}$ |

# B.2.4 Propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t,\tau) = \delta(\tau) + a \exp(-i 2\pi f_D t) \delta(\tau - \tau_d),$$

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

## B.2.4.1 Propagation conditions for CQI tests with multiple CSI processes

For CQI tests with multiple CSI processes, the following additional multi-path profile is used for 2 port transmission:

$$H = \begin{bmatrix} 1 & j \\ 1 & -j \end{bmatrix} \circ H_{MP}$$

Where $\circ$ represents Hadamard product, $H_{MP}$ indicates the 2x2 propagation channel generated in the manner defined in Clause B.2.4.

# B.2.5 Void

# B.2.6 MBSFN Propagation Channel Profile

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

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

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

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

where $D_s/2$ is the initial distance of the train from eNodeB, and $D_{\min}$ is eNodeB Railway track distance, both in meters; $v$ is the velocity of the train in m/s, $t$ is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1 and B.3.2-B.3.4 respectively, where the required input parameters listed in table B.3-1 and the resulting Doppler shift shown in Figure B.3-1 are applied for all frequency bands.

**Table B.3-1: High speed train scenario**

| Parameter | Value |
|---|---|
| $D_s$ | 300 m |
| $D_{\min}$ | 2 m |
| $v$ | 300 km/h |
| $f_d$ | 750 Hz |

NOTE 1: Parameters for HST conditions in table B.3-1 including $f_d$ and Doppler shift trajectories presented on figure B.3-1 were derived from Band 7 and are applied for performance verification in all frequency bands.

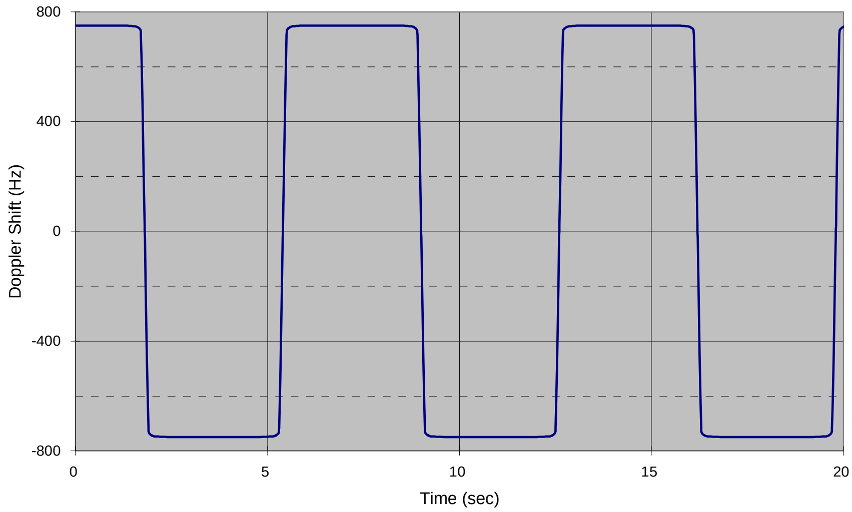


**Figure B.3-1: Doppler shift trajectory**

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

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

# B.4 Beamforming Model

## B.4.1 Single-layer random beamforming (Antenna port 5, 7, or 8)

Single-layer transmission on antenna port 5 or on antenna port 7 or 8 without a simultaneous transmission on the other antenna port, is defined by using a precoder vector $W(i)$ of size $2\times1$ 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 specific to a test case.

The CSI reference symbols $a_{k,l}^{(p)}$ satisfying $p \bmod 2 = 1$, $p \in \{15,16,..,22\}$, are transmitted on the same physical antenna element as the modulation symbols $y_{bf}(i)$. The CSI reference symbols $a_{k,l}^{(p)}$ satisfying $p \bmod 2 = 0$, $p \in \{15,16,..,22\}$, are transmitted on the same physical antenna element as the modulation symbols $\tilde{y}_{bf}(i)$.

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

Dual-layer transmission on antenna ports 7 and 8 is defined by using a precoder matrix $W(i)$ of size $2 \times 2$ randomly selected with the number of layers $\upsilon = 2$ 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, $y(i) = \begin{bmatrix} y^{(7)}(i) & y^{(8)}(i) \end{bmatrix}^T$, $i = 0,1,..., M_{\text{symb}}^{\text{ap}} - 1$, with $M_{\text{symb}}^{\text{ap}}$ being the number of modulation symbols per antenna port including the user-specific reference symbols, and generates a block of signals $y_{bf}(i) = \begin{bmatrix} y_{bf}(i) & \tilde{y}_{bf}(i) \end{bmatrix}^T$ 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 specific to a test case.

The CSI reference symbols $a_{k,l}^{(p)}$ satisfying $p \bmod 2 = 1$, $p \in \{15,16,..,22\}$, are transmitted on the same physical antenna element as the modulation symbols $y_{bf}(i)$. The CSI reference symbols $a_{k,l}^{(p)}$ satisfying $p \bmod 2 = 0$, $p \in \{15,16,..,22\}$, are transmitted on the same physical antenna element as the modulation symbols $\tilde{y}_{bf}(i)$.

## B.4.3 Generic beamforming model (antenna ports 7-14)

The transmission on antenna port(s) $p = 7,8,..., \upsilon + 6$ is defined by using a precoder matrix $W(i)$ of size $N_{CSI} \times \upsilon$, where $N_{CSI}$ is the number of CSI reference signals configured per test and $\upsilon$ is the number of spatial layers. This precoder takes as an input a block of signals for antenna port(s) $p = 7,8,..., \upsilon + 6$, $y^{(p)}(i) = \begin{bmatrix} y^{(7)}(i) & y^{(8)}(i) & \cdots & y^{(6+\upsilon)}(i) \end{bmatrix}$, $i = 0,1,..., M_{\text{symb}}^{\text{ap}} - 1$, with $M_{\text{symb}}^{\text{ap}}$ being the number of modulation symbols per antenna port including the user-specific reference symbols (DM-RS), and generates a block of signals $y_{bf}^{(q)}(i) = \begin{bmatrix} y_{bf}^{(0)}(i) & y_{bf}^{(1)}(i) & \ldots & y_{bf}^{(N_{CSI}-1)}(i) \end{bmatrix}^T$ the elements of which are to be mapped onto the same time-frequency index pair $(k, l)$ but transmitted on different physical antenna elements:

$$\begin{bmatrix} y_{bf}^{(0)}(i) \\ y_{bf}^{(1)}(i) \\ \vdots \\ y_{bf}^{(N_{CSI}-1)}(i) \end{bmatrix} = W(i) \begin{bmatrix} y^{(7)}(i) \\ y^{(8)}(i) \\ \vdots \\ y^{(6+\upsilon)}(i) \end{bmatrix}$$

The precoder matrix $W(i)$ is specific to a test case.

The physical antenna elements are identified by indices $j = 0,1,..., N_{ANT} - 1$, where $N_{ANT} = N_{CSI}$ is the number of physical antenna elements configured per test.

Modulation symbols $y_{bf}^{(q)}(i)$ with $q \in \{0,1,..., N_{CSI} - 1\}$ (i.e. beamformed PDSCH and DM-RS) are mapped to the physical antenna index $j = q$.

Modulation symbols $y^{(p)}(i)$ with $p \in \{0,1,..., P - 1\}$ (i.e. PBCH, PDCCH, PHICH, PCFICH) are mapped to the physical antenna index $j = p$, where $P$ is the number of cell-specific reference signals configured per test.

Modulation symbols $a_{k,l}^{(p)}$ with $p \in \{0,1,..., P - 1\}$ (i.e. CRS) are mapped to the physical antenna index $j = p$, where $P$ is the number of cell-specific reference signals configured per test.

Modulation symbols $a_{k,l}^{(p)}$ with $p \in \{15,16,...,14 + N_{CSI}\}$ (i.e. CSI-RS) are mapped to the physical antenna index $j = p - 15$, where $N_{CSI}$ is the number of CSI reference signals configured per test.

## B.4.4 Random beamforming for EPDCCH distributed transmission (Antenna port 107 and 109)

EPDCCH distributed transmission on antenna port 107 and antenna port 109 is defined by using a pair of precoder vectors $W_1(i)$ and $W_2(i)$ each of size $2 \times 1$, which are not identical and randomly selected per EPDCCH PRB pair with the number of layers $\upsilon = 1$ 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 $p \in \{107, 109\}$, with $M_{\text{symb}}^{\text{ap}}$ the number of modulation symbols including the user-specific reference symbols (DMRS), and generates a block of signals $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$. When EPDCCH is associated with port 107, the transmitted block of signals is deonted as

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W_1(i) y^{(107)}(i).$$

When EPDCCH is associated with port 109, the transmitted block of signals is denoted as

$$\begin{bmatrix} y_{bf}(i) \\ \tilde{y}_{bf}(i) \end{bmatrix} = W_2(i) y^{(109)}(i).$$

## B.4.5 Random beamforming for EPDCCH localized transmission (Antenna port 107, 108, 109 or 110)

EPDCCH localized transmission on antenna port 107, 108, 109 or 110 is defined by using a precoder vector $W(i)$ of size 2×1 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 $p \in \{107, 108, 109, 110\}$, with $M_{\text{symb}}^{\text{ap}}$ the number of modulation symbols including the user-specific reference symbols (DMRS), and generates a block of signals $y_{bf}(i) = \left[ y_{bf}(i) \quad \tilde{y}_{bf}(i) \right]^T$ the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

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

# B.5 Interference models for enhanced performance requirements Type-A

This clause provides a description for the modelling of interfering cell transmissions for enhanced performance requirements Type-A including: definition of dominant interferer proportion, transmission mode 3, 4 and 9 type of interference modelling.

## B.5.1 Dominant interferer proportion

Each interfering cell involved in enhanced performance requirements Type-A is characterized by its associated dominant interferer proportion (DIP) value:

$$DIP_i = \frac{\hat{I}_{or(i+1)}}{N_{oc}'}$$

where is $\hat{I}_{or(i+1)}$ is the average received power spectral density from the i-th strongest interfering cell involved in the requirement scenario ( $\hat{I}_{or(1)}$ is assumed to be the power spectral density associated with the serving cell) and $N_{oc}' = \sum_{j=2}^{N} \hat{I}_{or(j)} + N_{oc}$ where $N_{oc}$ is the average power spectral density of a white noise source consistent with the definition provided in subclause 3.2 and $N$ is the total number of cells involved in a given requirement scenario.

## B.5.2 Transmission mode 3 interference model

This subclause provides transmission mode 3 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth. Transmitted physical channels shall include PSS, SSS and PBCH.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For rank-1 transmission over a subband, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For rank-2 transmission over a subband, precoding for spatial multiplexing with large delay CDD over two layers for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.2.2 of [4].

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.5.3 Transmission mode 4 interference model

This subclause provides transmission mode 4 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth. Transmitted physical channels shall include PSS, SSS and PBCH.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For each subframe and CQI subband, a precoding matrix for the number of layers $\upsilon$ associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-1 of [4]. Note that codebook index 0 shall be excluded from random precoder selection when the number of layers is $\upsilon = 2$.

Precoding for spatial multiplexing with cell-specific reference signals for the number of antenna ports in the requirement scenario shall be applied to 16QAM randomly modulated layer symbols, as specified in subclause 6.3.4.2.1 of [4] with the selected precoding matrices for each subframe and each CQI subband.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.5.4 Transmission mode 9 interference model

This subclause provides transmission mode 9 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the entire PDSCH region and the full transmission bandwidth. Transmitted physical channels shall include PSS, SSS and PBCH.

For each subframe and each CQI subband as defined in subclause 7.2 of [6], a transmission rank shall be randomly determined independently from other CQI subbands as well as other interfering cells. Probabilities of occurrence of each possible transmission rank are as specified in the requirement scenario.

For each subframe and each CQI subband, a precoding matrix for the number of layers $\upsilon$ associated to the selected rank shall be selected randomly from Table 6.3.4.2.3-2 of [4].

The generic beamforming model in subclause B.4.3 shall be applied assuming cell-specific reference signals and CSI reference signals as specified in the requirement scenario. Random precoding with selected rank and precoding matrices for each subframe and each CQI subband shall be applied to 16QAM randomly modulated layer symbols including the user-specific reference symbols over antenna port 7 when the rank is one and antenna ports 7, 8 when the rank is two.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

# Annex C (normative): Downlink Physical Channels

# C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

# C.2 Set-up

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

**Table C.2-1: Downlink Physical Channels required for connection set-up**

| Physical Channel |
|---|
| PBCH |
| SSS |
| PSS |
| PCFICH |
| PDCCH |
| EPDCCH |
| PHICH |
| PDSCH |

# C.3 Connection

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

## C.3.1 Measurement of Receiver Characteristics

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, unless otherwise stated.

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

| Physical Channel | EPRE Ratio |
|---|---|
| PBCH | PBCH_RA = $\rho_A + \sigma$ |
| | PBCH_RB = $\rho_B + \sigma$ |
| PSS | PSS_RA = 0 (Note 3) |
| SSS | SSS_RA = 0 (Note 3) |
| PCFICH | PCFICH_RB = $\rho_B + \sigma$ |
| PDCCH | PDCCH_RA = $\rho_A + \sigma$ |
| | PDCCH_RB = $\rho_B + \sigma$ |
| EPDCCH | EPDCCH_RA = $\rho_A + \delta$ |
| | EPDCCH_RB = $\rho_B + \delta$ |
| PDSCH | PDSCH_RA = $\rho_A$ |
| | PDSCH_RB = $\rho_B$ |
| PMCH | PMCH_RA = $\rho_A$ |
| | PMCH_RB = $\rho_B$ |
| MBSFN RS | MBSFN RS_RA = $\rho_A$ |
| | MBSFN RS_RB = $\rho_B$ |
| OCNG | OCNG_RA = $\rho_A + \sigma$ |
| | OCNG_RB = $\rho_B + \sigma$ |

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

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

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

NOTE 4: $\rho_A$, $\rho_B$, $\sigma$ and $\delta$ are test specific.

urpose of the test set up only.

**Table C.3.2-2: Power allocation for OFDM symbols and reference signals**

| Parameter | Unit | Value | Note |
|---|---|---|---|
| Total transmitted power spectral density $I_{or}$ | dBm/15 kHz | Test specific | 1. $I_{or}$ shall be kept constant throughout all OFDM symbols |
| Cell-specific reference signal power ratio $E_{RS} / I_{or}$ | | Test specific | 1. Applies for antenna port *p* |
| Energy per resource element EPRE | | Test specific | 1. The complex-valued symbols $y^{(p)}(i)$ and $a_{k,l}^{(p)}$ defined in [4] shall conform to the given EPRE value.<br>2. For TM8, TM9, and TM10 the reference point for EPRE is before the precoder in Annex B.4. |

# C.3.3 Aggressor cell power allocation for Measurement of Performance Requirements when ABS is Configured

For the performance requirements and channel state information reporting when ABS is configured, the power allocation for the physical channels of the aggressor cell in non-ABS and ABS is listed in Table C.3.3-1.

**Table C.3.3-1: Downlink physical channels transmitted in aggressor cell when ABS is configured in this cell**

| Physical Channel | Parameters | Unit | EPRE Ratio | |
|---|---|---|---|---|
| | | | Non-ABS | ABS |
| PBCH | PBCH_RA | dB | $\rho_A$ | Note 1 |
| | PBCH_RB | dB | $\rho_B$ | Note 1 |
| PSS | PSS_RA | dB | $\rho_A$ | Note 1 |
| SSS | SSS_RA | dB | $\rho_A$ | Note 1 |
| PCFICH | PCFICH_RB | dB | $\rho_B$ | Note 1 |
| PHICH | PHICH_RA | dB | $\rho_A$ | Note 1 |
| | PHICH_RB | dB | $\rho_B$ | Note 1 |
| PDCCH | PDCCH_RA | dB | $\rho_A$ | Note 1 |
| | PDCCH_RB | dB | $\rho_B$ | Note 1 |
| PDSCH | PDSCH_RA | dB | N/A | Note 1 |
| | PDSCH_RB | dB | N/A | Note 1 |
| OCNG | OCNG_RA | dB | $\rho_A$ | Note 1 |
| | OCNG_RB | dB | $\rho_B$ | Note 1 |
| Note 1: $-\infty$ dB is allocated for this channel in this test. | | | | |

**Table C.3.3-2: Downlink physical channels transmitted in aggressor cell when ABS is configured in this cell when the CRS assistance information is provided**

| Physical Channel | Parameters | Unit | EPRE Ratio | |
|---|---|---|---|---|
| | | | Non-ABS | ABS |
| PBCH | PBCH_RA | dB | $\rho_A$ | $\rho_A$ |
| | PBCH_RB | dB | $\rho_B$ | $\rho_B$ |
| PSS | PSS_RA | dB | $\rho_A$ | $\rho_A$ |
| SSS | SSS_RA | dB | $\rho_A$ | $\rho_A$ |
| PCFICH | PCFICH_RB | dB | $\rho_B$ | Note 1 |
| PHICH | PHICH_RA | dB | $\rho_A$ | Note 1 |
| | PHICH_RB | dB | $\rho_B$ | Note 1 |
| PDCCH | PDCCH_RA | dB | $\rho_A$ | Note 1 |
| | PDCCH_RB | dB | $\rho_B$ | Note 1 |
| PDSCH | PDSCH_RA | dB | N/A | Note 1 |
| | PDSCH_RB | dB | N/A | Note 1 |
| OCNG | OCNG_RA | dB | $\rho_A$ | Note 1 |
| | OCNG_RB | dB | $\rho_B$ | Note 1 |
| Note 1: $-\infty$ dB is allocated for this channel in this test. | | | | |

# C.3.4 Power Allocation for Measurement of Performance Requirements when Quasi Co-location Type B: same Cell ID

For the performance requirements related to quasi-colocation type B behaviour when transmission points share the same Cell ID, the power allocation for the physical channels of the serving cell is listed in table C.3.4-1 and the power allocation for the physical channels of the cell transmitting PDSCH is listed in table C.3-4-2

**Table C.3.4-1: Downlink physical channels transmitted in the serving cell (TP1)**

| Physical Channel | EPRE Ratio |
|---|---|
| PBCH | PBCH_RA = $\rho_A + \sigma$ |
| | PBCH_RB = $\rho_B + \sigma$ |
| PSS | PSS_RA = 0 (Note 2) |
| SSS | SSS_RA = 0 (Note 2) |
| PDSCH | PDSCH_RA = $\rho_A$ |
| | PDSCH_RB = $\rho_B$ |
| PCFICH | PCFICH_RB = $\rho_B + \sigma$ |
| PDCCH | PDCCH_RA = $\rho_A + \sigma$ |
| | PDCCH_RB = $\rho_B + \sigma$ |

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

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

NOTE 3: $\rho_A$, $\rho_B$ and $\sigma$ are test specific.

**Table C.3.4-2: Downlink physical channels for the transmission point transmitting PDSCH (TP2)**

| Physical Channel | Value |
|---|---|
| PDSCH | Test Specific |

# 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:<br>Leclanché<br>Lithium<br>Mercury/nickel & cadmium | <br>0,85 * nominal<br>0,95 * nominal<br>0,90 * nominal | <br>Nominal<br>1,1 * Nominal | <br>Nominal<br>1,1 * Nominal<br>Nominal |

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

# E.2.3 Vibration

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

**Table E.2.3-1**

| Frequency | ASD (Acceleration Spectral Density) random vibration |
|---|---|
| 5 Hz to 20 Hz | 0,96 $m^2/s^3$ |
| 20 Hz to 500 Hz | 0,96 $m^2/s^3$ at 20 Hz, thereafter –3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 36.101 for extreme operation.

# Annex F (normative): Transmit modulation

## F.1 Measurement Point

Figure F.1-1 shows the measurement point for the unwanted emission falling into non-allocated RB(s) and the EVM for the allocated RB(s).

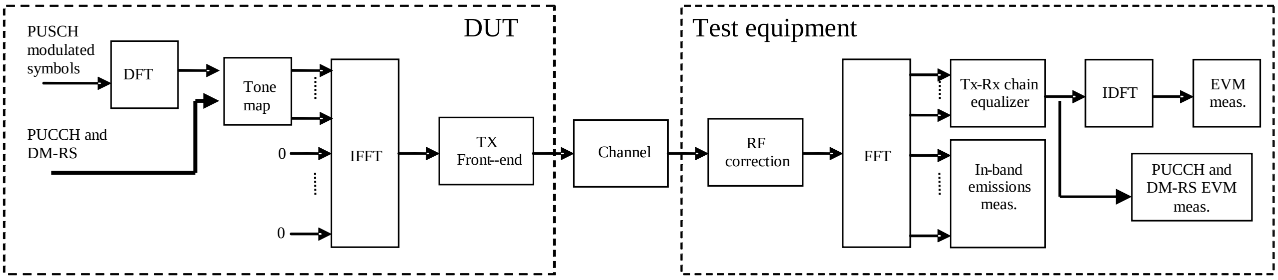


**Figure F.1-1: EVM measurement points**

## F.2 Basic Error Vector Magnitude measurement

The EVM is the difference between the ideal waveform and the measured waveform for the allocated RB(s)

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

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

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

where

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

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

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

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

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

The relative in-band emissions are, given by

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

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 carrier leakage shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative carrier leakage power also has to satisfy the applicable requirement.

At this stage the allocated RBs shall be separated from the non-allocated RBs. In the case of PUCCH and PUSCH EVM, the signal on the non-allocated RB(s), $Y(t, f)$, is used to evaluate the in-band emissions.

Moreover, the following procedure applies only to the signal on the allocated RB(s).

- In the case of PUCCH and PUSCH, the UL EVM analyzer shall estimate the TX chain equalizer coefficients $\tilde{a}(t, f)$ and $\tilde{\varphi}(t, f)$ used by the ZF equalizer for all subcarriers by time averaging at each signal subcarrier of the amplitude and phase of the reference and data symbols. The time-averaging length is 1 slot. This process creates an average amplitude and phase for each signal subcarrier used by the ZF equalizer. The knowledge of data modulation symbols may be required in this step because the determination of symbols by demodulation is not reliable before signal equalization.

- In the case of PRACH, the UL EVM analyzer shall estimate the TX chain coefficients $\tilde{a}(t)$ and $\tilde{\varphi}(t)$ used for phase and amplitude correction and are seleted so as to minimize the resulting EVM. The TX chain coefficients are not dependent on frequency, i.e. $\tilde{a}(t, f) = \tilde{a}(t)$ and $\tilde{\varphi}(t, f) = \tilde{\varphi}(t)$. The TX chain coefficient are chosen independently for each preamble transmission and for each $\Delta\tilde{t}$.

At this stage estimates of $\Delta\tilde{f}$, $\tilde{a}(t, f)$, $\tilde{\varphi}(t, f)$ and $\Delta\tilde{c}$ are available. $\Delta\tilde{t}$ is one of the extremities of the window $W$, i.e. $\Delta\tilde{t}$ can be $\Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$ or $\Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$, where $\alpha = 0$ if $W$ is odd and $\alpha = 1$ if $W$ is even. The EVM analyser shall then

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

- calculate $EVM_h$ with $\Delta\tilde{t}$ set to $\Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$.

# F.5 Window length

## F.5.1 Timing offset

As a result of using a cyclic prefix, there is a range of $\Delta\tilde{t}$, which, at least in the case of perfect Tx signal quality, would give close to minimum error vector magnitude. As a first order approximation, that range should be equal to the length of the cyclic prefix. Any time domain windowing or FIR pulse shaping applied by the transmitter reduces the $\Delta\tilde{t}$ range within which the error vector is close to its minimum.

## F.5.2 Window length

The window length $W$ affects the measured EVM, and is expressed as a function of the configured cyclic prefix length. In the case where equalization is present, as with frequency domain EVM computation, the effect of FIR is reduced. This is because the equalization can correct most of the linear distortion introduced by the FIR. However, the time domain windowing effect can't be removed.

## F.5.3 Window length for normal CP

The table below specifies the EVM window length at channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz, for normal CP. The nominal window length for 3 MHz is rounded down one sample to allow the window to be centered on the symbol.

**Table F.5.3-1 EVM window length for normal CP**

| Channel Bandwidth MHz | Cyclic prefix length[1] $N_{cp}$ for symbol 0 | Cyclic prefix length[1] $N_{cp}$ for symbols 1 to 6 | Nominal FFT size | Cyclic prefix for symbols 1 to 6 in FFT samples | EVM window length *W* in FFT samples | Ratio of *W* to CP for symbols 1 to 6 [2] |
|---|---|---|---|---|---|---|
| 1.4 | 160 | 144 | 128 | 9 | 5 | 55.6 |
| 3 | | | 256 | 18 | 12 | 66.7 |
| 5 | | | 512 | 36 | 32 | 88.9 |
| 10 | | | 1024 | 72 | 66 | 91.7 |
| 15 | | | 1536 | 108 | 102 | 94.4 |
| 20 | | | 2048 | 144 | 136 | 94.4 |
| Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed.<br>Note 2: These percentages are informative and apply to symbols 1 through 6. Symbol 0 has a longer CP and therefore a lower percentage. | | | | | | |

# F.5.4 Window length for Extended CP

The table below specifies the EVM window length at channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz, for extended CP. The nominal window lengths for 3 MHz and 15 MHz are rounded down one sample to allow the window to be centered on the symbol.

**Table F.5.4-1 EVM window length for extended CP**

| Channel Bandwidth MHz | Cyclic prefix length[1] $N_{cp}$ | Nominal FFT size | Cyclic prefix in FFT samples | EVM window length *W* in FFT samples | Ratio of *W* to CP [2] |
|---|---|---|---|---|---|
| 1.4 | 512 | 128 | 32 | 28 | 87.5 |
| 3 | | 256 | 64 | 58 | 90.6 |
| 5 | | 512 | 128 | 124 | 96.9 |
| 10 | | 1024 | 256 | 250 | 97.4 |
| 15 | | 1536 | 384 | 374 | 97.4 |
| 20 | | 2048 | 512 | 504 | 98.4 |
| Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed.<br>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<br>Note 2: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied<br>Note 3: These percentages are informative | | | | |

# F.6 Averaged EVM

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

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

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

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

Thus we get:

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

The calculation of the EVM for the demodulation reference signal, $EVM_{DMRS}$, follows the same procedure as calculating the general EVM, with the exception that the modulation symbol set $T_m$ defined in clause F.2 is restricted to symbols containing uplink demodulation reference signals.

The basic $EVM_{DMRS}$ measurements are first averaged over 20 slots in the time domain to obtain an intermediate average $\overline{EVM}_{DMRS}$.

$$\overline{EVM}_{DMRS} = \sqrt{\frac{1}{20}\sum_{i=1}^{20} EVM_{DMRS,i}^2}$$

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

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

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

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

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

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

Thus we get:

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

# F.7 Spectrum Flatness

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

# Annex G (informative): Reference sensitivity level in lower SNR

This annex contains information on typical receiver sensitivity when HARQ transmission is enabled allowing operation in lower SNR regions (HARQ is disabled in conformance testing), thus representing the configuration normally used in live network operation under noise-limited conditions.

# G.1 General

The reference sensitivity power level $P_{SENS}$ with HARQ retransmission enabled (operation in lower SNR) is the minimum mean power applied to both the UE antenna ports at which the residual BLER after HARQ shall meet the requirements for the specified reference measurement channel. The residual BLER after HARQ transmission is defined as follows:

$$BLER_{residual} = 1 - \frac{A}{B}$$

$A$ : Number of correctly decoded MAC PDUs

$B$ : Number of transmitted MAC PDUs (Retransmitted MAC PDUs are not counted)

# G.2 Typical receiver sensitivity performance (QPSK)

The residual BLER after HARQ shall be lower than 1% for the reference measurement channels as specified in Annexes G.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table G.2-1 and Table G.2-2

**Table G.2-1: Reference sensitivity QPSK $P_{SENS}$**

| 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 | | | | [-102] | | | FDD |
| 2 | | | | TBD | | | FDD |
| 3 | | | | TBD | | | FDD |
| 4 | | | | TBD | | | FDD |
| 5 | | | | TBD | | | FDD |
| 6 | | | | TBD | | | FDD |
| 7 | | | | TBD | | | FDD |
| 8 | | | | TBD | | | FDD |
| 9 | | | | TBD | | | FDD |
| 10 | | | | TBD | | | FDD |
| 11 | | | | TBD | | | FDD |
| 12 | | | | TBD | | | FDD |
| 13 | | | | TBD | | | FDD |
| 14 | | | | TBD | | | FDD |
| … | | | | | | | |
| 17 | | | | TBD | | | FDD |
| 18 | | | | TBD | | | FDD |
| 19 | | | | TBD | | | FDD |
| 20 | | | | TBD | | | FDD |
| 21 | | | | TBD | | | FDD |
| 22 | | | | TBD | | | FDD |
| 23 | | | | TBD | | | FDD |
| 26 | | | | TBD | | | FDD |
| 27 | | | | TBD | | | FDD |
| 28 | | | | TBD | | | FDD |
| … | | | | | | | |
| 33 | | | | [-102] | | | TDD |
| 34 | | | | [-102] | | | TDD |
| 35 | | | | [-102] | | | TDD |
| 36 | | | | [-102] | | | TDD |
| 37 | | | | [-102] | | | TDD |
| 38 | | | | [-102] | | | TDD |
| 39 | | | | [-102] | | | TDD |
| 40 | | | | [-102] | | | TDD |
| 42 | | | | [-102] | | | TDD |
| 43 | | | | [-102] | | | TDD |
| 44 | | | | [-102] | | | TDD |
| Note 1: The transmitter shall be set to $P_{UMAX}$ as defined in clause 6.2.5<br>Note 2: Reference measurement channel is G.3 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1<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. | | | | | | | |

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

**Table G.2-2: Minimum uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / NRB / Duplex mode | | | | | | | |
|---|---|---|---|---|---|---|---|
| **E-UTRA Band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex Mode** |
| 1 | | | | [6][1] | | | FDD |
| 2 | | | | [6][1] | | | FDD |
| 3 | | | | [6][1] | | | FDD |
| 4 | | | | [6][1] | | | FDD |
| 5 | | | | [6][1] | | | FDD |
| 6 | | | | [6][1] | | | FDD |
| 7 | | | | [6][1] | | | FDD |
| 8 | | | | [6][1] | | | FDD |
| 9 | | | | [6][1] | | | FDD |
| 10 | | | | [6][1] | | | FDD |
| 11 | | | | [6][1] | | | FDD |
| 12 | | | | [6][1] | | | FDD |
| 13 | | | | [6][1] | | | FDD |
| 14 | | | | [6][1] | | | FDD |
| … | | | | | | | |
| 17 | | | | [6][1] | | | FDD |
| 18 | | | | [6][1] | | | FDD |
| 19 | | | | [6][1] | | | FDD |
| 20 | | | | [6][1] | | | FDD |
| 22 | | | | [6][1] | | | FDD |
| 21 | | | | [6][1] | | | FDD |
| 23 | | | | [6][1] | | | FDD |
| 26 | | | | [6][1] | | | FDD |
| 27 | | | | [6][1] | | | FDD |
| 28 | | | | [6][1] | | | FDD |
| … | | | | | | | |
| 33 | | | | 50 | | | TDD |
| 34 | | | | 50 | | | TDD |
| 35 | | | | 50 | | | TDD |
| 36 | | | | 50 | | | TDD |
| 37 | | | | 50 | | | TDD |
| 38 | | | | 50 | | | TDD |
| 39 | | | | 50 | | | TDD |
| 40 | | | | 50 | | | TDD |
| 42 | | | | 50 | | | TDD |
| 43 | | | | 50 | | | TDD |
| 44 | | | | 50 | | | TDD |
| Note 1: The UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).<br>Note 2: For the UE which supports both Band 11 and Band 21 the minimum uplink configuration for reference sensitivity is FFS.<br>Note 3: For Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RBstart _11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RBstart _16 | | | | | | | |

Unless given by Table G.2-3, the minimum requirements specified in Tables G.2-1 and G.2-2 shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

**Table G.2-3: Network Signalling Value for reference sensitivity**

| E-UTRA Band | Network Signalling value |
|---|---|
| 2 | NS_03 |
| 4 | NS_03 |
| 10 | NS_03 |
| 12 | NS_06 |
| 13 | NS_06 |
| 14 | NS_06 |
| 17 | NS_06 |
| 19 | NS_08 |
| 21 | NS_09 |
| 23 | NS_03 |
| 35 | NS_03 |
| 36 | NS_03 |

# G.3 Reference measurement channel for REFSENSE in lower SNR

Tables G.3-1 and G.3-2 are applicable for Annex G.2 (Reference sensitivity level in lower SNR).

**Table G.3-1 Fixed Reference Channel for Receiver Requirements (FDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | | | | 10 | | |
| Allocated resource blocks | | | | | 50 | | |
| Subcarriers per resource block | | | | | 12 | | |
| Allocated subframes per Radio Frame | | | | | 10 | | |
| Modulation | | | | | QPSK | | |
| Target Coding Rate | | | | | 1/3 | | |
| Number of HARQ Processes | Processes | | | | 8 | | |
| Maximum number of HARQ transmissions | | | | | [4] | | |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | | 4392 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 4392 | | |
| Transport block CRC | Bits | | | | 24 | | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | | 1 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | | 13800 | | |
| For Sub-Frame 5 | Bits | | | | N/A | | |
| For Sub-Frame 0 | Bits | | | | 12960 | | |
| Max. Throughput averaged over 1 frame | kbps | | | | 3952.8 | | |
| UE Category | | | | | 1-8 | | |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz<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: Redundancy version coding sequence is {0, 1, 2, 3} for QPSK. | | | | | | | |

**Table G.3-2 Fixed Reference Channel for Receiver Requirements (TDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel Bandwidth | MHz | | | | 10 | | |
| Allocated resource blocks | | | | | 50 | | |
| Uplink-Downlink Configuration (Note 5) | | | | | 1 | | |
| Allocated subframes per Radio Frame (D+S) | | | | | 4+2 | | |
| Number of HARQ Processes | Processes | | | | 7 | | |
| Maximum number of HARQ transmission | | | | | [4] | | |
| Modulation | | | | | QPSK | | |
| Target coding rate | | | | | 1/3 | | |
| Information Bit Payload per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | | | | 4392 | | |
| For Sub-Frame 1, 6 | | | | | 3240 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 4392 | | |
| Transport block CRC | Bits | | | | 24 | | |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frame 4, 9 | | | | | 1 | | |
| For Sub-Frame 1, 6 | | | | | 1 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 1 | | |
| Binary Channel Bits Per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | | | | 13800 | | |
| For Sub-Frame 1, 6 | | | | | 11256 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 13104 | | |
| Max. Throughput averaged over 1 frame | kbps | | | | 1965.6 | | |
| UE Category | | | | | 1-5 | | |

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

# Annex H (normative): Modified MPR behavior

## H.1 Indication of modified MPR behavior

This annex contains the definitions of the bits in the field *modifiedMPRbehavior* indicated in the IE UE Radio Access Capability [7] by a UE supporting an MPR or A-MPR modified in a later release of this specification.

**Table H.1-1: Definitions of the bits in the field *modifiedMPRbehavior***

| **Index of field** (bit number) | **Definition** (description of the supported functionality if indicator set to one) | **Notes** |
|---|---|---|
| 0 (leftmost bit) | - The MPR for intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation specified in Clause 6.2.3A in version 12.5.0 of this specification | - This bit can be set to 1 by a UE supporting intra-band contiguous CA bandwidth class C |
| 1 | - The A-MPR associated with NS_05 for Band 1 in Clause 6.2.4 in version 12.10.0 of this specification. | - This bit can be set to 1 by a UE supporting A-MPR associated to NS_05 for Band 1. |
| 2 | The A-MPR associated with NS_04 for Band 41 in Table 6.2.4-4 in version 14.1.0 of this specification. | This bit can be set to 1 by a power class 3 UE supporting A-MPR associated to NS_04 for Band 41. |

# Annex I (informative): Change history

**Table H-1: Change History**

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

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|---|---|---|---|---|---|---|---|
| 12-2008 | RP#42 | RP-080911 | 90r1 | | | Introduction of Maximum Sensitivity Degradation | 8.4.0 |
| 12-2008 | RP#42 | RP-080911 | 103 | | | Removal of [] from Section 7 Receiver characteristic | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 62 | | | Alignement of TB size n Ref Meas channel for RX characteristics | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 78 | | | TDD Reference Measurement channel for RX characterisctics | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 73r1 | | | Addition of 64QAM DL referenbce measurement channel | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 74r1 | | | Addition of UL Reference Measurement Channels | 8.4.0 |
| 12-2008 | RP#42 | RP-080912 | 104 | | | Reference measurement channels for PDSCH performance requirements (TDD) | 8.4.0 |
| 12-2008 | RP#42 | RP-080913 | 68 | | | MIMO Correlation Matrix Corrections | 8.4.0 |
| 12-2008 | RP#42 | RP-080915 | 67 | | | Correction to the figure with the Transmission Bandwidth configuration | 8.4.0 |
| 12-2008 | RP#42 | RP-080916 | 77 | | | Modification to EARFCN | 8.4.0 |
| 12-2008 | RP#42 | RP-080917 | 85r1 | | | New Clause 5 outline | 8.4.0 |
| 12-2008 | RP#42 | RP-080919 | 102 | | | Introduction of Bands 12 and 17 in 36.101 | 8.4.0 |
| 12-2008 | RP#42 | RP-080927 | 84r1 | | | Clarification of HST propagation conditions | 8.4.0 |
| 03-2009 | RP#43 | RP-090170 | 156r2 | | | A-MPR table for NS_07 | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 170 | | | Corrections of references (References to tables and figures) | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 108 | | | Removal of [ ] from Transmitter Intermodulation | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 155 | | | E-UTRA ACLR for below 5 MHz bandwidths | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 116 | | | Clarification of PHS band including the future plan | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 119 | | | Spectrum emission mask for 1.4 MHz and 3 MHz bandwidhts | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 120 | | | Removal of "Out-of-synchronization handling of output power" heading | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 126 | | | UE uplink power control | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 128 | | | Transmission BW Configuration | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 130 | | | Spectrum flatness | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 132r2 | | | PUCCH EVM | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 134 | | | UL DM-RS EVM | 8.5.0 |
| 03-2009 | RP#43 | RP-090170 | 140 | | | Removal of ACLR2bis requirements | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 113 | | | In-band blocking | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 127 | | | In-band blocking and sensitivity requirement for band 17 | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 137r1 | | | Wide band intermodulation | 8.5.0 |
| 03-2009 | RP#43 | RP-090171 | 141 | | | Correction of reference sensitivity power level of Band 9 | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 109 | | | AWGN level for UE DL demodulation performance tests | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 124 | | | Update of Clause 8: additional test cases | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 139r1 | | | Performance requirement structure for TDD PDSCH | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 142r1 | | | Performance requirements and reference measurement channels for TDD PDSCH demodulation with UE-specific reference symbols | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 145 | | | Number of information bits in DwPTS | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 160r1 | | | MBSFN-Unicast demodulation test case | 8.5.0 |
| 03-2009 | RP#43 | RP-090172 | 163r1 | | | MBSFN-Unicast demodulation test case for TDD | 8.5.0 |
| 03-2009 | RP#43 | RP-090173 | 162 | | | Clarification of EARFCN for 36.101 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 110 | | | Correction to UL Reference Measurement Channel | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 114 | | | Addition of MIMO (4x4, medium) Correlation Matrix | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 121 | | | Correction of 36.101 DL RMC table notes | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 125 | | | Update of Clause 9 | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 138r1 | | | Clarification on OCNG | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 161 | | | CQI reference measurement channels | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 164 | | | PUCCH 1-1 Static Test Case | 8.5.0 |
| 03-2009 | RP#43 | RP-090369 | 111 | | | Reference Measurement Channel for TDD | 8.5.0 |
| 03-2009 | RP#44 | | | | | Editorial correction in Table 6.2.4-1 | 8.5.1 |
| 05-2009 | RP#44 | RP-090540 | 167 | | | Boundary between E-UTRA fOOB and spurious emission domain for 1.4 MHz and 3 MHz bandwiths. (Technically Endorsed CR in R4-50bis - R4-091205) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **168** | | | EARFCN correction for TDD DL bands. (Technically Endorsed CR in R4-50bis - R4-091206) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **169** | | | Editorial correction to in-band blocking table. (Technically | **8.6.0** |

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| | | | | | | Endorsed CR in R4-50bis - R4-091238) | |
| **05-2009** | **RP#44** | RP-090540 | **171** | | | CR PRACH EVM. (Technically Endorsed CR in R4-50bis - R4-091308) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **172** | | | CR EVM correction. (Technically Endorsed CR in R4-50bis - R4-091309) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **177** | | | CR power control accuracy. (Technically Endorsed CR in R4-50bis - R4-091418) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **179** | | | Correction of SRS requirements. (Technically Endorsed CR in R4-50bis - R4-091426) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **186** | | | Clarification for EVM. (Technically Endorsed CR in R4-50bis - R4-091512) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **187** | | | Removal of [ ] from band 17 Refsens values and ACS offset frequencies | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **191** | | | Completion of band17 requirements | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **192** | | | Removal of 1.4 MHz and 3 MHz bandwidths from bands 13, 14 and 17. | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **223** | | | CR: 64 QAM EVM | **8.6.0** |
| **05-2009** | **RP#44** | RP-090540 | **201** | | | CR In-band emissions | **8.6.0** |
| **05-2009** | RP#44 | RP-090540 | 203 | | | CR EVM exclusion period | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 204 | | | CR In-band emissions timing | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 206 | | | CR Minimum Rx exceptions | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 207 | | | CR UL DM-RS EVM | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 218r1 | | | A-MPR table for NS_07 | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 205r1 | | | CR In-band emissions in shortened subframes | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 200r1 | | | CR PUCCH EVM | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 178r2 | | | No additional emission mask indication. (Technically Endorsed CR in R4-50bis - R4-091421) | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 220r1 | | | Spectrum emission requirements for band 13 | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 197r2 | | | CR on aggregate power tolerance | **8.6.0** |
| 05-2009 | RP#44 | RP-090540 | 196r2 | | | CR: Rx IP2 performance | **8.6.0** |
| 05-2009 | RP#44 | RP-090541 | 198r1 | | | Maximum output power relaxation | **8.6.0** |
| 05-2009 | RP#44 | RP-090542 | 166 | | | Update of performance requirement for TDD PDSCH with MBSFN configuration. (Technically Endorsed CR in R4-50bis - R4-091180) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090542 | **175** | | | Adding AWGN levels for some TDD DL performance requirements. (Technically Endorsed CR in R4-50bis - R4-091406) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090542 | **182** | | | OCNG Patterns for Single Resource Block FRC Requirements. (Technically Endorsed CR in R4-50bis - R4-091504) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090542 | 170r1 | | | Update of Clause 8: PHICH and PMI delay. (Technically Endorsed CR in R4-50bis - R4-091275) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090543 | 183 | | | Requirements for frequency-selective fading test. (Technically Endorsed CR in R4-50bis - R4-091505) | **8.6.0** |
| 05-2009 | RP#44 | RP-090543 | **199** | | | CQI requirements under AWGN conditions | **8.6.0** |
| 05-2009 | RP#44 | RP-090543 | **188r1** | | | Adaptation of UL-RMC-s for supporting more UE categories | **8.6.0** |
| 05-2009 | RP#44 | RP-090543 | **193r1** | | | Correction of the LTE UE downlink reference measurement channels | **8.6.0** |
| 05-2009 | RP#44 | RP-090543 | **184r1** | | | Requirements for frequency non-selective fading tests. (Technically Endorsed CR in R4-50bis - R4-091506) | **8.6.0** |
| 05-2009 | RP#44 | RP-090543 | **185r1** | | | Requirements for PMI reporting. (Technically Endorsed CR in R4-50bis - R4-091510) | **8.6.0** |
| **05-2009** | **RP#44** | RP-090543 | 221r1 | | | Correction to DL RMC-s for Maximum input level for supporting more UE-Categories | **8.6.0** |
| **05-2009** | **RP#44** | RP-090543 | 216 | | | Addition of 15 MHz and 20 MHz bandwidths into band 38 | **8.6.0** |
| **05-2009** | **RP#44** | RP-090559 | 180 | | | Introduction of Extended LTE800 requirements. (Technically Endorsed CR in R4-50bis - R4-091432) | **9.0.0** |
| **09-2009** | **RP#45** | RP-090826 | 239 | | | A-MPR for Band 19 | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 225 | | | LTE UTRA ACLR1 centre frequency definition for 1.4 and 3 MHz BW | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 227 | | | Harmonization of text for LTE Carrier leakage | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 229 | | | Sensitivity requirements for Band 38 15 MHz and 20 MHz bandwidths | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 236 | | | Operating band edge relaxation of maximum output power for Band 18 and 19 | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 238 | | | Addition of 5MHz channel bandwidth for Band 40 | **9.1.0** |
| **09-2009** | **RP#45** | RP-090822 | 245 | | | Removal of unnecessary requirements for 1.4 and 3 MHz bandwidths on bands 13 and 17 | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 261 | | | Correction of LTE UE ACS test parameter | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 263R1 | | | Correction of LTE UE ACLR test parameter | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 286 | | | Uplink power and RB allocation for receiver tests | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 320 | | | CR Sensitivity relaxation for small BW | **9.1.0** |

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| **09-2009** | **RP#45** | RP-090877 | 324 | | | Correction of Band 3 spurious emission band UE co-existence | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 249R1 | | | CR Pcmax definition (working assumption) | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 330 | | | Spectrum flatness clarification | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 332 | | | Transmit power: removal of TC and modification of REFSENS note | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 282R1 | | | Additional SRS relative power requirement and update of measurement definition | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 284R1 | | | Power range applicable for relative tolerance | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 233 | | | TDD UL/DL configurations for CQI reporting | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 235 | | | Further clarification on CQI test configurations | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 243 | | | Corrections to UL- and DL-RMC-s | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 247 | | | Reference measurement channel for multiple PMI requirements | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 290 | | | CQI reporting test for a scenario with frequency-selective interference | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 265R2 | | | CQI reference measurement channels | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 321R1 | | | CR RI Test | **9.1.0** |
| **09-2009** | **RP#45** | RP-090875 | 231 | | | Correction of parameters for demodulation performance requirement | **9.1.0** |
| **09-2009** | **RP#45** | RP-090875 | 241R1 | | | UE categories for performance tests and correction to RMC references | **9.1.0** |
| **09-2009** | **RP#45** | RP-090875 | 333 | | | Clarification of Ês  definition in the demodulation requirement | **9.1.0** |
| **09-2009** | **RP#45** | RP-090875 | 326 | | | Editorial corrections and updates to PHICH PBCH test cases. | **9.1.0** |
| **09-2009** | **RP#45** | RP-090875 | 259R3 | | | Test case numbering in section 8 Performance tests | **9.1.0** |
| 12-2009 | RP-46 | RP-091264 | 335 | | | Test case numbering in TDD PDSCH performance test (Technically endorsed at RAN 4 52bis in R4-093523) | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 337 | | | Adding beamforming model for user-specfic reference signal (Technically endorsed at RAN 4 52bis in R4-093525) | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 339R1 | | | Adding redundancy sequences to PMI test (Technically endorsed at RAN 4 52bis in R4-093581) | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 341 | | | Throughput value correction at FRC for Maximum input level (Technically endorsed at RAN 4 52bis in R4-093660) | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 343 | | | Correction to the modulated E-UTRA interferer (Technically endorsed at RAN 4 52bis in R4-093662) | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 345R1 | | | OCNG: Patterns and present use in tests (Technically endorsed at RAN 4 52bis in R4-093664) | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 347 | | | OCNG: Use in receiver and performance tests (Technically endorsed at RAN 4 52bis in R4-093666) | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 349 | | | Miscellaneous corrections on CSI requirements (Technically endorsed at RAN 4 52bis in R4-093676) | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 351 | | | Removal of RLC modes (Technically endorsed at RAN 4 52bis in R4-093677) | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 353 | | | CR Rx diversity requirement (Technically endorsed at RAN 4 52bis in R4-093703) | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 355 | | | A-MPR notation in NS_07 (Technically endorsed at RAN 4 52bis in R4-093706) | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 359 | | | Single- and multi-PMI requirements (Technically endorsed at RAN 4 52bis in R4-093846) | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 363 | | | CQI reference measurement channel (Technically endorsed at RAN 4 52bis in R4-093970) | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 364 | | | LTE MBSFN Channel Model (Technically endorsed at RAN 4 52bis in R4-094020) | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 367 | | | Numbering of PDSCH (User-Specific Reference Symbols) Demodulation Tests | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 369 | | | Numbering of PDCCH/PCFICH, PHICH, PBCH Demod Tests | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 371 | | | Remove [ ] from Reference Measurement Channels in Annex A | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 373R1 | | | Corrections to RMC-s for Maximum input level test for low UE categories | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 377 | | | Correction of UE-category for R.30 | 9.2.0 |
| 12-2009 | RP-46 | RP-091286 | 378 | | | Introduction of Extended LTE1500 requirements for TS36.101 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 384 | | | CR: Removal of 1.4 MHz and 3 MHz channel bandwidths from additional spurious emissions requirements for Band 1 PHS protection | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 386R3 | | | Clarification of measurement conditions of spurious emission requirements at the edge of spurious domain | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 390 | | | Spurious emission table correction for TDD bands 33 and 38. | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 392R2 | | | 36.101 Symbols and abreviations for Pcmax | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 394 | | | UTRAACLR1 requirement definition for 1.4 and 3 MHz BW completed | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 396 | | | Introduction of the ACK/NACK feedback modes for TDD requirements | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 404R3 | | | CR Power control exception R8 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 416R1 | | | Relative power tolerance: special case for receiver tests | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 420R1 | | | CSI reporting: test configuration for CQI fading requirements | 9.2.0 |

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|---|---|---|---|---|---|---|---|---|
| 12-2009 | RP-46 | RP-091284 | 421R1 | | | | Inclusion of Band 20 UE RF parameters | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 425 | | | | Editorial corrections and updates to Clause 8.2.1 FDD demodulation test cases | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 427 | | | | CR: time mask | 9.2.0 |
| 12-2009 | RP-46 | RP-091264 | 430 | | | | Correction of the payload size for PDCCH/PCFICH performance requirements | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 432 | | | | Transport format and test point updates to RI reporting test cases | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 434 | | | | Transport format and test setup updates to frequency-selective interference CQI tests | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 436 | | | | CR RI reporting configuration in PUCCH 1-1 test | 9.2.0 |
| 12-2009 | RP-46 | RP-091261 | 438 | | | | Addition of R.11-1 TDD references | 9.2.0 |
| 12-2009 | RP-46 | RP-091292 | 439 | | | | Performance requirements for LTE MBMS | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 442R1 | | | | In Band Emissions Requirements Correction CR | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 444R1 | | | | PCMAX definition | 9.2.0 |
| 03-2010 | RP-47 | RP-100246 | 453r1 | | | | Corrections of various errors in the UE RF requirements | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 462r1 | | | | UTRA ACLR measurement bandwidths for 1.4 and 3 MHz | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 493 | | | | Band 8 Coexistence Requirement Table Correction | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 489r1 | | | | Rel 9 CR for Band 14 | 9.3.0 |
| 03-2010 | RP-47 | RP-100246 | 485r1 | | | | CR Band 1- PHS coexistence | 9.3.0 |
| 03-2010 | RP-47 | RP-100247 | 501 | | | | Fading CQI requirements for FDD mode | 9.3.0 |
| 03-2010 | RP-47 | RP-100247 | 499 | | | | CR correction to RI test | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 451 | | | | Reporting mode, Reporting Interval and Editorial corrections for demodulation | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 464r1 | | | | Corrections to 1PRB PDSCH performance test in presence of MBSFN. | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 458r1 | | | | OCNG corrections | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 467 | | | | Addition of ONCG configuration in DRS performance test | 9.3.0 |
| 03-2010 | RP-47 | RP-100249 | 465r1 | | | | PDSCH performance tests for low UE categories | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 460r1 | | | | Use of OCNG in CSI tests | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 491r1 | | | | Corrections to CQI test configurations | 9.3.0 |
| 03-2010 | RP-47 | RP-100250 | 469r1 | | | | Corrections of some CSI test parameters | 9.3.0 |
| 03-2010 | RP-47 | RP-100251 | 456r1 | | | | TBS correction for RMC UL TDD 16QAM full allocation BW 1.4 MHz | 9.3.0 |
| 03-2010 | RP-47 | RP-100262 | 449 | | | | Editorial corrections on Band 19 REFSENS | 9.3.0 |
| 03-2010 | RP-47 | RP-100263 | 470r1 | | | | Band 20 UE RF requirements | 9.3.0 |
| 03-2010 | RP-47 | RP-100264 | 446r1 | | | | A-MPR for Band 21 | 9.3.0 |
| 03-2010 | RP-47 | RP-100264 | 448 | | | | RF requirements for UE in later releases | 9.3.0 |
| 03-2010 | RP-47 | RP-100268 | 445 | | | | 36.101 CR: Editorial corrections on LTE MBMS reference measurement channels | 9.3.0 |
| 03-2010 | RP-47 | RP-100268 | 454 | | | | The definition of the Doppler shift for LTE MBSFN Channel Model | 9.3.0 |
| 03-2010 | RP-47 | RP-100239 | 478r3 | | | | Modification of the spectral flatness requirement and some editorial corrections | 9.3.0 |
| 06-2010 | RP-48 | RP-100619 | 559 | | | | Corrections of tables for Additional Spectrum Emission Mask | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 538 | | | | Correction of transient time definition for EVM requirements | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 557r2 | | | | CR on UE coexistence requirement | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 547r1 | | | | Correction of antenna configuration and beam-forming model for DRS | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 536r1 | | | | CR: Corrections on MIMO demodulation performance requirements | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 528r1 | | | | Corrections on the definition of PCMAX | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 568 | | | | Relaxation of the PDSCH demodulation requirements due to control channel errors | 9.4.0 |
| 06-2010 | RP-48 | RP-100619 | 566 | | | | Correction of the UE output power definition for RX tests | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 505r1 | | | | Fading CQI requirements for TDD mode | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 521 | | | | Correction to FRC for CQI index 0 | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 516r1 | | | | Correction to CQI test configuration | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 532 | | | | Correction of CQI and PMI delay configuration description for TDD | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 574 | | | | Correction to FDD and TDD CSI test configurations | 9.4.0 |
| 06-2010 | RP-48 | RP-100620 | 571 | | | | Minimum requirements for Rank indicator reporting | 9.4.0 |
| 06-2010 | RP-48 | RP-100628 | 563 | | | | LTE MBMS performance requirements (FDD) | 9.4.0 |
| 06-2010 | RP-48 | RP-100628 | 564 | | | | LTE MBMS performance requirements (TDD) | 9.4.0 |
| 06-2010 | RP-48 | RP-100629 | 553r2 | | | | Performance requirements for dual-layer beamforming | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 524r2 | | | | CR: low Category CSI requirement | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 519 | | | | Correction of FRC reference and test case numbering | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 526 | | | | Correction of carrier frequency and EARFCN of Band 21 for TS36.101 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 508r1 | | | | Addition of PDSCH TDD DRS demodulation tests for Low UE categories | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 539 | | | | Specification of minimum performance requirements for low UE category | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 569 | | | | Addition of minimum performance requirements for low UE | 9.4.0 |

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|---|---|---|---|---|---|---|---|
| | | | | | | category TDD CRS single-antenna port tests | |
| 06-2010 | RP-48 | RP-100631 | 549r3 | | | Introduction of sustained downlink data-rate performance requirements | 9.4.0 |
| 06-2010 | RP-48 | RP-100683 | 530r1 | | | Band 20 Rx requirements | 9.4.0 |
| 09-2010 | RP-49 | RP-100920 | 614r2 | | | Add OCNG to MBMS requirements | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 599 | | | Correction of PDCCH content for PHICH test | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 597r1 | | | Beamforming model for transmission on antenna port 7/8 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 600r1 | | | Correction of full correlation in frequency-selective CQI test | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 601 | | | Correction on single-antenna transmission fixed reference channel | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 605 | | | Reference sensitivity requirements for the 1.4 and 3 MHz bandwidths | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 608r1 | | | CR for DL sustained data rate test | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 611 | | | Correction of references in section 10 (MBMS performance requirements) | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 613 | | | Band 13 and Band 14 spurious emission corrections | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 617r1 | | | Rx Requirements | 9.5.0 |
| 09-2010 | RP-49 | RP-100926 | 576r1 | | | Clarification on DL-BF simulation assumptions | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 582r1 | | | Introduction of additional Rel-9 scenarios | 9.5.0 |
| 09-2010 | RP-49 | RP-100925 | 575r1 | | | Correction to band 20 ue to ue Co-existence table | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 581r1 | | | Test configuration corrections to CQI reporting in AWGN | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 595 | | | Corrections to RF OCNG Pattern OP.1 and 2 | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 583 | | | Editorial corrections of 36.101 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 586 | | | Addition of minimum performance requirements for low UE category TDD tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 590r1 | | | Downlink power for receiver tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 591 | | | OCNG use and power in beamforming tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 593 | | | Throughput for multi-datastreams transmissions | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 588 | | | Missing note in Additional spurious emission test with NS_07 | 9.5.0 |
| 09-2010 | RP-49 | RP-100927 | 596r2 | | | CR LTE_TDD_2600_US spectrum band definition additions to TS 36.101 | 10.0.0 |
| 12-2010 | RP-50 | RP-101309 | 680 | | | Demodulation performance requirements for dual-layer beamforming | 10.1.0 |
| 12-2010 | RP-50 | RP-101325 | 672 | | | Correction on the statement of TB size and subband selection in CSI tests | 10.1.0 |
| 12-2010 | RP-50 | RP-101327 | 652 | | | Correction to Band 12 frequency range | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 630 | | | Removal of [ ] from TDD Rank Indicator requirements | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 635r1 | | | Test configuration corrections to CQI TDD reporting in AWGN (Rel-10) | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 645 | | | EVM window length for PRACH | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 649 | | | Removal of NS signalling from TDD REFSENS tests | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 642r1 | | | Correction of Note 4 In Table 7.3.1-1: Reference sensitivity QPSK PREFSENS | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 627 | | | Add 20 RB UL Ref Meas channel | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 654r1 | | | Additional in-band blocking requirement for Band 12 | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 678 | | | Further clarifications for the Sustained Downlink Data Rate Test | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 673r1 | | | Correction on MBMS performance requirements | 10.1.0 |
| 12-2010 | RP-50 | RP-101349 | 667r3 | | | CR Removing brackets of Band 41 reference sensitivity to TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101356 | 666r2 | | | Band 42 and 43 parameters for UMTS/LTE 3500 (TDD) for TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101359 | 646r1 | | | CR for CA, UL-MIMO, eDL-MIMO, CPE | 10.1.0 |
| 12-2010 | RP-50 | RP-101361 | 620r1 | | | Introduction of L-band in TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101379 | 670r1 | | | Correction on the PMI reporting in Multi-Laye Spatial Multiplexing performance test | 10.1.0 |
| 12-2010 | RP-50 | RP-101380 | 679r1 | | | Adding antenna configuration in CQI fading test case | 10.1.0 |
| 01-2011 | | | | | | Clause numbering correction | 10.1.1 |
| 03-2011 | RP-51 | RP-110359 | 695 | | | Removal of E-UTRA ACLR for CA | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 699 | | | PDCCH and PHICH performance: OCNG and power settings | 10.2.0 |
| 03-2011 | RP-51 | RP-110336 | 706r1 | | | Spurious emissions measurement uncertainty | 10.2.0 |
| 03-2011 | RP-51 | RP-110352 | 707r1 | | | REFSENSE in lower SNR | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 710 | | | PMI performance: Power settings and precoding granularity | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 715r2 | | | Definition of configured transmitted power for Rel-10 | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 717 | | | Introduction of requirement for adjacent intraband CA image rejection | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 719 | | | Minimum requirements for the additional Rel-9 scenarios | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 723 | | | Corrections to power settings for Single layer beamforming with simultaneous transmission | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 726r1 | | | Correction to the PUSCH3-0 subband tests for Rel-10 | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 730 | | | Removing the square bracket for TS36.101 | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 739 | | | Removal of square brackets for dual-layer beamforming demodulation performance requirements | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 751 | | | CR: Maximum input level for intra band CA | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 754r2 | | | UE category coverage for dual-layer beamforming | 10.2.0 |

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| 03-2011 | RP-51 | RP-110343 | 756r1 | | | Further clarifications for the Sustained Downlink Data Rate Test | 10.2.0 | |
| 03-2011 | RP-51 | RP-110343 | 759 | | | Removal of square brackets in sustained data rate tests | 10.2.0 | |
| 03-2011 | RP-51 | RP-110337 | 762r1 | | | Clarification to LTE relative power tolerance table | 10.2.0 | |
| 03-2011 | RP-51 | RP-110343 | 764 | | | Introducing UE-selected subband CQI tests | 10.2.0 | |
| 03-2011 | RP-51 | RP-110343 | 765 | | | Verification framework for PUSCH 2-2 and PUCCH 2-1 reporting | 10.2.0 | |
| 04-2011 | | | | | | Editorial: Spec Title correction, removal of “Draft” | 10.2.1 | |
| 06-2011 | RP-52 | RP-110804 | 766 | | | Add Expanded 1900MHz Band (Band 25) in 36.101 | 10.3.0 | |
| 06-2011 | RP-52 | RP-110795 | 768 | | | Fixing Band 24 inclusion in TS 36.101 | 10.3.0 | |
| 06-2011 | RP-52 | RP-110788 | 772 | | | CR: Corrections for UE to UE co-existence requirements of Band 3 | 10.3.0 | |
| 06-2011 | RP-52 | RP-110812 | 774 | | | Add 2GHz S-Band (Band 23) in 36.101 | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 782 | | | CR: Band 19 A-MPR refinement | 10.3.0 | |
| 06-2011 | RP-52 | RP-110796 | 787 | | | REFSENS in lower SNR | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 805 | | | Clarification for MBMS reference signal levels | 10.3.0 | |
| 06-2011 | RP-52 | RP-110792 | 810 | | | FDD MBMS performance requirements for 64QAM mode | 10.3.0 | |
| 06-2011 | RP-52 | RP-110787 | 814 | | | Correction on CQI mapping index of RI test | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 824 | | | Corrections to in-band blocking table | 10.3.0 | |
| 06-2011 | RP-52 | RP-110794 | 826 | | | Correction of TDD Category 1 DRS and DMRS RMCs | 10.3.0 | |
| 06-2011 | RP-52 | RP-110794 | 828 | | | TDD MBMS performance requirements for 64QAM mode | 10.3.0 | |
| 06-2011 | RP-52 | RP-110796 | 829 | | | Correction of TDD RMC for Low SNR Demodulation test | 10.3.0 | |
| 06-2011 | RP-52 | RP-110796 | 830 | | | Informative reference sensitivity requirements for Low SNR for TDD | 10.3.0 | |
| 06-2011 | RP-52 | RP-110787 | 778r1 | | | Minor corrections to DL-RMC-s for Maximum input level | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 832 | | | PDCCH and PHICH performance: OCNG and power settings | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 818r1 | | | Correction on 2-X PMI test for R10 | 10.3.0 | |
| 06-2011 | RP-52 | RP-110791 | 816r1 | | | Addition of performance requirements for dual-layer beamforming category 1 UE test | 10.3.0 | |
| 06-2011 | RP-52 | RP-110789 | 834 | | | Performance requirements for PUCCH 2-0, PUCCH 2-1 and PUSCH 2-2 tests | 10.3.0 | |
| 06-2011 | RP-52 | RP-110807 | 835r1 | | | CR  for UL MIMO and CA | 10.3.0 | |
| 09-2011 | RP-53 | RP-111248 | 862r1 | | | Removal of unnecessary channel bandwidths from REFSENS tables | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 869r1 | | | Clarification on BS precoding information field for RI FDD and PUCCH 2-1 PMI tests | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 872r1 | | | CR for B14Rx requirement Rrel 10 | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 890r1 | | | CR to TS36.101: Correction on the accuracy test of CQI. | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 893 | | | CR to TS36.101: Correction on CQI mapping index of TDD RI test | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 904 | | | Correction of code block numbers for some RMCs | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 907 | | | Correction to UL RMC for FDD and TDD | 10.4.0 | |
| 09-2011 | RP-53 | RP-111248 | 914r1 | | | Adding codebook subset restriction for single layer closed-loop spatial multiplexing test | 10.4.0 | |
| 09-2011 | RP-53 | RP-111251 | 883 | | | Sustained data rate: Correction of the ACK/NACK feedback mode | 10.4.0 | |
| 09-2011 | RP-53 | RP-111251 | 929 | | | 36.101 CR on MBSFN FDD requirements(R10) | 10.4.0 | |
| 09-2011 | RP-53 | RP-111251 | 938 | | | TDD MBMS performance requirements for 64QAM mode | 10.4.0 | |
| 09-2011 | RP-53 | RP-111252 | 895 | | | Further clarification for the dual-layer beamforming demodulation requirements | 10.4.0 | |
| 09-2011 | RP-53 | RP-111255 | 908r1 | | | Introduction of Band 22 | 10.4.0 | |
| 09-2011 | RP-53 | RP-111255 | 939 | | | Modifications of Band 42 and 43 | 10.4.0 | |
| 09-2011 | RP-53 | RP-111260 | 944 | | | CR for TS 36.101 Annex B: Static channels for CQI tests | 10.4.0 | |
| 09-2011 | RP-53 | RP-111262 | 878r1 | | | Correction of CSI reference channel subframe description | 10.4.0 | |
| 09-2011 | RP-53 | RP-111262 | 887 | | | Correction to UL MIMO | 10.4.0 | |
| 09-2011 | RP-53 | RP-111262 | 926r1 | | | Power control accuracy for intra-band carrier aggregation | 10.4.0 | |
| 09-2011 | RP-53 | RP-111262 | 927r1 | | | In-band emissions requirements for intra-band carrier aggregation | 10.4.0 | |
| 09-2011 | RP-53 | RP-111262 | 930r1 | | | Adding the operating band for UL-MIMO | 10.4.0 | |
| 09-2011 | RP-53 | RP-111265 | 848 | | | Corrections to intra-band contiguous CA RX requirements | 10.4.0 | |
| 09-2011 | RP-53 | RP-111265 | 863 | | | Intra-band contiguos CA MPR requirement refinement | 10.4.0 | |
| 09-2011 | RP-53 | RP-111265 | 866r1 | | | Intra-band contiguous CA EVM | 10.4.0 | |
| 09-2011 | RP-53 | RP-111266 | 935 | | | Introduction of the downlink CA demodulation requirements | 10.4.0 | |
| 09-2011 | RP-53 | RP-111266 | 936r1 | | | Introduction of CA UE demodulation requirements for TDD | 10.4.0 | |
| 12-2011 | RP-54 | RP-111684 | 947 | | | Corrections of UE categories of Rel-10 reference channels for RF requirements | 10.5.0 | |
| 12-2011 | RP-54 | RP-111684 | 948 | | | Alternative way to define channel bandwidths per operating band for | 10.5.0 | |
| 12-2011 | RP-54 | RP-111686 | 949 | | | CR for TS36.101: Adding note to the function of MPR | 10.5.0 | |
| 12-2011 | RP-54 | RP-111680 | 950 | | | Clarification on applying CSI reports during rank switching in RI FDD test - Rel-10 | 10.5.0 | |
| 12-2011 | RP-54 | RP-111734 | 953r1 | | | Corrections for Band 42 and 43 introduction | 10.5.0 | |
| 12-2011 | RP-54 | RP-111680 | 956 | | | UE spurious emissions | 10.5.0 | |
| 12-2011 | RP-54 | RP-111682 | 959 | | | Add scrambling identity n_SCID for MU-MIMO test | 10.5.0 | |
| 12-2011 | RP-54 | RP-111690 | 960r1 | | | P-MPR definition | 10.5.0 | |
| 12-2011 | RP-54 | RP-111693 | 962 | | | Pcmax,c Computation Assumptions | 10.5.0 | |

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|---|---|---|---|---|---|---|---|
| 12-2011 | RP-54 | RP-111733 | 963r1 | | | Correction of frequency range for spurious emission requirements | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 966 | | | General review of the reference measurement channels | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 945 | | | Corrections of Rel-10 demodulation performance requirements<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 946 | | | Corrections of UE categories for Rel-10 CSI requirements<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 982r2 | | | Introduction of SDR TDD test scenario for CA UE demodulation<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 971r1 | | | CR on Colliding CRS for non-MBSFN ABS | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 972r1 | | | Introduction of eICIC demodulation performance requirements for FDD and TDD | 10.5.0 |
| 12-2011 | RP-54 | RP-111686 | 985 | | | Adding missing UL configuration specification in some UE receiver requirements for case of 1 CC UL capable UE | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 998 | | | Correction and maintenance on CQI and PMI requirements (Rel-10) | 10.5.0 |
| 12-2011 | RP-54 | RP-111735 | 1004 | | | MPR for CA Multi-cluster | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 1005 | | | CA demodulation performance requirements for LTE FDD | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1006 | | | CQI reporting accuracy test on frequency non-selective scheduling on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1007 | | | CQI reporting accuracy test on frequency-selective scheduling on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1008 | | | PMI reporting accuracy test for TDD on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1009r1 | | | CR for TS 36.101: RI performance requirements | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1010r1 | | | CR for TS 36.101: Introduction of static CQI tests (Rel-10) | 10.5.0 |
| 03-2012 | RP-55 | RP-120291 | 1014 | | | RF: Updates and corrections to the RMC-s related annexes (Rel-10) | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1015r1 | | | On eICIC ABS pattern | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1016r1 | | | On eICIC interference models | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1017r1 | | | TS36.101 CR: on eDL-MIMO channel model using cross-polarized antennas | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1020r1 | | | TS36.101 CR: Correction to MBMS Performance Test Parameters | 10.6.0 |
| 03-2012 | RP-55 | RP-120303 | 1021 | | | Harmonic exceptions in LTE UE to UE co-ex tests | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1023 | | | Unified titles for Rel-10 CSI tests | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1033r1 | | | Introduction of reference channel for eICIC demodulation | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1040r1 | | | Correction of Actual code rate for CSI RMCs | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1041r1 | | | Definition of synchronized operation | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1048r1 | | | Intra band contiguos CA Ue to Ue Co-ex | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1049r1 | | | REL-10 CA specification editorial consistency | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1053 | | | Beamforming model for TM9 | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1054 | | | Requirement for CA demodulation with power imbalance | 10.6.0 |
| 03-2012 | RP-55 | RP-120298 | 1057 | | | Updating Band 23 duplex specifications | 10.6.0 |
| 03-2012 | RP-55 | RP-120298 | 1058r1 | | | Correcting UE Coexistence Requirements for Band 23 | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1059r1 | | | CA demodulation performance requirements for LTE TDD | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1061 | | | Requirement for CA SDR FDD test scenario | 10.6.0 |
| 03-2012 | RP-55 | RP-120293 | 1064r1 | | | TS36.101 RF editorial corrections Rel 10 | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1067r1 | | | Introduction of TM9 demodulation performance requirements | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1071r1 | | | Introduction of a CA demodulation test for UE soft buffer management testing | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1072 | | | MPR formula correction For intra-band contiguous CA Bandwidth Class C | 10.6.0 |
| 03-2012 | RP-55 | RP-120303 | 1077r1 | | | CR for 36.101: B41 REFSENS and MOP changes to accommodate single filter architecture | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1082 | | | TM3 tests for eICIC | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1083r1 | | | Introduction of requirements of CQI reporting definition for ecICIC | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1084 | | | eDL MIMO CSI requirements | 10.6.0 |
| 03-2012 | RP-55 | RP-120306 | 1070r1 | | | Introduction of Band 26/XXVI to TS 36.101 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1074 | | | Band 41 CA CR for TS36.101, section 5 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1075r1 | | | Band 41 CA CR for TS36.101, section 6 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1076 | | | Band 41 CA CR for TS36.101, section 7 | 11.0.0 |
| 06-2012 | RP-56 | RP-120795 | 1085r2 | | | Modulator specification tightening | 11.1.0 |
| 06-2012 | RP-56 | RP-120777 | 1087r1 | | | Carrier aggregation Relative power tolerance, removal of TBD. | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1089 | | | UE spurious emissions for Band 7 and Band 38 coexistence | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1092 | | | Deleting square brackets in Reference Measurement Channels | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1097 | | | CR to TS36.101: Correction on parameters for the eDL-MIMO CQI and PMI tests | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1098r1 | | | CR to TS36.101: Fixed reference channel for PDSCH demodulation performance requirements on eDL-MIMO – NOT implemented as it is based on a wrong version of the spec | 11.1.0 |

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|---|---|---|---|---|---|---|---|
| 06-2012 | RP-56 | RP-120774 | 1107 | | | RMC correction on eDL-MIMO RI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1108r1 | | | FRC correction on frequency selective CQI and PMI test (Rel-11) | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1111 | | | Correction on test point for PMI test (Rel-11) | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1114r1 | | | Corrections and clarifications on eICIC demodulation test | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1117r1 | | | Corrections and clarifications on eICIC CSI tests | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1119r1 | | | Corrections on UE performance requirements | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1120 | | | Introduction of CA band combination Band1 + Band19 to TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120769 | 1127 | | | Addition of ETU30 channel model | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1140 | | | Addition of Maximum Throughput for R.30-1 TDD RMC | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1141 | | | CR for 36.101: The clarification of MPR and A-MPR for CA | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1142 | | | Corrections for eICIC demod test case with MBSN ABS | 11.1.0 |
| 06-2012 | RP-56 | RP-120785 | 1144 | | | Removing brackets of contiguous allocation A-MPR for CA_NS_04 | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1149r1 | | | Introduction of PDCCH test with colliding RS on MBSFN-ABS | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1153r1 | | | Some clarifications and OCNG pattern for eICIC demodulation requirements | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1155 | | | Introduction of TDD CA Soft Buffer Limitation | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1156 | | | B26 and other editorial corrections | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1161 | | | Corrections on CQI and PMI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1163 | | | FRC for TDD PMI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1165r1 | | | Clean-up of UL-MIMO for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1171 | | | Removal of unnecessary references to single carrier requirements from Interband CA subclauses | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1174 | | | PDCCH wrong detection in receiver spurious emissions test | 11.1.0 |
| 06-2012 | RP-56 | RP-120776 | 1184 | | | Corrections to 3500 MHz | 11.1.0 |
| 06-2012 | RP-56 | RP-120793 | 1189r2 | | | Introduction of Band 44 | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1193r1 | | | Target SNR setting for eICIC demodulation requirement | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1196 | | | Editorial simplification to CA REFSENS UL allocation table | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1199 | | | Correction of wrong table refernces in CA receiver tests | 11.1.0 |
| 06-2012 | RP-56 | RP-120791 | 1200r1 | | | Introduction of e850_LB (Band 27) to TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120764 | 1212 | | | Correction of PHS protection requirements for TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120793 | 1213r1 | | | Introduction of Band 28 into TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1215r1 | | | Proposed revision of subclause 4.3A for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1217r1 | | | Proposed revision on subclause 6.3.4A for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1219r1 | | | Aligning requirements between Band 18 and Band 26 in TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1221 | | | SNR definition | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1223 | | | Correction of CSI configuraiton for CA TM4 tests R11 | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1225 | | | CR on CA UE receiver timing window R11 | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1226 | | | Extension of static eICIC CQI test | 11.1.0 |
| 09-2012 | RP-57 | RP-121294 | 1230 | | | Correct Transport Block size in 9RB 16QAM Uplink Reference Measurement Channel | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1233r1 | | | RF: Corrections to power allocation parameters for transmission mode 8 (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1235 | | | RF-CA: non-CA notation and applicability of test points in scenarios without and with CA operation (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1237 | | | ACK/NACK feedback modes for FDD and TDD TM4 CA demodulation requirements (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1239 | | | Correction of feedback mode for CA TDD demodulation requirements (resubmission of R4-63AH-0194 for Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1241 | | | ABS pattern setup for MBSFN ABS test (resubmission of R4-63AH-0204 for Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1243 | | | CR on eICIC CQI definition test (resubmission of R4-63AH-0205 for Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1245 | | | Transmission of CQI feedback and other corrections (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1247 | | | Target SNR setting for eICIC MBSFN-ABS demodulation requirements (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121335 | 1248 | | | Introduction of CA_1_21 RF requirements into TS36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121300 | 1251 | | | Corrections of spurious emission band UE co-existence applicable in Japan | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1253 | | | Correction on RMC for frequency non-selective CQI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1255 | | | Requirements for the eDL-MIMO CQI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1257 | | | Clarification on PDSCH test setup under MBSFN ABS | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1258 | | | Update of Band 28 requirements | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1262 | | | Applicabilty of statement allowing RBW < Meas BW for spurious | 11.2.0 |
| 09-2012 | RP-57 | RP-121298 | 1265 | | | Clarification of RB allocation for DRS demodulation tests | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1267 | | | Removal of brackets for CA Tx | 11.2.0 |
| 09-2012 | RP-57 | RP-121337 | 1268r1 | | | TS 36.101 CR for CA_38 | 11.2.0 |
| 09-2012 | RP-57 | RP-121327 | 1269 | | | Introduction of CA_B7_B20 in 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1271 | | | Corrections of FRC subframe allocations and other minor problems | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1274 | | | Introduction of requirements for TDD CA Soft Buffer Limitation | 11.2.0 |

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| 09-2012 | RP-57 | RP-121307 | 1276 | | | Correction of eDL-MIMIO CSI RMC tables and references | 11.2.0 |
| 09-2012 | RP-57 | RP-121307 | 1278 | | | Correction of MIMO channel model for polarized antennas | 11.2.0 |
| 09-2012 | RP-57 | RP-121303 | 1280 | | | Addition of 15 and 20MHz Bandwidths for Band 23 to TS 36.101 (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121334 | 1283r1 | | | Add requirements for inter-band CA of B_1-18 and B_11-18 in TS36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1285r1 | | | CR for MPR mask for multi-clustered simultaneous transmission in single CC in Rel-11 | 11.2.0 |
| 09-2012 | RP-57 | RP-121447 | 1288r2 | | | Introduction of Japanese Regulatory Requirements to LTE Band 8(R11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1289 | | | CR for Band 27 MOP | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1290 | | | CR for Band 27 A-MPR | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1291 | | | CR to replace protected frequency range with new band number 27 | 11.2.0 |
| 09-2012 | RP-57 | RP-121215 | 1292r1 | | | Introduction of CA band combination Band3 + Band5 to TS 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1300r1 | | | Requirements for eDL-MIMO RI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1304 | | | Corrections to TM9 demodulation tests | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1306 | | | Correction to PCFICH power parameter setting | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1310r1 | | | Correction on frequency non-selective CQI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1313r1 | | | eDL-MIMO CQI/PMI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1316 | | | Correction of the definition of unsynchronized operation | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1320r1 | | | Correction to Transmit Modulation Quality Tests for Intra-Band CA | 11.2.0 |
| 09-2012 | RP-57 | RP-121338 | 1324r2 | | | 36.101 CR for LTE_CA_B7 | 11.2.0 |
| 09-2012 | RP-57 | RP-121331 | 1325 | | | Introduction of CA_3_20 RF requirements into TS36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1326 | | | A-MPR table correction for NS_18 | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1332r1 | | | Bandwidth combination sets for intra-band and inter-band carrier aggregation | 11.2.0 |
| 09-2012 | RP-57 | RP-121325 | 1339 | | | Introduction of LTE Advanced Carrier Aggregation of Band 4 and Band 13 | 11.2.0 |
| 09-2012 | RP-57 | RP-121326 | 1340r1 | | | Introduction of CA configurations CA-12A-4A and CA-17A-4A | 11.2.0 |
| 09-2012 | RP-57 | RP-121324 | 1341 | | | Introduction of CA_B3_B7 in 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121328 | 1343 | | | Introduction of Band 2 + Band 17 inter-band CA configuration into 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1351 | | | FRC for TM9 FDD | 11.2.0 |
| 09-2012 | RP-57 | RP-121295 | 1352 | | | Random precoding granularity in PMI tests | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1358 | | | Introduction of RI test for eICIC | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1360 | | | Notes for deltaTib and deltaRib tables | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1361 | | | CR for A-MPR masks for NS_CA_1C | 11.2.0 |
| 12-2012 | RP-58 | RP-121884 | 1362 | | | Introduction of CA_3_8 RF requirements to TS 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121870 | 1363 | | | Removal of square brackets for Band 27 in Table 5.6.1-1 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1366 | | | Some changes related to CA tests and overview table of DL measurement channels | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1368 | | | Correction of eICIC CQI tests | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1370 | | | Correction of eICIC demodulation tests | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1374 | | | Correction on CSI-RS subframe offset parameter | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1376 | | | Correction on FRC table in CSI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1382 | | | Correction of reference channel table for TDD eDL-MIMIO RI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121850 | 1386 | | | OCNG patterns for Sustained Data rate testing | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1388r1 | | | Introduction of one periodic CQI test for CA deployments | 11.3.0 |
| 12-2012 | RP-58 | RP-121894 | 1396 | | | Introduction of CA_B5_B12 in 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121850 | 1401 | | | Introducing the additional frequency bands of 5 MHz x 2 in 1.7 GHz in Japan to Band 3 | 11.3.0 |
| 12-2012 | RP-58 | RP-121887 | 1406r1 | | | Reference sensitivity for the small bandwidth of CA_4-12 | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1407 | | | CR on eICIC RI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1409 | | | Cleaning of 36.101 Performance sections Rel-11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1416 | | | Out-of-band blocking requirements for inter-band carrier aggregation | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1418 | | | Adding missed SNR reference values for CA soft buffer tests | 11.3.0 |
| 12-2012 | RP-58 | RP-121890 | 1422 | | | Introduction of CA_4A-5A into 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1431 | | | Clean up of specification R11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1436 | | | Band 1 to Band 33 and Band 39 UE coexistence requirements | 11.3.0 |
| 12-2012 | RP-58 | RP-121871 | 1437r1 | | | Editorial corrections for Band 26 | 11.3.0 |
| 12-2012 | RP-58 | RP-121896 | 1438 | | | Introduction of Band 5 + Band 17 inter-band CA configuration into 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1442 | | | Correction of eDL-MIMO RI test and RMC table for the CSI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1444 | | | Minor correction to ceiling function example - rel11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1449 | | | Correction of SNR definition | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1450 | | | Brackets clean up for eICIC CSI/demodulation | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1455 | | | CR on eICIC RI testing (Rel-11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1459 | | | Correction on FRC table | 11.3.0 |
| 12-2012 | RP-58 | RP-121879 | 1461r1 | | | CR for LTE_B14 HPUE (Power Class 1 ) | 11.3.0 |

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| 12-2012 | RP-58 | RP-121862 | 1464 | | | Adding references to the appropriate beamforming model (Rel-11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121898 | 1465r1 | | | Introduction of CA_8_20 RF requirements into TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121882 | 1468r1 | | | Introduction of inter-band CA_11-18 into TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1472r1 | | | Introduction of advanced receivers demodulation performance (FDD) | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1473r1 | | | Introduction of performance requirements for verifying the receiver type for advanced receivers (FDD/TDD) | 11.3.0 |
| 12-2012 | RP-58 | RP-121886 | 1474 | | | CR to remove the square bracket of A-MPR in TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1476 | | | Correction of some errors in reference sensitivity for CA in TS 36.101 (R11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1480r1 | | | Introduction of Advanced Receivers Test Cases for TDD | 11.3.0 |
| 12-2012 | RP-58 | RP-121901 | 1490r1 | | | Introduction of Band 29 | 11.3.0 |
| 12-2012 | RP-58 | RP-121849 | 1494 | | | Low-channel Band 1 coexistence with PHS | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1498r1 | | | Completion of the tables of bandwidth combinations specified for CA | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1499r1 | | | Exceptions to REFSENS requrirements for class A2 CA combinations | 11.3.0 |
| 12-2012 | RP-58 | RP-121892 | 1500 | | | Introduction of carrier aggregation configuration CA_4-7 | 11.3.0 |
| 12-2012 | RP-58 | RP-121870 | 1504 | | | Editorial corrections to Band 27 specifications | 11.3.0 |
| 12-2012 | RP-58 | RP-121878 | 1505 | | | Band 28 AMPR for DTV protection | 11.3.0 |
| 12-2012 | RP-58 | RP-121852 | 1509r1 | | | UE-UE coexistence between bands with small frequency separation | 11.3.0 |
| 12-2012 | RP-58 | RP-121911 | 1510 | | | Adding UE-UE Coexistence Requirement for Band 3 and Band 26 | 11.3.0 |
| 12-2012 | RP-58 | RP-121866 | 1513 | | | Maintenance of Band 23 UE Coexistence | 11.3.0 |
| 12-2012 | RP-58 | RP-121851 | 1515 | | | Corrections to TM4 rank indicator Test 3 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1517 | | | Correction of test configuraitons and FRC for CA demodulation with power imbalance | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1518 | | | Applicable OFDM symbols of Noc_2 for PDCCH/PCFICH ABS-MBSFN test cases | 11.3.0 |
| 03-2013 | RP-59 | RP-130279 | 1519 | | | OCNG patterns for Enhanced Performance Requirements Type A | 11.4.0 |
| 03-2013 | RP-59 | RP-130277 | 1520 | | | Corrections on in-band blocking for Band 29 for carrier aggregation | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1523 | | | Brackets removal in Rel-11 TM4 rank indicator Test 3 | 11.4.0 |
| 03-2013 | RP-59 | RP-130279 | 1524r1 | | | Cleanup of Advanced Receivers requirement scenarios for demodulation and CSI (FDD/TDD) | 11.4.0 |
| 03-2013 | RP-59 | RP-130258 | 1528 | | | Corrections to CQI reporting | 11.4.0 |
| 03-2013 | RP-59 | RP-130262 | 1536 | | | Corrections for eICIC performance requirements (rel-11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1539 | | | Correction of CA power imbalance performance requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1543 | | | Correction of a symbol for MPR in single carrier for TS 36.101(R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1544r1 | | | Correction of some inter-band CA requiements for TS 36.101 (R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130276 | 1546 | | | Correction of contigous allocation A-MPR for CA_NS_05 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1547r1 | | | Clarification of spurious emission domain for CA in TS 36.101 (R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1548 | | | CR for CA performance requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130284 | 1553r1 | | | Introduction of downlink non-contiguous CA into REL -11 TS 36.101 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1557 | | | CA_1C: CA_NS_02 and CA_NS_03 A-MPR REL-11 | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1560 | | | Editorial corrections to subclause 5 | 11.4.0 |
| 03-2013 | RP-59 | RP-130267 | 1562 | | | Addition of UE Regional Requirements to Band 23 Based on New Regulatory Order in the US | 11.4.0 |
| 03-2013 | RP-59 | RP-130272 | 1567 | | | Band 26: modification of A-MPR for 'NS_15' | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1571r1 | | | Band 41 requirements for operation in China and Japan | 11.4.0 |
| 03-2013 | RP-59 | RP-130260 | 1574 | | | Remove [ ] from CSI test case parameters | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1575 | | | Corrections to UE co-existence | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1579 | | | UE-UE co-existence between Band 1 and Band 33/39 | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1580 | | | Correction on reference to note for Band 7 and 38 co-existence | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1584r1 | | | Cleanup for CA UE RF requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1586 | | | Corrections on UL configuration for CA UE receiver requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1588 | | | Correction of Transmit modulation quality requirements for CA | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1590 | | | Revision of Common Test Parameters for User-specific Demodulation Tests | 11.4.0 |
| 03-2013 | RP-59 | RP-130278 | 1595 | | | Correction for a Band 27 A-MPR table | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1597 | | | Correction of CA CQI test setup | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1600r1 | | | Correction of B12 DL Specification in Table 5.5A-2 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1602 | | | Correction of table reference | 11.4.0 |
| 06-2013 | RP-60 | RP-130765 | 1604r1 | | | Complementary description for definition of MIMO Correlation Matrices using cross polarized antennas | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1607 | | | Correction of transport format parameters for CQI index 10 (15 | 11.5.0 |

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| 06-2013 | RP-60 | RP-130765 | 1610 | | | Maintenance of Band 23 A-MPR (NS_11) in TS 36.101 (Rel-11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1613 | | | CR for 36.101 : Adding the definition of CA_NS_05 and CA_NS_06 for additional spurious emissions for CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1619 | | | CR for introducing UE TM3 demodulation performance requirements under high speed | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1623 | | | Correction of test parameters for eICIC performance requirements | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1625 | | | Correction of test parameters for eICIC CSI requirements | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1627 | | | Correction of resource allocation for the multiple PMI Cat 1 UE test | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1629 | | | Removal of note 2 from band 28 | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1641 | | | Correction of the CSI-RS parameter configuration | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1650r1 | | | Addition of Band 41 for intra-band non-contiguous CA for 36.101 | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1654r1 | | | MPR for intra-band non-contiguous CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1656 | | | Modification of configured output power to account for larger tolerance | 11.5.0 |
| 06-2013 | RP-60 | RP-130769 | 1658r1 | | | Missing symbols in the NS_15 table | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1673 | | | Corrections to Rx requirements for inter-band CA configurations with REFSENS exceptions | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1681r1 | | | Correction for TS 36.101 | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1684 | | | RF: Corrections to RMC-s for sustained data rate test | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1685 | | | Non-contiguous intraband CA channel spacing | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1689 | | | Carrier aggregation in multi RAT and multiple band combination terminals | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1691 | | | Completion of out-of-band blocking requirements for inter-band CA with one UL | 11.5.0 |
| 06-2013 | RP-60 | RP-130767 | 1695r1 | | | CR on the bandwidth coverage issue of CA demodulation performance (Rel-11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1697 | | | Correction on UE maximum output power for intra-band CA (R11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1698r1 | | | CR for introduction of FeICIC demodulation performance requirements | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1701 | | | Removing bracket from CA_11A-18A requirments | 11.5.0 |
| 06-2013 | RP-60 | RP-130767 | 1703 | | | CR on the bandwidth coverage issue of CA CQI performance (Rel-11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1705 | | | Corrections to ACLR for Rel-11 CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1716 | | | Corrections to NS_11 A-MPR Table | 11.5.0 |
| 06-2013 | RP-60 | RP-130769 | 1717 | | | Corrections to NS_12 A-MPR Table | 11.5.0 |
| 09-2013 | RP-61 | RP-131285 | 1731r1 | | | CR on performance requirements of CA soft buffer managemen (Rel-11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1735 | | | CR on applicability of CA sustained data rate tests (Rel-11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131293 | 1738r1 | | | Performance requirement for UE under EVA200 | 11.6.0 |
| 09-2013 | RP-61 | RP-131290 | 1742r1 | | | CR for introduction of FeICIC PBCH performance requirement | 11.6.0 |
| 09-2013 | RP-61 | RP-131290 | 1744r1 | | | CR for introduction of FeICIC RI reporting requirements | 11.6.0 |
| 09-2013 | RP-61 | RP-131292 | 1746 | | | Beamforming model for EPDCCH test | 11.6.0 |
| 09-2013 | RP-61 | RP-131285 | 1753r1 | | | Introduction of performance requirements for verifying the receiver type for CSI-RS based advanced receivers (FDD/TDD) | 11.6.0 |
| 09-2013 | RP-61 | RP-131285 | 1754r1 | | | CR for 36.101 : Add the definition of 5+20MHz for spectrum emission mask for CA | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1766 | | | UE REFSENS when supporting intra-band CA and inter-band CA | 11.6.0 |
| 09-2013 | RP-61 | RP-131279 | 1771 | | | Correlation matrix for high speed train demodulation scenarios (Rel-11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131280 | 1775 | | | Corrections to sustained data rate test (Rel-11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131290 | 1785r1 | | | CR for introduction of FeICIC CQI requirements | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1793 | | | Clarification of multi-cluster transmission | 11.6.0 |
| 09-2013 | RP-61 | RP-131293 | 1799r1 | | | CA UE Coexistence Table update (Release 11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131302 | 1801 | | | Coexistence between Band 27 and Band 38 (Release 11) | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1806 | | | Incorrect REFSENS UL allocation for CA_1C | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1810 | | | Contiguous intraband CA REFSENS with one UL | 11.6.0 |
| 09-2013 | RP-61 | RP-131293 | 1812r1 | | | Remianed Transmitter requirements for intra-band non-contiguous CA | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1816 | | | Correction to Rel-11 A-MPR for CA_NS_04 | 11.6.0 |
| 09-2013 | RP-61 | RP-131281 | 1820 | | | The Pcmax clauses restructured | 11.6.0 |
| 09-2013 | RP-61 | RP-131285 | 1830 | | | MPR for intra-band non-contiguous CA | 11.6.0 |
| 12-2013 | RP-62 | RP-131928 | 1846r1 | | | Corrections to the notes in the band UE co-existence requirements table (Rel-11) | 11.7.0 |
| 12-2013 | RP-62 | RP-131924 | 1851 | | | Clean-up of uplink reference measurement channels (Rel-11) | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1853r2 | | | Introduction of test 1-A for CoMP | 11.7.0 |
| 12-2013 | RP-62 | RP-131931 | 1866 | | | CA_NS_05 Emissions | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 1868 | | | NS signaling for CA refsens | 11.7.0 |
| 12-2013 | RP-62 | RP-131928 | 1876r2 | | | Intraband CA channel bandwidth combination table restructuring | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1879 | | | CR Minimum requirement with Same Cell ID (with multiple NZP | 11.7.0 |

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| | | | | | | CSI-RS resources) | |
| 12-2013 | RP-62 | RP-131939 | 1886 | | | CR on correction of definition on Fraction of Maximum Throughput for CA | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 1888 | | | CR on correction of test configurations of CA soft buffer tests | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 1892r1 | | | CR for FeICIC demodulation performance requirements | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 1894r3 | | | CR on FeICIC PBCH performance requirement | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 1896r3 | | | CR on RI reporting requirement | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 1898 | | | Beamforming model for EPDCCH localized test | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 1900 | | | Downlink physical setup for EPDCCH test | 11.7.0 |
| 12-2013 | RP-62 | RP-131926 | 1903 | | | Correction on the UE category for eICIC CQI test | 11.7.0 |
| 12-2013 | RP-62 | RP-131931 | 1905 | | | CR for receiver type verification test of CSI-RS based advanced receivers (Rel-11) | 11.7.0 |
| 12-2013 | RP-62 | RP-131928 | 1915r2 | | | Allowed power reductions for multiple transmissions in a subframe | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 1925r2 | | | Introduce high SNR TM3 test for FeICIC PDSCH | 11.7.0 |
| 12-2013 | RP-62 | RP-131927 | 1933r1 | | | CR on correction of FRC of power imbalance test | 11.7.0 |
| 12-2013 | RP-62 | RP-131927 | 1936 | | | UE-UE coexistence for Band 40 | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1939r2 | | | CR to Introduce fading CQI test for CoMP (FDD) | 11.7.0 |
| 12-2013 | RP-62 | RP-131927 | 1944 | | | CR Removing Addition of $\Delta$Tc to P-MPR | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1954r2 | | | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource) | 11.7.0 |
| 12-2013 | RP-62 | RP-131931 | 1960 | | | CA performance requirements for TDD intra-band NC CA | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 1961r1 | | | Introduction of reference SNR-s for FeICIC demodulation performance requirements | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 1963 | | | OCNG pattern for EPDCCH test | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 1967r1 | | | Introduction of UE TM3 demodulation performance requirements under ETU300 | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1969r1 | | | Introduction of test 1-A for CoMP TDD | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 1971 | | | Modification of TM9 test to verify correct SNR estimation | 11.7.0 |
| 12-2013 | RP-62 | RP-131928 | 1983r1 | | | Correction to blocking requirements and use of $\Delta R_{IB}$ | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 1987r1 | | | CR on test point clarification for CA demodulation test | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1993r1 | | | CR to Introduce fading CQI test for CoMP (TDD) | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1995 | | | CR to Introduce channel model for CoMP fading CQI tests | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 1997r1 | | | CR to Introduce RI test for CoMP (FDD) | 11.7.0 |
| 12-2013 | RP-62 | RP-131924 | 1999r1 | | | Simplification of Band 12/17 in-band blocking test cases | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 2000r1 | | | Distributed EPDCCH Demodulation Test | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 2002r1 | | | Localized EPDCCH Demodulation Test | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 2004r1 | | | Reference Measurement Channels for EPDCCH | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 2006r1 | | | Introduction of DL CoMP FDD static CQI test | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 2008r1 | | | Introduction of DL CoMP TDD static CQI test | 11.7.0 |
| 12-2013 | RP-62 | RP-131924 | 2013 | | | P-max for Band 38 to Band 7 coexistence | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 2023r2 | | | Minimum requirement with Same Cell ID (with multiple NZP CSI-RS resources) TDD | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 2025r2 | | | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource) TDD | 11.7.0 |
| 12-2013 | RP-62 | RP-131936 | 2027 | | | Editoral change on FeICIC PBCH Noc setup | 11.7.0 |
| 12-2013 | RP-62 | RP-131931 | 2034r1 | | | Correction of nominal guard bands for bandwidth classes A and C | 11.7.0 |
| 12-2013 | RP-62 | RP-131937 | 2041r1 | | | CR to Introduce RI test for CoMP (TDD) | 11.7.0 |
| 12-2013 | RP-62 | RP-131931 | 2044 | | | Correction of TDD PCFICH/PDCCH test parameter table | 11.7.0 |
| 12-2013 | RP-62 | RP-131939 | 2046 | | | Add EVA200 to table of channel model parameters | 11.7.0 |
| 12-2013 | RP-62 | RP-131926 | 2058 | | | CA_1C: Correction on CA_NS_02 A-MPR table | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 2065 | | | Introduction of EPDCCH TM10 localized test R-11 | 11.7.0 |
| 12-2013 | RP-62 | RP-131938 | 2067 | | | Introduction of SDR test for PDSCH with EPDCCH scheduling | 11.7.0 |
| 03-2014 | RP-63 | RP-140368 | 2091r1 | | | CR for maintanence of CA soft buffer tests in Rel-11 | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2096r1 | | | CR on TM9 localized ePDCCH test | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2100r1 | | | CR on reference measurement channel for ePDCCH test | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2105 | | | Cleanup of the specification for FeICIC (Rel-11) | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2107r1 | | | UL-DL configuration and other parameters for FeICIC TDD CQI fading test (Rel-11) | 11.8.0 |
| 03-2014 | RP-63 | RP-140375 | 2088 | | | CR for introduction of 15MHz based SDR tests in Rel-11 | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2109r1 | | | CR for TS36.101 COMP demodulation requirements | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2111r1 | | | CR for Combinations of channel model parameters | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2112 | | | CR for EPDCCH power allocation (Rel-11) | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2085 | | | CR on reference measurement channel for TM10 PDSCH demodulation test | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2073r1 | | | CR of EPDCCH localzied test with TM10 QCL Type-B configuration (Rel-11) | 11.8.0 |
| 03-2014 | RP-63 | RP-140368 | 2146 | | | Correction of coding rate for 18RBs in UL RMC table | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2130r1 | | | CR to finalize RI test for CoMP | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2162r1 | | | Distributed EPDCCH Demodulation Test | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2128r1 | | | CR to finalize fading CQI test for CoMP | 11.8.0 |
| 03-2014 | RP-63 | RP-140370 | 2159r1 | | | Correction of table notes for NS_12-NS_15 spurious emissions requirements | 11.8.0 |

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| 03-2014 | RP-63 | RP-140368 | 2136 | | | Configured transmitted power for CA | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2143r1 | | | Channel spacing for non-contiguous intra-band carrier aggregation | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2141 | | | Clarification of contiguous and non-contiguous intra-band UE capabilities in the same band | 11.8.0 |
| 03-2014 | RP-63 | RP-140368 | 2158 | | | Correction of a table note for Pcmax | 11.8.0 |
| 03-2014 | RP-63 | RP-140368 | 2121 | | | CR for 36.101. Editorial correction on OCNG pattern | 11.8.0 |
| 03-2014 | RP-63 | RP-140374 | 2124r1 | | | CR on correction of downlink SDR tests with EPDCCH scheduling | 11.8.0 |
| 03-2014 | RP-63 | RP-140375 | 2118 | | | Introduction of requirements for SNR test for TM9 | 11.8.0 |
| 03-2014 | RP-63 | RP-140371 | 2126r2 | | | Correction on DL CoMP static CQI tests (Rel 11) | 11.8.0 |
| 06-2014 | RP-64 | RP-140909 | 2176r2 | | | RF: Corrections to spurious emission requirements with NS different than NS_01 (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2197r1 | | | CR on correction on TDD IRC CQI test | 11.9.0 |
| 06-2014 | RP-64 | RP-140917 | 2206r1 | | | CR of EPDCCH localzied test with TM10 QCL Type-B configuration (Rel-11): correction of CSI-RS configurations | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2208 | | | Clean up of TM9 SNR tests | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2214r1 | | | Correction of UE TM3 demodulation performance requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140917 | 2215r1 | | | CR for EPDCCH test (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2217r1 | | | CR of modification on FeICIC rank testing (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2219r1 | | | CR on FeICIC PBCH performance requirement (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2221r1 | | | Correction on out-of-band blocking for CA | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2225 | | | Update demodualtion performance requirements with new UE categories | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2227r1 | | | Correction for CA sustained data rate test (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2230r1 | | | CR on OCNG and propagation conditions for dual layer TM9 test | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2232 | | | Clarification of Intra-band contiguous CA class C Narrow band blocking requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2238 | | | Correction for CA soft buffer test (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2246r1 | | | Remove [ ] from eICIC TDD RI requirement | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2255 | | | Verification of exceptions of REFSENS requirements for carrier aggregation | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2257 | | | Applicability of exceptions to reference sensitivity requirements for CA | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2261r1 | | | Editorial corrections for UE performance requirments for R11 | 11.9.0 |
| 06-2014 | RP-64 | RP-140909 | 2268 | | | In-band blocking case nubering re-establisment | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2272 | | | CR for TS36.101 FRC tables for COMP demodulation requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2281r1 | | | Finalization of CoMP demodulation test cases | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2285 | | | CR for finalizing DL COMP CSI reporting requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2287r1 | | | CR for adding DL CoMP CSI RMC tables (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2313 | | | UE to UE co-existence between B42/B43 | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2317 | | | Perf: Corrections to CA (Class C) performance with power imbalance (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2320r1 | | | CR of modification on FeICIC rank testing (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2322r1 | | | CR of introducing FeICIC TM9 testing (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140917 | 2324r1 | | | CR for EPDCCH SDR test (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2327 | | | Clean-up CR for demodulation requirements (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2332 | | | Throughput calculation for eICIC demodulation requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2334r1 | | | Introduction of Band 28 requirements for flexible operation in Japan | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2336r1 | | | Add missing Uplink downlink configuration to eICIC TDD RI requirement | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2340 | | | Cleanup of terminology for Rx requirements | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2343 | | | CR on separating CA UE demodulation tests from single carrier tests in Rel-11 | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2350 | | | Test configuration for intra-band contiguous carrier aggregation power control | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2361r1 | | | Correction of test configurations for intra-band non-contiguous aggregation | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2364 | | | Clarification on CA bandwidth classes | 11.9.0 |
| 06-2014 | RP-64 | RP-140917 | 2373 | | | CR on correction of downlink SDR tests with EPDCCH scheduling | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2376 | | | Corrections on CA CQI tests | 11.9.0 |
| 06-2014 | RP-64 | RP-140911 | 2386r1 | | | CR on PDSCH transmission for eICIC CSI requirements (Rel-11) | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2390 | | | CA_7C A-MPR Corrections | 11.9.0 |
| 06-2014 | RP-64 | RP-140918 | 2393 | | | CR for TS36.101 CSI RMC table | 11.9.0 |
| 06-2014 | RP-64 | RP-140914 | 2424 | | | CR on correction for TM10 CSI reporting requirements | 11.9.0 |
| 09-2014 | RP-65 | RP-141525 | 2503 | | | Perf: Cleanup and better description of DL-RMC-s with dynamic coding rate for CSI requirements (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141525 | 2564 | | | Corrections to UE coex table | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2433 | | | Correction on support of a bandwidth combination set | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2465 | | | Unequal DL CC RB allocations in Maximum input level | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2468 | | | Intra-band contiguous CA ACS case 2 test clarification | 11.10.0 |

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| 09-2014 | RP-65 | RP-141527 | 2483 | | | Corrections on delta Tc for UE MOP for intra-band contiguous CA | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2486 | | | Removal of Class B in UE TX requirement | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2515r1 | | | CR for CA applicability rule in 36.101 in Rel-11 | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2518 | | | Editorial CR for CA performance tests in 36.101 in Rel-11 | 11.10.0 |
| 09-2014 | RP-65 | RP-141527 | 2547 | | | Correction to NS_20 A-MPR for Band 23 | 11.10.0 |
| 09-2014 | RP-65 | RP-141530 | 2446r1 | | | CR of introducing FeICIC TM9 testing (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141530 | 2453 | | | Maintenance of CoMP demodulation performance requirements (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141530 | 2455 | | | Clean-up CR for EPDCCH and FeICIC PBCH (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141530 | 2470 | | | Throughput calculation for feICIC demodulation requirements | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2438 | | | CR on correction on CQI reporting TDD CSI meas in case two CSI subframe sets with CRS test (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2440 | | | CR on correction on RI reporting CSI meas in case two CSI subframe sets with CRS tests (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2443 | | | Clarification of high speed train scenario in 36.101 (Rel-11) | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2472r1 | | | Max input for Intra-band non-contiguous CA | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2477 | | | CQI reporting under fading: CQI indices in set | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2489 | | | Correction on A-MPR table | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2498 | | | RF: Corrections to spurious emission band co-existence requirement for Band 44 | 11.10.0 |
| 09-2014 | RP-65 | RP-141532 | 2521 | | | CR on CA power imbalance tests in Rel-11 | 11.10.0 |
| 12-2014 | RP-66 | RP-142144 | 2573 | | | CR for REFSENSE in lower SNR and change history | 11.11.0 |
| 12-2014 | RP-66 | RP-142142 | 2586 | | | CR for 1 PRB allocation performance in presence of MBSFN (rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2589 | | | Maintenance of CA demodulation performance requirements (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2591 | | | Clean up for FeICIC demodulation performance requirements (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2628 | | | CR to fix error of CA capability for CA performance tests in 36.101 in Rel-11 | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2633 | | | Editorial CR for UL configuration table for intra-band contiguous and non-contiguous CA in 36.101, Rel-11 | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2636 | | | Defintion of the bits in the bitmap for indication of modified MPR behavior | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2660 | | | Maintenance of TM10 demodulation test configurations on PQI set and ZP-CSIRS ( Rel-11 test 8.3.1.3.2, 8.3.2.4.2 ) | 11.11.0 |
| 12-2014 | RP-66 | RP-142149 | 2608r1 | | | Correction on UE TM3 demodulation performance requirements | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2619r1 | | | CQI reporting in AWGN: CQI indices in set | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2670r1 | | | Correction of CoMP TDD CSI tests (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2640r1 | | | Applicability of in-gap and out-of-gap measurements for intra-band NC CA | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2699 | | | Delete the incorrect notes for FDD DMRS demodulation tests (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2719 | | | Band 22 correction in UE to UE co-existance table. | 11.11.0 |
| 12-2014 | RP-66 | RP-142148 | 2707r1 | | | Introduction of minimum requirements for intra-band NC CA with timing offset | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2726r1 | | | CR for CA applicability rule in 36.101 in Rel-11 | 11.11.0 |
| 12-2014 | RP-66 | RP-142149 | 2675r1 | | | CR to remove CA capability column in CA performance test tables (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142149 | 2677r1 | | | CR to specify applicability of CoMP RI test (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2746r1 | | | TS36.101 removal of brackets (RF) | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2754 | | | Correction to Transmit Modulation Quality for CA | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2709r1 | | | Clarification of UL and DL CA configuration | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2716r1 | | | Clarification of notes relating to interferer offsets in intraband CA receiver requirement tables. | 11.11.0 |
| 12-2014 | RP-66 | RP-142147 | 2734r1 | | | Band 28 and NS_24 | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2757 | | | Correction to Note 2 of Harmonic Signal Exceptions in Spurious Emissions | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2750r1 | | | Removal of brackets and TBD from CA feature | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2687r1 | | | Removal of bracket for UL MIMO | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2696r1 | | | Maintenance of CA performance requirements (Rel-11) | 11.11.0 |
| 12-2014 | RP-66 | RP-142144 | 2703r2 | | | UE to UE co-existence between B42/B43 | 11.11.0 |
| 03-2015 | RP-67 | RP-150384 | 2763 | | | Correction for timing offset test for intraband non-contiguous CA | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2778 | | | Modification of CSI reference measurement channel Rel-11 | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2782 | | | Editorial correction on symbols for enhanced performance requirements type A | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2796 | | | UL HARQ in PDSCH and PDCCH/PCFICH demod test cases for eICIC/feICIC with MBSFN ABS | 11.12.0 |
| 03-2015 | RP-67 | RP-150382 | 2799 | | | Correction to eICIC aggressor cell configurations | 11.12.0 |
| 03-2015 | RP-67 | RP-150382 | 2804 | | | Removal of eDL-MIMO term from specification | 11.12.0 |
| 03-2015 | RP-67 | RP-150382 | 2818 | | | UE to UE co-existence between B42/B43 | 11.12.0 |
| 03-2015 | RP-67 | RP-150382 | 2821 | | | Corrections to CA in-band emissions requirement | 11.12.0 |
| 03-2015 | RP-67 | RP-150381 | 2829 | | | Uplink RMCs for sustained data rate test | 11.12.0 |

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|---|---|---|---|---|---|---|---|
| 03-2015 | RP-67 | RP-150382 | 2832 | | | Corrections to the CA power imbalance test | 11.12.0 |
| 03-2015 | RP-67 | RP-150392 | 2841 | | | Editorial CR for CA UE performance tests in 36.101 in Rel-11 | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2846 | | | UE spurious emissions structure correction for CA | 11.12.0 |
| 03-2015 | RP-67 | RP-150382 | 2849 | | | Removal of Pcmax requirements for UL inter-band CA in early release | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2865 | | | Band 28 UE emissions correction | 11.12.0 |
| 03-2015 | RP-67 | RP-150384 | 2866 | | | Implementation of CA configurations specified in later releases | 11.12.0 |
| 07-2015 | RP-68 | RP-150954 | 2869 | | | Intra-band contiguous CA reference sensitivity definition for Class D | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 2900 | | | UE to UE co-existence between B42/B43 | 11.13.0 |
| 07-2015 | RP-68 | RP-150955 | 2908 | | | Corrections on UL transmit power for CA receiver requirements | 11.13.0 |
| 07-2015 | RP-68 | RP-150958 | 2916 | | | Editorial CR for CA UE performance tests in 36.101 in Rel-11 | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 2930 | | | 3.5 GHz out-of-band blocking | 11.13.0 |
| 07-2015 | RP-68 | RP-150958 | 2942 | | | Correction of CA performance tests (Rel-11) | 11.13.0 |
| 07-2015 | RP-68 | RP-150958 | 2946 | | | Updates to the definitions of CA capability (Rel-11) | 11.13.0 |
| 07-2015 | RP-68 | RP-150955 | 2949 | | | Clarification of PDSCH allocation in CSI PUSCH 3-0 feICIC tests (Rel-11) | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 2955 | | | NS value for intra-band contiguous CA configurations not allowed A-MPR | 11.13.0 |
| 07-2015 | RP-68 | RP-150957 | 2957r1 | | | Receiver spurious emissions requirements for downlink-only bands | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 2970 | | | Corrections to NS_22 and NS_23 | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 2991 | | | Clarification to spurious emission requirement for the edge of spurious domain | 11.13.0 |
| 07-2015 | RP-68 | RP-150955 | 2995r1 | | | Correction to CA_7C A-MPR in CA-NS_06 | 11.13.0 |
| 07-2015 | RP-68 | RP-150958 | 3001 | | | CR for updating CA applicability rule in 36.101 in Rel-11 | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 3017 | | | EVM for Intra-band contiguous UL CA for non-equal Channel BWs | 11.13.0 |
| 07-2015 | RP-68 | RP-150954 | 3013r1 | | | Clarification on uplink configuration for reference sensitivity of inter-band CA. – NOT implemented as it is based on a wrong version of the spec | 11.13.0 |

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|---|---|---|---|---|---|---|---|
| 09-2015 | RP-69 | RP-151476 | 3034 | | | Correction to CoMP demodulation requirements | 11.14.0 |
| 09-2015 | RP-69 | RP-151475 | 3038 | | | Correction to RI test parameters in TS 36.101 (Rel-11) | 11.14.0 |
| 09-2015 | RP-69 | RP-151483 | 3048 | | | UE co-existence requirements between Band 42 and Japanese bands | 11.14.0 |
| 09-2015 | RP-69 | RP-151476 | 3063 | | | Correction to RC.2 TDD Nr. HARQ Proc. into TS36.101 | 11.14.0 |
| 09-2015 | RP-69 | RP-151475 | 3074 | | | Correction to PDCCH/PCFICH test parameters in TS 36.101 (Rel-11) | 11.14.0 |
| 09-2015 | RP-69 | RP-151475 | 3078 | | | Correction to PMI delay in PMI test for TDD | 11.14.0 |
| 09-2015 | RP-69 | RP-151475 | 3100 | | | Correction on UE maximum output power class of Band 22 for UL MIMO | 11.14.0 |
| 09-2015 | RP-69 | RP-151475 | 3163 | | | Correction of applicability of CA_NS_31 | 11.14.0 |
| 12-2015 | RP-70 | RP-152132 | 3169a | | | Corrections to applicability of CSI requirements for low UE categories (Rel-11) | 11.15.0 |
| 12-2015 | RP-70 | RP-152130 | 3200r1 | | | CR: Removal of 1.4MHz MBMS test (Rel-11) | 11.15.0 |
| 12-2015 | RP-70 | RP-152132 | 3203 | | | Correction of the AMPR table for NS_14 in TS 36.101 R11 | 11.15.0 |
| 12-2015 | RP-70 | RP-152130 | 3230 | | | Correction to reference channel for CQI requirements | 11.15.0 |
| 12-2015 | RP-70 | RP-152132 | 3244 r1 | | | CR on FRC for CDM-multiplexed DM RS | 11.15.0 |
| 12-2015 | RP-70 | RP-152132 | 3247 | | | Correction to physical channel for CQI reporting in type A test case | 11.15.0 |
| 12-2015 | RP-70 | RP-152132 | 3267 r1 | | | Clarification of Pcell support in 36.101 Rel-11 in CA scenarios | 11.15.0 |
| 12-2015 | RP-70 | RP-152132 | 3271 r1 | | | A-MPR correction for CA_NS_06 CA-7C non-contiguous RB allocation | 11.15.0 |
| 12-2015 | RP-70 | RP-152131 | 3283 | | | Missing RB allocation and OCNG Pattern for Cat 1 UEs in Multiple PMI CSI Reference Symbol tests | 11.15.0 |
| 03-2016 | RP-71 | RP-160488 | 3379 | | | Correction to Type A CQI test parameters in TS 36.101 | 11.16.0 |
| 03-2016 | RP-71 | RP-160488 | 3393 | 1 | | Beamforming model correction on TM10 DPS UE tests | 11.16.0 |
| 03-2016 | RP-71 | RP-160487 | 3401 | | | [Rel-11] NS_05 modification for PHS protection in Japan | 11.16.0 |
| 03-2016 | RP-71 | RP-160488 | 3403 | | | CQI reports in CoMP fading test | 11.16.0 |
| 03-2016 | RP-71 | RP-160489 | 3434 | | | Correction on UE category in Annex of TS 36.101 | 11.16.0 |
| 03-2016 | RP-71 | RP-160488 | 3450 | | | Correction to TDD CQI Reporting for feICIC | 11.16.0 |
| 03-2016 | RP-71 | RP-160488 | 3471 | | | CR of editorial change on PHICH group and Ng in Rel-11 | 11.16.0 |
| 06/2016 | RP-72 | RP-161140 | 3536 | | F | Maintenance CR for demodulation performance requirements (Rel-11) | 11.17.0 |
| 06/2016 | RP-72 | RP-161140 | 3612 | - | F | CR: Maintenance CR for demodulation performance requirements (Rel-11) | 11.17.0 |
| 06/2016 | RP-72 | RP-161141 | 3621 | 2 | D | Editorial correction for TM4 MMSE-IRC PDSCH demodulation test | 11.17.0 |
| 09/2016 | RP-73 | RP-161632 | 3653 | | A | Improving the single antenna port description in UL-MIMO clauses | 11.18.0 |
| 09/2016 | RP-73 | RP-161784 | 3660 | | F | Correction of CA REFSENS harmonic formula | 11.18.0 |
| 09/2016 | RP-73 | RP-161633 | 3669 | | F | CR: Update the power level setting for tests 8.3.1.2 and 8.3.2.3 (Rel-11) | 11.18.0 |
| 09/2016 | RP-73 | RP-161633 | 3762 | | F | CR for fixing power level for TM9 dual layer test in Rel-11 | 11.18.0 |
| 09/2016 | RP-73 | RP-161633 | 3796 | | F | Correction of OCNG (Rel-11) | 11.18.0 |
| 12/2016 | RP-74 | RP-162411 | 4019 | | A | RMCs and applicabilility of core RF requirements | 11.19.0 |
| 12/2016 | RP-74 | RP-162411 | 4028 | | A | Correction of spurious emissions requirements for Band 9 range and intra-band CA | 11.19.0 |
| 12/2016 | RP-74 | RP-162413 | 4062 | 1 | F | Corrections to CA table reference and header | 11.19.0 |
| 12/2016 | RP-74 | RP-162406 | 4099 | | A | Versioning indicator bit for NS_04 A-MPR table | 11.19.0 |
| 12/2016 | RP-74 | RP-162413 | 4155 | 1 | F | RF: Beamforming model missing in chapter 9 TM9 receiver Type A tests (Rel-11) | 11.19.0 |
| 01/2017 | RP-74 | | | | | Page header informatiom update | 11.19.1 |
| 03/2017 | RP-75 | RP-170580 | 4210 | | F | Addition of missing note for bands 7 and 39 UE to UE co-ex | 11.20.0 |
| 03/2017 | RP-75 | RP-170580 | 4214 | | F | Correction of CA_NS_06 non-contiguous resource allocation MPR formula | 11.20.0 |
| 09/2017 | RP-77 | RP-171965 | 4518 | 2 | A | Correction of band 43 spurious emissions limit (Rel-11) | 11.21.0 |
| 09/2017 | RP-77 | RP-171964 | 4594 | | A | Correction for EPA delay profiles of r.m.s delay spread (Rel-11) | 11.21.0 |
| 09/2017 | RP-77 | RP-171966 | 4636 | | F | Update to CA_NS_04 SEM and additional spurious emissions | 11.21.0 |
| 12/2017 | RP-78 | RP-172605 | 4853 | | F | Update to A-MPR for CA_NS_04 | 11.22.0 |

# History

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